Being Efficiently Fickle:
A Dynamic Theory of Organizational Choice

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ABSTRACT

A central proposition in organization theory is that discrete organizational forms are matched to environmental conditions, market strategies, or exchange conditions. This paper develops a contrary theoretical proposition. We argue that efficiency may dictate modulating between discrete governance modes (i.e., structural modulation) in response to a stable set of exchange conditions. If governance choices are discrete as much of organization theory argues, then the consequent steady-state functionality delivered by these organizational forms is itself discrete. However, if the desired functionality lies in between the steady-state functionality delivered by two discrete choices, then efficiency gains may be available by modulating between modes. We develop an analytical model of structural modulation and examine factors that influence when modulation is efficiency enhancing as well as the optimal rate of modulation. We conclude that, under certain conditions, structural modulation is efficiency enhancing. Further, contrary to theories that highlight the potentially destructive consequences of inertia on organizational survival, we identify important efficiency yielding benefits of inertia.

INTRODUCTION

The organizations literature is rife with theories in which organizational forms are contingent on the environment or the nature of work. Structural contingency theories, the configuration literature, organizational ecology theories, transaction cost economics, and agency theory all employ the notion of contingent fit, in which organizational modes are matched to market strategies, exchange conditions, or the environment. Based on the logic of these theories, which we describe below, organizations in stable environments performing a stable set of activities will maintain stable organizational forms. Structural change must therefore follow changes in the environment or changes in the underlying activities being performed.

The pattern of structural change in organizations that we observe, however, often seems difficult to explain as merely a response to exogenous environmental change or changes in the nature of work. In fact, managers often appear rather fickle in their choices of organizational structure, in some cases vacillating with surprising speed between or among distinct structural alternatives. We are not alone in this observation. Others have noted such fickle behavior, particularly in regard to centralization and decentralization decisions. Eccles and Nohria (1992: 127) describe this phenomenon as the "time-honored cycle between centralization and decentralization."[1] Cummings (1995: 112), similarly argues that organizations have "oscillated between centralization and decentralization" and that "the relationship between centralization and autonomy [is] a picture which is nothing if not circular, characterized by ebb and flow." Carnall (1990: 20) also contends that "Once upon a time it was not relevant to ask managers 'Is your organization centralized or decentralized?' but, rather, 'In what direction is it going this year?' Mintzberg (1979:294) maintains that "the swings between centralization and decentralization at the top of large American corporations have resembled the movements of women's hemlines."

[1] Eccles and Nohria (1992: 239) identify other explicit cycles such as those between product and market structures, between function and production structures, between geography and product structures, and between functional and geographical structures.

Examples of such vacillation in structural choices are not restricted to the choice between centralization and decentralization. We have observed patterns of vacillation in make-buy choices, in choices regarding the geographic location of activities, and in various other structural choices.

A pattern of vacillation is of course not necessarily inconsistent with the functional/efficiency arguments of contingent-fit theories. Environments or conditions of exchange may vacillate and thereby precipitate these structural changes. However, we view this vacillating environment hypothesis to be at best a partial explanation for the illustrations we have examined closely. Alternatively, fickle behavior need not be functional; structural choices may reflect processes of imitation in which the latest fads or fashions are adopted with only limited examination (Abrahamson, 1996; Banerjee, 1992; Bikchandani et al., 1992). Or, vacillation may reflect management turnover—new managers seeking to leave their distinctive mark by initiating organizational change.

In this paper we explore an efficiency or functional explanation for such modulation in organizational structure. Our theory involves no exogenous environmental or technological triggers and follows directly from very basic assumptions in organization theory. Our principal hypothesis is that under certain conditions managers modulate between or among discrete structures to approximate, albeit temporarily, levels of functionality unachievable when organizations remains fixed with a particular structure. Modulating or cycling an organization's formal structure over time dynamically positions the informal organization, as defined by communication patterns, knowledge flows, and work routines, at levels that closely approximate the optimum functionality. However, given the discrete nature of many choices in formal organizational structure, these positions are transient—achievable only through modulation—and not achievable by any stable selection of a single organizational form. Of course, organizational change can be costly and large costs can entirely erode the benefit from modulation. Yet, when the costs of change are sufficiently low or the benefit from temporarily achieving these intermediate levels of functionality sufficiently high, the question facing managers is not whether to modulate between or cycle among alternative organizational structures, but rather how frequently.

We contend that this dynamic theory of organizational change and structural choice has implications for both managers and scholars. Our theory runs contrary to most organization theories that predict a static fit between organization and environment. Our theory indicates that even in *stable* environments with a *stable* set of managers pursuing a *stable* market strategy, efficiency considerations may dictate modulating between or among organizational choices. In this regard our theory departs significantly from contingent-fit theories of organization. Our model predicts a static fit only when the costs of change are high, the benefit from temporarily achieving intermediate levels of functionality is low, or the optimal functionality is close to the steady-state functionality delivered by a single structure. Our theory is general in the sense that it has application for modulation between or cycling among any discrete organizational structures. However, to be concrete, we develop our model using the activity as the unit of analysis and limit organizational choices to two discrete structural modes, which we believe represents the prototypical phenomenon. Finally, our theory suggests that managers, by minimizing the costs of change, can enhance efficiency by enabling more rapid vacillation.

The paper proceeds as follows. We first provide several illustrations of the phenomenon. Next, we review the assumptions that underlie our model and describe how our assumptions combine to support the notion of efficiency enhancing modulation. We then more formally investigate modulation and develop deeper insights about when modulation is efficiency enhancing by introducing a stylized analytical model based on systems theory. Finally, we discuss the implications of our theory and model.

ILLUSTRATIONS

Our exercise in this paper is theoretical, not empirical. However, a few illustrations of vacillation provide useful context. While we cannot assume fully static environments surrounding the organizations in these illustrations, patterns of environmental change sufficient to explain these patterns of vacillation seem unlikely.

Hewlett-Packard. Through the 1970s, Hewlett-Packard was well known for its highly decentralized organizational structure and remarkable record of innovation. However, in the early 1980s coordination problems among its independent divisions repeatedly surfaced. Decentralization led independent divisions to develop computers, peripherals, and components that were both incompatible and internally competitive. This redundancy was both costly and confusing to consumers. HP attempted to address its coordination problems with incremental organizational adjustments like cross-divisional committees, task forces, and marketing initiatives. However, John Young, then CEO of HP, called these attempts "a half-step that didn't get the job done". In 1984, Young centralized product development for all computers and centralized sales and marketing into a common unit.

Although HP's financial performance initially recovered, by 1990 it had entered a steep decline in financial performance. The centralization effort for computer products, which was successful in ameliorating coordination problems, eventually produced an expanding bureaucracy, slowness in product development, and a significant drop in innovation. In response, Young decentralized by separating computing into computer products and computer systems each with its own sales and marketing organization. Individual product lines within each group were decentralized and treated as separate business units. In commenting on this shift, Young remarked, "If I had my life to live over again I would have [decentralized] earlier, maybe as much as two years" (Yoder, 1991).

In 1993, Lew Platt became HP's CEO. By 1995, Platt had consolidated and centralized customer support and all computer activities (Levine, 1995; Gerard, 1999). However, three years later in November of 1998, he decentralized computing into four organizations: Ink Jet Imaging Solutions, Laser Jet Imaging Systems, Computer Products, and Enterprise Computing Solutions (Burrows, 1998; Gerrad, 1999). In discussing the 1998 organizational changes, Platt describes the realignment as "easing back on corporate control of HP's business units" and "giving managers more freedom to define their own goals and policies."

In 1999, HP spun off its instruments and medical businesses. Then in 2000, new CEO Carly Fiorina, again centralized HP. She "dismantled [HP's] decentralized approach" by consolidating HP's 83 product divisions into four centralized units: corporate sales, consumer sales, printing, and computers (Burrows, 2001). This centralization effort was chosen to cut costs and improve coordination. Thus, six times within 16 years, HP made fundamental shifts between centralizing and decentralizing a core set of activities within the corporation.

While recognizing the clear limitations of presenting such an analysis, Figure 1 graphically displays the pattern of HP's stock price after controlling for the general movement of the S&P500 Index. Demarcated on the graph is the chronology of HP's structural shifts. Clearly evident in this graph is a cyclical pattern to HP's share price performance (independent of the general movement of the S&P 500 Index) that generally coincides with these structural changes. Share price improves following a structural change, but eventually degrades. While this pattern by no means eliminates alternative explanations, it is consistent with a theory of endogenously motivated change.[2] Indeed, our observation is that each time these shifts were prompted by logical organizational consequences of the prior structural choice. Centralization achieved coordination across products, but eventually excessive bureaucracy. Decentralization yielded high innovation, but eventually insufficient coordination.

<Insert Figure 1 about here>

Ford Motor. For many decades Ford Motor maintained highly autonomous international operations each with independent product design, manufacturing, and purchasing. In a major reorganization in 1994, Ford globally centralized purchasing, engineering, and manufacturing. The result was enormous cost savings as economies of scale, common design platforms, and purchasing

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[2] The S&P 500 index is a broad based measure of economic activity and should reflect broad environmental shocks. We replicated the exercise with a NASDAQ index and S&P computer index, which are more narrowly defined and should reflect environmental shocks related to narrower segments of the economy. The characteristic shape of the data presented in Figure 1 changed little when the different indices were used; although, the high technology bubble of the late 1990 is more visible in the last of the indices. This comparison indicates that the characteristic shape is relatively robust to more narrow measures of the environment.

power were exploited. Global profitability greatly improved. However, in this centralization process, regional managers lost autonomy, particularly over local product design. The results were automobiles poorly adapted to local tastes and circumstances. As a result, international markets suffered significant sales declines. In Europe, the Ford brand dropped from 2nd to 4th in market share. In Brazil, Ford lost 4 percentage points in market share, due largely to an inability to respond to changing market conditions. Recognizing that their prior decision to centralize caused these problems, Ford announced intentions to dramatically decentralize globally, creating local regional managers with autonomy greater than that possessed prior to 1994 (Kerwin and Naughton, 1999). Again, decades of divisional autonomy yielded innovative and locally responsive designs, but poor cross-divisional coordination. A period of centralization yielded vital coordination, but poorly responsive designs.

ValveCo. ValveCo (a pseudonym) manufactures plumbing supplies for use in a variety of industrial settings.[3] Prior to 1984, design engineers, who typically focus on incremental improvements, were located centrally at corporate headquarters. This centralization provided a focused product development program and enabled knowledge transfer and learning among design engineers. However, products were often poorly designed for manufacturing, which yielded high costs and low quality. Consequently, in 1984 design engineers were distributed geographically to the five manufacturing plants in Mexico, Kentucky, New York, Arkansas, and Georgia. Decentralized interaction between design and plant personnel lead to more manufacturable designs. Gradually, however, the design engineers were drawn more deeply into plant operations, leaving little time for new design efforts. Furthermore, plant managers with limited engineering experience proved to be poor supervisors for the design engineers and corporate efforts to coordinate new design initiatives also proved very difficult. Consequently, in 1990, the design engineers were centralized by relocating them to corporate headquarters. While centralization facilitated coordinated design initiatives, with time the problem of poor manufacturability once again emerged.

The pattern repeated: design engineers were dispersed to the manufacturing plants in 1994 and centralized again at headquarters in 1998. Based on our interviews with this company the motivations for these shifts in structure were not exogenous changes in the environment, but rather increasing deficiencies of the current structure.

We also know of firms that vacillated among three discrete forms. For instance, KPMG cycled among three discrete forms or structures (industry-focused, functional, and geographic) with 5 discernable structural changes within 7 years. Moreover, examples of vacillation are not restricted to internal structural choices. We have interviewed executives at an oil and gas firm that fluctuated several times over the past decade between internally and externally sourcing its distribution function. Similarly, we are aware of a medical supply firm that has cycled five times over the past twenty years between internal and external sourcing of key information service activities. Our assertion is that vacillation overtime between (or among) organizational modes, though certainly not universal, is a rather pervasive organizational phenomenon. More importantly, we assert that contingency theory arguments, which rely on exogenous changes to drive organizational change, seem inadequate as explanations.

A DYNAMIC MODEL OF STRUCTURAL CHOICE

Antecedents

We seek to explore the efficiency properties of such patterns of vacillation in organizational structure. The impetus for structural change stems from performance failure. Poor performance triggers a search for a better match between the organization and the environment (Levinthal & March, 1981; Nelson & Winter, 1982; Sastry, 1997; Zajac et al., 2000). However, unlike most other theoretical models of organizational change (Kelly & Amburgey, 1991; Hannan & Freeman, 1984; Zajac et al., 2000), our impetus for change is endogenous. Our theory argues that even in the absence of environmental change, efficiency/functional considerations may frequently warrant change in organizational structure, specifically a pattern of vacillation in structure.

Static or contingent-fit theories, such as contingency theory (Galbraith, 1977; Lawrence and Lorsch, 1967), organizational configuration theories (Mintzberg, 1979; Miles & Snow, 1978), transaction cost economics (Williamson, 1975), and Chandler's (1962) theory of the multi-divisional firm, argue that the choice of organizational forms involves matching structures, which differ in functionality, to environments, exchange conditions, or market strategies. In these theories organizational choices remain unchanged and static unless and until market strategies, exchange conditions, or environments change. Organizational functionality, which is the quality, state, or relation of being able to perform some set of actions, can be described by a wide variety of dimensions such as capacity to coordinate, the capacity to adapt, the capacity to innovate, the capacity to be flexible, etc. For instance, scholars often distinguish between the functionality delivered by centralization and that delivered by decentralization. Centralization promotes coordination and specialization within functions, but mutes incentives for flexibility and localized innovation. Decentralization, by contrast, promotes innovation and flexibility, but impedes coordination. In contingent-fit models, the manager's implicit task is to maximize performance by matching the actual or realized functionality delivered by an organizational form to the desired functionality, which, costs aside, equates to maximum performance.

These contingent-fit models, however, suffer from an important shortcoming. Choices of formal organizational structure influence but do not define an organization's actual functionality. The actual functionality delivered by an organizational form is determined by the patterns of communication, by the networks of influence, by patterns of decision-making, and by the structure of norms that emerge in large part from the informal organization. This informal organization defines work routines and knowledge flows that are primary determinants of an organization's functionality. A long tradition of research in organization theory recognizes the central role of the informal organization in defining how work is performed and tasks are accomplished (Roethlisberger & Dickson, 1939; Crozier, 1964; Trist & Bamforth, 1951). Roethlisberger and Dickson (1939:558) were among the first to highlight the distinction between the formal and informal organization. They note that:

> The patterns of human interrelations, as defined by the systems, rules, policies, and regulations of the company, constitute the formal organization … It includes the systems, policies, rules, regulations of the plant which express what the relations of one person to another are supposed to be in order to achieve effectively the task of technical production (558).

While the formal structure is the "normative system designed by management" or the "blueprint for behavior" (Scott: 82), the informal organization is the actual behavior of organizational members. Roethlisberger and Dickson (1939: 559) comment:

> Many of the actually existing patterns of human interaction have no representation in the formal organization at all, and these are inadequately represented by the formal organization … Too often it is assumed that the organizational of a company corresponds to a blueprint plan or organization chart. Actually it never does.

The informal organization has important functional qualities (easing communication, facilitating trust, establishing flows of knowledge, granting authority, establishing work routines, etc.) that are difficult to dictate through formal structure. Consequently, a contingent-fit model of organizational choice must recognize the distinct role of the informal organization in dictating an organization's functionality. As Lincoln (1982: 11) recognizes, "…informal networks are indispensable to organizational functioning, and managers must learn to manipulate them for organizational ends."

Informal organization may be difficult to shape directly. Fortunately, choices of formal structure appear to strongly influence the shape of the informal organization (Stevenson, 1990; Shrader et al., 1989; Kadushin & Brimm, 1990; Tichy, 1980). Patterns of communication, patterns of influence, and patterns of decision making develop over time in response to an organization's formal structure. Empirical studies suggest a large overlap between emergent informal networks of communication and influence and the structure of formal authority (see Ibarra, 1992). For instance, Brass (1984) and Krackhardt (1990) show that an individual's hierarchical position and his or her centrality in the informal network are closely related. The studies of Burns & Stalker (1961), Hage et al. (1971) and Lawrence & Lorsch (1967) also confirm that differing informal networks emerge from differently structured organizations. Tichy & Fombrum (1979) introduced the metaphor of "organizational structure" representing the "pegs upon which the emergent network hangs" with

"…Variations in these pegs… alter[ing] the form of the emergent networks" (p. 929). Formal structure is therefore a mechanism through which the informal organization can be shaped.

The model we develop is a contingent-fit model of informal rather than formal organization. In our model, however, the informal organization is influenced only indirectly through the choice of formal structure. Attempts to match the informal organization to the environment precipitate patterns of vacillation in structural choice. Demonstrating the logic of this conclusion necessitates persuading the reader of two assumptions common to organization theory—structural organizational alternatives are discrete and an organization' functionality responds with inertia to changes in the formal organization—which we discuss below. A third assumption, that organizational change is costly, is necessary to explain why we don't observe infinitely rapid patterns of vacillation.

Discrete Structural Alternatives

Our initial assumption argues that managers, in choosing organizational structures, confront many choices that are discrete. While managers may have latitude to make some fine adjustments in the configuration of these discrete structures, gaps in functionality exist simply because the range of structural options is not continuous, which is sometimes referred to as first order discrete. Managers choose organizational forms that in the long run deliver the actual level of functionality that most closely matches the level desired.

Discreteness in organizational structures is consistent with a variety of organizational theories. In discussing transactions cost economics, Williamson (1991a: 271), argues that, "…each viable form of governance …is defined by a syndrome of attributes that bear a supporting relation to one another. Many hypothetical forms of organization never arise, or quickly die out, because they combine inconsistent features."[4] Williamson (1991b:165) views "selective intervention" in

[4] Recent empirical work provides support for the type of weak form-selection espoused by Williamson. For example, Bigelow (2001), Nickerson and Silverman (2001) and Silverman et al. (1997) have found in the auto manufacturing and trucking industries that organizational choices that are inefficient with respect to transaction cost economics predictions face lower financial performance are more likely to exit.

which elements of hierarchy as a governance form are infused within markets, as problematic. Milgrom and Roberts (1990) also argue that organizational forms are composed of elements or decision variables that "are mutually complementary and so tend to be adopted together with each making the others more attractive" (Milgrom et al. 1991:84). By such reasoning, managers cannot modify singular elements of a cluster of complements and expect improvements in functionality. Attempts to dramatically change individual elements of organizational forms unwind the pattern of complementarity that supports the form. Such deviances from patterns of complementarity cause performance to diminish. Williamson (1991a) and Masten (1991) also characterize markets, hierarchies, and relational governance as discretely different forms in part because they are supported by distinctly different legal regimes.

Punctuated equilibrium models used in organizational theory (Gersick, 1991; Tushman & Romanelli, 1985) use the same complementarities logic to support the discreteness of organizational choices. These theories argue that organizational forms are systems with limits beyond which "change is actively prevented" (Gould, 1989: 124). Movement from one system to the next is abrupt rather than gradual. As Gersick (1991:14) argues, "Systems do not evolve through a gradual blending from one state to the next." Instead, changes are more abrupt and comprehensive. This resistance to change and discontinuous nature of change is generated by a pattern of "deep structure" that governs these stable systems or forms. Gersick (1991:15) defines deep structure as, "a network of fundamental, interdependent 'choices,' of the basic configuration into which a system's units are organized and the activities that maintain …this configuration." Punctuated equilibrium theorists therefore seek to identify the sets of choices that define this supporting deep structure. Attempts to marginally change form will be resisted by the deep structure. Only revolutionary change that adopts an entirely new set of choices can circumvent this resistance.

The organizational configuration literature also argues that organizational forms fall into discrete categories. Thus, Mintzberg (1979: 300) postulates that "effective organizations achieve an internal consistency among their design parameters, in effect, a structural configuration." Consistent with this hypothesis, scholars observe that not all combinations of design parameters are observed with equal frequency in organizational populations (Meyer et al., 1993; Baron et al., 1999). Organizational populations are instead composed of clusters of traits. Attempts to structure organizational forms that deviate from these commonly found clusters are lower performing (Doty et al., 1993; Mintzberg, 1979) and hence face diminished survival chances. Miller and Friesen (1980) present evidence of such clustering in organizational traits among organizations they studied. While there are clear discrepancies among the organizational forms that these scholars describe, this notion of discreteness and interdependence of design elements is shared.

The notion of discreteness is perhaps most clearly illustrated in thinking about the choice between a decentralized, multi-divisional structure and a centralized, functional structure. Weber (1946) describes traditional, centralized hierarchies as "ideal types" that in Scott's (1981:69) interpretation of Weber "operate not in isolation, but as part of a system of elements that, in combination, … provide more effective and efficient administration." Empirical work clearly highlights the qualitatively different character of the decentralized, multi-divisional form relative to the centralized hierarchy (Chandler, 1962; Scott,1970; Rumelt, 1974). A decentralized organization requires "different styles and systems of reward, control, resource allocation, review, and new business development" (Rumelt, 1974:3).[5] Hence, we adopt the following assumption:

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[5] We recognize that support for the discrete nature of organizational modes is not universal. Some argue that intermediate solutions are viable, though the unit of analysis in these discussions is not always clear. Thus, Henri Fayol contends that the "question of centralization or decentralization is simply a matter of proportion, it is a matter of finding the optimal degree for the particular concern (Fayol, 1949: 33, cited in Cummings, 1995). Simon (1965: 102-103) also asserted in reference to centralization and decentralization that one must find the "golden mean." Brown and Eisenhardt (1997) similarly maintain that organizations can craft "semi-structured" organizations that lie between the extremes of very rigid and highly chaotic organizations. In regard to boundary choices, Bradach and Eccles (1989) and Hennart (1993) argue that between markets and hierarchies is a continuum of hybrid governance choices. Yet, others argue that these hybrid or intermediate choices are themselves discrete, governed by patterns of complementarity (Powell, 1990; Williamson, 1991a; Zenger, 1997). In economics, much of the writing on agency theory (Demsetz, 1988; Jensen & Meckling, 1976) implicitly assumes that design choices are arrayed continuously. However, even agency theorists have recently recognized the discrete nature of organizational forms (Holmstrom & Milgrom, 1994; Milgrom et al., 1991). While this debate cannot be resolved here, the vast majority of the organizations literature supports an assumption of complementarity among organizational elements that leads to discreteness in structural alternatives.

Assumption 1: The choice of formal organization for any given activity is discrete.[6]

Informal Organization, Inertia, & Trajectories of Functionality

Our second assumption concerns the speed with which the informal organization responds to these discrete choices in formal structure. If, as discussed previously, the formal structure provides the "pegs" around which the informal organization is draped then movement in these pegs causes movement in the informal organization. Melville Dalton (1959) described in his classic study on informal organization that, "… the formal largely orders the direction the informal takes (p. 237)." Patterns of communication, influence, and decision making develop over time in response to an organization's formal structure. Thus, changes in the formal organization influence and cause changes in the informal organization. These changes in informal organization are more continuous and gradual than the abrupt and potentially rapid changes in formal organization. We define the gradual manner with which the informal organization responds to changes in formal structure as a characteristic of an organization's inertia.

Organizational inertia is a central construct in several organization theories. These theories point to several causes of inertia. Hannan and Freeman (1984:149) argue that the magnitude of an organization's inertia is related to normative standards and political coalitions that emerge within organizations. Historical investments in personnel, plant, and equipment also promote inertia by discouraging disruption to the routines that support them. The organizational routines literature argues that the rules, standard operating procedures, and patterns of decision-making that comprise routines are resistant to change even in the wake of formal structural change (Cyert and March, 1963; March and Simon, 1958; Nelson and Winter, 1982).

The existence of inertia in the informal organization causes an organization's functionality to change more slowly than change in formal organization. There is a lag between the

[6] In truth, most organizations are compilations of activities. While managers commonly make centralization and decentralization choices regarding entire clusters of activities, it is more precise to view the manager's organizational choices at the activity level. An activity is a set of common tasks that are technologically separable from other tasks. For each activity, the manager faces a discrete mode choice such as centralization or decentralization, integration or outsourcing.

implementation of a new formal structure and the realization of the new structure's steady-state functionality. For example, a structural change from decentralization to centralization or the reverse encourages a reconfiguration of communication patterns, routines, patterns of information flow, normative standards, and political influence patterns. The more fully established are the social patterns and routines, the greater the lag between changes in formal structure (incentives, administrative controls, and reporting relationships) and the corresponding functionality. Centralization of a particular function neither immediately severs cross-functional ties nor immediately destroys communication patterns, routines, patterns of information flow, normative standards, and political influence patterns established while decentralized. Rather, under pressure from the structural incentives of the new organizational mode, the close ties, routines, and patterns of influence associated with the old governance mode atrophy while at the same time new ties, routines, and patterns of influence form. Thus, suppose a business school dean abolishes a departmental structure in favor of more centralized decision-making. This abrupt structural change will have a gradual impact on patterns of communication, patterns of political behavior, and routines related to the performance of work. Presumably, communication will shift away from being localized within academic disciplines. Patterns of politicking will shift toward lobbying efforts directed at the dean. Routines for performing common activities such as recruiting, teaching allocation, and performance evaluation will also shift.

Many, perhaps most, organizations never reach the steady-state functionality associated with an organizational mode because managers shift the organizational form prior to achieving these states. Consequently, the informal organization is constantly migrating along one trajectory or another. Thus, in reviewing prior research on organizations, Miller and Friesen (1980:592) conclude that:

> "mechanistic" (Burns & Stalker, 1961) firms tended to become still more mechanistic over time, it also was true that firms moving in an "organic" direction would become still more organic later. Initial increases in centralization would lead to still more centralization; but the same was true for the movement toward decentralization. A sort of momentum seems to prevail… In other words, any organizational tendency, whatever its direction, will tend to have momentum associated with it… Most organizations are always changing.

Our observation is that such momentum merely reflects the informal organization responding with inertia to changes in formal organization. Hence, we assume:

> **Assumption 2**: The actual functionality of an organization embedded in the informal organization responds with inertia to changes in the organization's formal structure.

Costs of Change

Our final assumption reflects a consistent theme in the organizational change literature—that organizational change is costly (e.g., Argyris, 1970; Coch and French, 1948; Kanter, 1983; Leavitt, 1965; Lewin, 1947). Much of the change literature is prescriptive in defining ways to reduce the costs of change. We assume that costs of changing organizational structure generally fall into two categories that we label up-front cost of change and dynamic costs of change. Up-front cost is defined as expenditures involved in planning and implementing the new organizational structure. Planning involves the design of new roles, processes, and facilities. Implementation typically incurs a substantially greater cost. For instance, management's decision to adopt a different organizational form must be communicated to workers. Communication frequently takes the form of both written notices, including the memoranda, new organizational charts, and descriptions of new reporting relationships, and meetings in which management describes the newly adopted organizational form to workers. Organization change may also impose tangible forfeitures in plant and equipment costs and tangible costs in relocating workers. These expenditures equate to an up-front cost for changing from one structural orientation to another (Miller and Friesen, 1980).

A second cost category involves a transitional loss of productivity due to workers resistance to change, which we define as the dynamic costs of change. While new responsibilities, new communication patterns, new patterns of information flows, and new political coalitions are desired outcomes of structural change, such changes may yield costly employee turnover, lower effort, and diminished productivity due to resistance to change. Miller and Friesen (1980: 600) suggest that organizational change creates "interpersonal conflicts, role uncertainties", which create added costs that diminish as workers adjust to new responsibilities, new communication patterns, new patterns of information flows, and the formation of new political coalitions. Such costs of change obviously dampen the motivation for organizational change.

Cumulative effects also might influence the transitional loss of productivity. For instance, patterns of vacillation may result in managers losing credibility with workers, who might act in ways to increase the dysfunctional costs described above. Or, the cost of change may escalate as one structure stays in place for a long period of time. Alternatively, workers might learn to expect and appreciate the benefits of change, which would decrease transitional productivity losses and may reduce the organization's inertia. For instance, Nelson and Winter (1982: 17) assert that "[o]ver time, organizations develop not only operating routines but also 'modification routines': procedures for changing and creating operating routines. … To routinize the process of change, however, an organization must gain experience in modifying operating routines." In short, organizations learn to change by changing" (Amburgey et al., 1993: 54), which may equate to a dynamic capability (Teece et al., 1997). While these cumulative effects may alter the costs of change or even the level of inertia over time, we view these effects as modest and the direction of their effect unclear. Hence, put aside these effects as opportunities for future research and propose the following assumption:

> **Assumption 3**: Organizational change is costly and incurs up-front costs of change and dynamic costs of change in which the latter diminish as interpersonal conflicts and role uncertainties under the new organizational mode diminish.

Using these three assumptions, we argue below that managers have incentives to vacillate among discrete organizational forms.

Efficiency Enhancing Modulation

If the steady state functionality delivered by a particular governance form matches precisely the desired functionality, then there is no motivation for organizational change. The motivation to modulate between organizational modes arises when management's desired organizational functionality lies in between the steady-state functionality delivered by two discrete organizational modes. This motivation may be a widespread phenomenon. For instance, Eccles and Nohria (1992:

117) describe tension between the two opposing organizational functionalities of specialization and coordination as a central organizational dilemma. They point to a set of vexing tradeoffs between the gains from specialization that come from a division of labor and the problem of how different activities are to be coordinated. Managers often desire both types of functionality but the existence of tradeoffs implies only one can be achieved at a time with any particular organizational structure. Lawrence and Lorsch articulated this same dilemma 25 years earlier in their discussions of balancing the opposing forces of "differentiation" and "integration." Thus, the central question is as follows: if, following assumption 1, organizational modes and their corresponding steady-state functionality are discrete, can management take any actions to bring actual functionality closer to desired functionality?

We posit that under certain conditions modulation between organizational forms may lead to dynamic efficiency gains. Given that the informal organization displays inertia, each switch between modes initiates a corresponding change in the trajectory of an organization's realized functionality. As an organization's realized functionality follows a trajectory that, given enough time, approaches the new mode's steady-state functionality, assumption 2 indicates that the organization displays functionality, albeit temporarily, that is intermediate to the two steady-state outcomes. Putting aside for the moment the costs of change, dynamic efficiency gains are the functionality benefits of the organization achieving temporary and intermediate levels of functionality that more closely approximate the desired functionality than that produced by either mode in steady-state.

For example, a decision to shift to a decentralized from a centralized mode initiates a pattern of changes in communication, influence, and decision-making that alter the functioning of the organization. As management initiates decentralization and the firm begins to benefit from higher-powered incentives, it still enjoys, albeit temporarily, benefits from the patterns of social communication that accompanied centralization. Overtime, however, the structure and incentives of decentralization reconfigure to create new social connections that undermine prior social connections and with them the corresponding functionality that existed under the centralized structure. Consequently, managers attempt to simulate an intermediate level of functionality and achieve dynamic efficiency gains by modulating between discrete organizational modes. Moreover, managers may modulate without a long-run understanding that they are doing so.

Comments by the CEO of Appex Corporation, which vacillated in its choice of organizational forms (Nohria and Berkley 1994, 135) illustrate these dynamic efficiency gains: "… an organizational structure becomes a tool you're using to create a balance between conflicting modes of organizational behavior, such as flexibility and consistency. Each structure emphasizes one type of behavior and de-emphasizes another. By continuing to change, you can balance the needs of the organization." Change is beneficial because "[s]ome of what is learned from an organizational change program stays with employees long after the program is replaced." For instance, "[p]eople get to know one another, they understand other functions. And because the organization is constantly changing, people don't have time to develop a power base within a particular structure. They have to identify with the broader objectives of the company." These comments resonate with our explanation for modulating between organizational forms and are consistent with the comments of others we have interviewed regarding patterns of vacillation. Nevertheless, if modulation is so beneficial, as this CEO's comments suggest, why not always modulate with extremely high levels of frequency?

Dynamic efficiency gains derived from modulation must be balanced against the costs of change, assumption 3. The disruption produced by change or damage to functionality can easily negate the benefits of change (Amburgey et al., 1993: 71). As either the up-front costs of change or the dynamic costs of change rise they attenuate and ultimately eliminate the net benefits of modulation. Thus, while switching modes may shift the organization's functionality in a desired trajectory, the costs of change may be substantial thereby lessening the frequency of modulation or making it inefficient altogether.

Cost notwithstanding, the potential dynamic efficiency gain hinges critically on the speed with which the functionality of the informal organization responds to a change in structure. If organizations' internal social structure responds rapidly to a mode change (i.e., display low levels of inertia) then few dynamic efficiency gains are generated because the organization spends little time in the intermediate states. Thus, we anticipate that higher levels of inertia lead to lower frequency modulation, ceteris paribus. We explore these and other relationships more formally below.

MODEL

We analytically investigate modulation between organization modes by constructing a stylized model based on system dynamics (Forrester 1961) also known as feedback theory (e.g., Dorf 1980). There is a long tradition in organization theory of using system dynamics to model organizational phenomenon.[7] We use the analytical model to estimate the optimal modulation frequency, or switching interval, and explore how the optimal switching interval varies with an organization's inertia and the costs of change. The model provides several insights that are not transparently deduced from our three assumptions. Feedback theory is used for modeling dynamic systems and provides a set of tools for investigating optimal control parameters—in our case the optimal switching interval or modulation frequency. A thermostatic control system for a house in which either the heating or cooling system is potentially active provides an appropriate analogy for our model. The feedback modeling approach employed here involves two steps. The first step models the dynamics of mode switching. Similar to a thermostatic control system where heating and cooling turn on and off to keep the house temperature vacillating around a desired temperature, the model developed below highlights how structural changes—centralization or decentralization—in organizational form can keep an organization's actual functionality vacillating around a desired functionality.[8] The second step incorporates the costs of switching, which, along with benefits, are used to estimate the optimal frequency for switching back and forth between organizational

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[7] The modeling approach developed in this paper is reminiscent of Ashby's (1952) classic study on cybernetics. A more detailed discussion of the benefits of applying systems theory to organization theory can be found in Sastry (1997).

[8] Our analytical model is developed to evaluate structural modulation between two discrete organizational modes. Although formally more complex, we believe that our theory applies to modulation among more than two modes, as was described in the KPMG Peat Marwick illustration. Nevertheless, developing an analytic representation of this process is a task for future research.

structures. Thus, just as the level of insulation in a house and the costs of heating and cooling affect the optimal rate of vacillation in a home's temperature, so too will the costs and benefits of organizational change affect the optimal frequency of organizational change.

The Dynamics of Mode Switching

We assume for simplicity that an organization's functionality, which typically is multidimensional, can be represented by a single time-varying variable. That is, we adopt a specific form of assumption 2 in which the trajectory of functionality between steady-state outcomes of alternative modes moves along a linear path in functionality space. Thus, the organization's functionality at any point in time is represented by the variable $y(t)$, which may vary with time t. This variable is akin to the temperature of the house at time t in our thermostat analogy. Using a single time-varying variable limits our model to analyzing modulation between two modes. Although, theoretically, modulation among more than two modes could be modeled using a multi-dimensional system of equations, we employ the two-mode single-dimension case because it captures much of the interesting dynamics without the added complexity of multidimensionality. Also, a single time-varying variable assumes that the trajectory along which an organization's functionality traverses does not depend on the direction of change. While response asymmetries due to the direction of change are possible, modeling them is beyond the scope of this paper.

Consider a firm that in choosing an organizational mode targets an optimal level of functionality, referred to herein as the input or "set-point", lying somewhere on y and represented by the constant u. Thus, this desired level of functionality could be thought of as the desired temperature to which the thermostat is set. Further assume that this set-point lies intermediate to the steady-state functionality delivered by two discrete governance choices: mode 1 and mode 2. In other words, the set-point temperature is assumed to lie between the temperatures achieved if a house was perpetually cooled or perpetually heated. Consistent with assumption 1, we assume that mode 1 delivers a steady-state functionality $y = d_1$ and mode 2 delivers a steady-state functionality $y = d_2$. For convenience and symmetry, we normalize the steady-state functionality so that $d_1 = 1$ and $d_2 = -1$ and assume the set point falls in between at $u = 0$. These assumptions imply that the set-point lies precisely in between the steady-state functionality delivered by the two modes. The desired functionality can be altered by changing the set-point. Consistent with feedback modeling, we define the difference between the desired functionality and the organization's actual functionality (e.g., the difference between the actual and desired temperature) as the "error," which is described by

$$\varepsilon(t) = u - y(t) \tag{1}$$

Assume that management instantaneously switches to mode 1 (e.g., turns off the heating and turns on the cooling) when the error exceeds some threshold e_h and switches to mode 2 (e.g., turns on the heating and turns off the cooling) when the error falls below some threshold e_l. (We need not assume an instantaneous switch; only that management can predict when a change needs to occur and that all planning and implementation of a new formal structure be done in advance so that a mode switch can occur when the error exceeds a threshold.) These thresholds represent management's decision rules about when to modulate: management switches to mode 1 from mode 2 when $\varepsilon(t) \geq \varepsilon_h$ and switches to mode 2 from mode 1 when $\varepsilon(t) \leq \varepsilon_l$. Instead of relying on two separate thresholds, we normalize the thresholds such that $\varepsilon_h = - \varepsilon_l = 1$ and multiply the error $\varepsilon(t)$ by a constant, c. This reformulation simplifies our analysis by reducing the number of parameters to be optimized from two to one. Conceptually, management's task is to select c, which equates to selecting the two thresholds (or in the case of a thermostat selecting the two temperature thresholds where heating is turned off and cooling is turned on and vice-versa). In essence, c determines when management should change modes. A large c would indicate that small errors (e.g., small temperature deviations from the set-point) lead managers to switch organization modes (i.e., managers are highly sensitive to small errors) and a low c would indicate that managers are insensitive to all but the largest errors (e.g., large temperature deviations from the set-point). The goal of our analysis is to find the optimal switching interval by optimizing c.

Finally, we model the organization's response to a change in organizational mode, i.e. the rate with which actual functionality migrates to the steady-state functionality of mode i (either 1 or 2) from mode j (either 2 or 1). Put differently, we model the functionality provided by the informal organization in response to a change in formal structure. In the thermostat analogy, this is equivalent to modeling how quickly the house's temperature responds to turning on heating or cooling. Generally, we believe that the rate of migration will be initially high because of the distance between current functionality and the steady-state functionality prescribed by the new mode's incentives and structure. Overtime, however, we expect the rate of migration will decrease as the current functionality asymptotically approaches the mode's steady-state functionality. Consistent with assumption 2, we expect the rate of migration to be inversely related to an organization's inertia.

This type of dynamic response can be generated by a variety of functions. However, we have no theory for choosing a specific functional form to model an organization's dynamic response and developing a complex model of dynamic response is beyond the scope of this paper. For this initial examination of modulation we choose to model an organization's dynamic response with a standard response function, which has an exponential decay, because it generates the desired response, is a function that allows us to represent the level of inertia with a single parameter, and is simple to simulate. For our model, the organization's actual functionality provided by the informal organization responds to a change in organizational mode according to

$$y(\mathrm{t}) = d_{\mathrm{j}} - (d_{\mathrm{j}} - y_{\mathrm{o}})e^{-\gamma \mathrm{t}} \quad (2)$$

where t is the time since the previous switch, y_o is the output value (level of functionality) when the switch is made, and d_j (j=1 or 2) is the mode to which management switches. In feedback theory, the term γ is referred to as a "time constant" and is an indicator of how quickly the output (the organization's actual functionality or the temperature within a house) responds to a change in input (the chosen organization mode or the choice of heating or cooling). We interpret the inverse of γ as a reflection of an organization's inertia to resist change. Thus, organizations with high degrees of inertia correspond to low values of γ and respond more slowly than organizations with low degrees of inertia, which correspond to high values of γ.[9]

Figure 2 describes this system in the form of a block diagram, which is a common way of representing a feedback system. The set-point, *u*, which is the desired functionality, appears on the left side of the diagram. The error, $\varepsilon(t)$, is the result of the summing operation, indicated by a plus sign in a circle, applied to *u* and (-1) times the actual or realized functionality $y(t)$. Thus, $\varepsilon(t)$ is the difference between desired and actual functionality. The error is multiplied by the constant *c*, which is shown in a block, to produce $c\varepsilon(t)$. The next block describes management's switching decision—management switches to mode d_1 when $c\varepsilon(t)$ exceeds the upper threshold and switches to mode d_2 when $c\varepsilon(t)$ falls below a lower threshold. The output of management's decision, d_j, represented as d(t) since management's decision changes over time, is a formal structural choice that operates on the informal organization, which we represent by the block labeled

$$M(\gamma, d_j, y_o) = d_j - (d_j - y_o)e^{-\gamma t} \quad (3)$$

to produce the output $y(t)$.

<Insert Figure 2 about here>

Figure 3 provides an illustration of how the feedback system, and hence mode switching, operates in real-time. The figure reports the values of ε(t), $c\varepsilon$(t), d(t), and y(t) on the vertical axis over time. To illustrate the system's dynamics, we begin at $t = 0$ and arbitrarily assume the system is in steady-state in the sense that $y(t)$ has reached the steady-state functionality of d_1 or d_2 (Figure 3 assumes d_2). (From a modeling perspective, initial conditions of this model matter only in that they

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[9] Our model assumes constant parameters and thus ignores temporal variations in γ. For instance, we do not consider cases where organizational change might be accelerated by management expending greater effort to reconfigure the organization or where managers may seek to slow the pace with which the informal organization shifts, thereby lengthening the change interval. Similarly, we ignore changes in organizational size and other features that may cause its inertia to change over time. Also, we do not consider cumulative affects such as management's loss of credibility or workers learning to expect and appreciate the benefits of change could cause organizational inertia to increase or decrease over time. While such refinements can be added to the model their effects are likely to be second order because, while they may change parameter values, these changes would not eliminate vacillation. Also, we do not anticipate parameter values will change their order of magnitude, which implies that such changes at most may lead to moderate changes in modulation frequency.

create a transient response, which typically dampens quickly.) Assume that at the initial condition the amplified error exceeds management's upper threshold (i.e., $c\varepsilon(t) \geq 1$). Thus, at $t = 0$ management switches to mode 1: d(t) immediately transitions from d_2 to d_1. The organization begins to respond to the mode switch and its functionality begins to move with an exponential decay towards mode 1's steady-state functionality. $\varepsilon(t)$ diminishes as the organization's functionality approaches the set-point and eventually reaches zero as the output equals the set-point. However, $\varepsilon(t)$ passes the set-point and grows in the opposite direction as the organization's functionality continues to approach the steady-state functionality of mode 1. Should $c\varepsilon(t)$ drop below the lower threshold ($c\varepsilon(t) \leq -1$), management again switches modes causing the organization's functionality to again approach the set-point and eventually move past it. This process continues and the organization's functionality modulates around the set-point. A thermostatic control system like the one we describe in our analogy would yield similar characteristic responses curves. We use this model to identify management's optimal c, which corresponds to an optimal time between mode switching, T.

<Insert Figure 3 about here>

Benefits, Costs, and Optimal Mode Switching

Optimizing c^* requires an assessment of the benefits and costs of mode switching. A standard feedback system approach for identifying an optimal decision rule is to construct a "performance" index that weighs benefits and costs of change (Dorf 1980:124). The performance index can be tailored to reflect the specific structure of costs and benefits involved in a system. We define a quadratic performance index, J, which is comprised of the dynamic efficiency gain of modulation, the up-front costs of change, and the dynamic costs of change. We define dynamic gain of modulation as the performance benefit that accrues or dissipates as an organization's functionality better or worse approximates the optimal functionality. We measure dynamic benefits, which are calculated as the square of the error, with reference to the set-point. The costs of changing modes are segmented into an up-front cost, F, which is incurred each time management switches mode, and a dynamic cost of change, which reflects the ongoing reconfiguration costs expended by management and organization to change mode.[10] Although our thermostatic control analysis is somewhat less appropriate here, the analogy remains in tack. For instance, F equates to the cost of an initial surge in energy required to turn on the heating or cooling system. The dynamic cost of change represents the ongoing cost to heat or cool once a system starts. Consistent with the organizational change literature and our prior assumption, this latter cost is conceptualized as great when the change is first made but diminishes as the organization's performance approaches the theoretical operating performance of the mode. We model dynamic cost by squaring the difference between steady state performance, d_j, and actual performance, $y(t)$. Thus, as $y(t)$ approaches d_j, the dynamic cost of change diminishes.

Employing quadratic measures in the performance index for benefits and dynamic costs is intuitively appealing because we anticipate that (1) the dynamic cost of change decreases at a decreasing rate as an organization's functionality approaches steady-state and (2) the benefit of alignment decreases at an increasing rate as misalignment increases. A quadratic index also guarantees either a minimum or a maximum c^* can be found. Alternatively, we could employ a linear performance index (i.e., one where absolute-value measures of benefit and dynamic cost are used in the performance index in place of squared measures). In results not reported here, simulations with a linear index yield equivalent results to the ones reported below.

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[10] Our model assumes that the trajectory an organization's functionality follows is linear and symmetric. We assume, for instance, that coordination and innovation are polar extremes on a single continuum and that structural changes push the organization's functionality back and forth on this single continuum. However, if the path of functionality is nonlinear, modulation could potentially lead to dysfunctionality and loss of efficiency during a mode change. Our analytic model incorporates these costs of dysfunctionality and loss of efficiency during a mode change by incorporating the dynamic costs of switching in the performance index. Thus, our assumption that the trajectory of change an organization's functionality follows is linear and symmetric is a mathematical convenience. We further note that organizational inertia is likely to cause the rate of change of various dimensions of functionality to be strongly, albeit negatively, correlated. Thus in switching to decentralization from centralization the organization gradually receives the benefits of decentralization while slowly losing the benefits of centralization. The inertial tendencies that make difficult the adoption of new internal social structures and hence display of new functionality also make difficult the immediate decay of existing social structures and the atrophy of old functionality, which limits the degree of dysfunctionality that could be experienced. Therefore, we expect that while change is costly, mode switching does deliver changes in functionality in the way represented by our analytic model. Ultimately, the shape of these change trajectories of functionality is an empirical issue.

Eq. (7) describes our performance index, which integrates benefits and costs over the interval *S*. The performance index is always negative because of its construction so the optimal decision rule will yield the least negative *J*. Thus, the optimal decision rule, c^*, is one that maximizes *J* with respect to *c*.

$$J = \int_0^S -w_1 \varepsilon(t)^2 - w_2(d_j - y(t))^2 - SF/\mathrm{T}\, dt \qquad (4)$$

The parameters w_1, w_2, and *F* determine relative benefits (w_1) and costs (w_2 and *F*) of mode switching. We normalize *F* by setting it equal to one and initially set w_1=1 and set w_2=0.1, our baseline case, which insures modulation is efficiency enhancing (as is discussed later, large values of w_2 and F and small values of w_1 eliminate the efficiency benefits of modulation). Because we are ultimately interested in switching interval, we report our results as a function of T instead of *c*. Taking the derivative of *J* with respect to *c* and setting the result equal to zero is the typical approach for solving for *c**. However, finding a closed form solution for maximizing *J* is complicated because management's decision rule is non-linear, initial conditions add a transient effect, and *J* is ever increasing with time. A common approach for optimizing a performance index based on a system with a non-linear decision rule is by simulating the system's operation for different values of the control parameters over a finite time interval, which we denote by *S*. *S* is chosen sufficiently small so that the integral is finite and sufficiently large so that any transient dynamics due to the initial condition at $t = 0$ dissipate. In our case, we simulated the system using Excel and numerically integrated *J* using a Reiman sum approximation with *S* equal to 100 and with each time period divided into five sub-intervals to improve integral approximation. Thus, the set of equations was calculated every 0.2 time units for a total of 500 calculations.

Assuming the baseline case, Figure 4 displays the performance index, *J*, on the vertical axis, with higher levels of performance indicated by higher values on the axis, versus T, which was generated by varying *c*, for several levels of organizational inertia, on the horizontal axis. In general, *J* approaches negative infinity when the switching interval is very small, which in the limit means that the formal organization changes constantly (e.g., the thermostatic control system would rapidly switch back and forth between heating and cooling) and provides terrible performance. As the switching interval increases and becomes longer, *J* initially increases for all levels of inertia. Ultimately, *J* reaches a maximum for each level of inertia and begins to decline as the time between mode switching increases. Note that choosing not to modulate, which equates to a very long switching interval yields sub-optimal performance for our initial parameter values. For instance, the house in our thermostat analogy would become very hot or very cold for long periods.

<Insert Figure 4 about here>

Figure 4 contains several important findings. First, the optimal switching interval increases with inertia (e.g., the larger the home the less frequent the thermostatic control system will vacillate between heating and cooling). For instance, the optimal switching interval for the lowest level of inertia displayed (γ=1) is approximately 1.2. The optimal switching interval increases to 2, 3.6, 5.3, and 10 as γ decreases (which corresponds to increasing inertia) to 0.1, 0.2, 0.5, and 1. Thus, the more inert an organization the longer the optimal switching interval and, correspondingly, the lower the optimal modulation frequency. Second, higher levels of inertia, up to a point, produce higher levels of performance, ceteris paribus (e.g., the larger the home the longer the realized temperature will be close to the desired temperature). For instance, the maximum performance index for the lowest level of inertia (γ=1) is –185. Increasing inertia from γ=0.5, γ=0.2, to γ=0.1 improves the maximum performance index from –138, -102, to -91, respectively. Increasing inertia from γ=0.1 to γ=0.05 does not alter the maximum performance index. For comparison, the performance index when management chooses <u>not</u> to modulate is –501 for all values of γ. This value also equates to the maximum performance for the theoretical extreme of an organization with infinite inertia, which indicates that eventually, for the highest levels of inertia, the performance index declines. Third, the shape of the performance-index curve for each value of γ is asymmetric with respect to the switching interval. Switching faster than is optimal penalizes performance more than delaying switching. Also, the convexity of these curves changes with the level of inertia—high levels of inertia produce highly convex curves while low levels of inertia produce less convex curves.

Because these findings depend on the parameter values in the baseline case, we undertook three sensitivity analyses by varying the relative weights of w_1, w_2, and F. Figure 5 displays the optimal switching-interval frontier for different levels of organizational inertia: inertia is plotted along the vertical axis and optimal switching interval is plotted along the horizontal axis. The optimal switching-interval frontier for the baseline case, reported in Figure 4, is displayed in Figure 5 under the label "Baseline". The first sensitivity analysis increased the up-front cost of change by 100 percent (F=2) while leaving w_1 and w_2 unchanged (see the curve labeled "F=2"). Increasing the up-front cost change by 100 percent essentially shifts the baseline curve to the right—the optimal modulation frequency decreases as the up-front cost of change increases for all values of γ. Although not shown in Figure 5, increases in the up-front cost of change yield lower values of the performance index until large up-front costs of change eliminate all efficiency gains from modulation—high up-front costs of change preclude modulation.

The second sensitivity analysis decreased by 50% (w_1=0.5) the benefit from better approximating the optimal functionality while leaving w_2 and F unchanged from the baseline case (see the curve in Figure 5 labeled "w_1=0.5"). Decreasing the benefit of modulation by 50 percent yields an optimal switching-interval frontier nearly identical to the first sensitivity analysis—the optimal modulation frequency decreases as the benefits that accrue from better approximating the optimal functionality decrease. Also, a decrease in w_1 shifts downward performance and, if the benefit is sufficiently small, eliminates all efficiency gains from modulation—the absence of functionality benefit from modulating precludes modulation.

Finally, the third sensitivity analysis increased the dynamic cost of change by 100 percent (w_2=0.2) while leaving w_1 and F unchanged from the baseline case (not shown in Figure 5). Increasing dynamic cost of change did not change the optimal switching-interval frontier found in the baseline case. Nonetheless, an increase in the dynamic cost of change shifts downward performance and, if the costs are large enough, eliminates all efficiency gains from modulation—high dynamic costs of change preclude modulation.

In sum, sensitivity analyses do not alter our primary findings that (1) the optimal switching interval increases with inertia, (2) higher levels of inertia produce higher levels of performance, ceteris paribus, and (3) the shape of the performance-index curve is asymmetric with respect to the switching interval. However, variation in the relative weights of up-front cost, dynamic cost, and benefit from better approximating the optimal functionality did effect whether or not modulation is efficiency enhancing. We find that modulation is inefficient and hence not undertaken when the costs of change are high or when the benefit from intermediate values of functionality is small. Although not reported here, we undertook an additional analysis whereby we changed the set-point to be close to one or the other of the organizational modes instead of in between the two modes. As expected, modulation is inefficient and not undertaken when the desired level of functionality is sufficiently close to the steady-state functionality delivered by one or the other modes.

<Insert Figure 5 about here>

IMPLICATIONS FOR ORGANIZATION THEORY AND MANAGEMENT

We suggested in this paper a theory of dynamic organizational choice. Our intent was to both explain an observed empirical phenomenon of fickle behavior and, more significantly, suggest that contingent-fit based theories of organizational alignment need refinement, even when applied in a static world where no changes in market strategy or environment occur. Using elementary assumptions from organization theory, our theory shows that a static environment (or market strategy) often demands a dynamic organizational response. Our model suggests that when no organizational mode provides a precise match to exchange attributes, managers can capture efficiency benefits by modulating between organizational modes, in order to approximate the optimal level of functionality, so long as the costs of change are sufficiently low. In our model, the pursuit of efficiency leads to dynamic instead of static alignment. Perhaps the most intriguing result of our model is the finding that inertia, at least up to a point, may yield efficiency advantages by allowing an organization's actual functionality to temporarily achieve intermediate levels. This improved efficiency occurs because inertia in actual functionality reduces the need or frequency with which an organization must change organizational modes.

By introducing a formal model, we bring precision to our theory. For instance, we think the formal model helps clarify the idea that the functionality delivered by the informal organization is a dynamic response to formal changes in structure. The formal model also provides insights not immediately discernable from our verbal theory. For instance, our simulations showed that managers that are unable to accurately estimate optimal switching time are better off delaying switching than switching prematurely. The formal model provides a foundation for future analysis that incorporates and analyzes refinements like the effect of cumulative learning on the frequency of change, which is not explored in this paper. More generally, as Sastry (1997) has shown, the use of formal control system models can benefit organizational theory by identifying weaknesses or inconsistencies in verbal models as well as by providing new insights.

Though highlighting the need for refinement in contingent-fit theories is central in our model, the value of contingent-fit theories of alignment is not obviated by our research. Indeed, our model suggests that under some conditions static alignment is optimal. Further, contingent-fit theories of alignment provide important inputs to predicting optimal levels of vacillation. Such theories specify both the desired functionality associated with environments, market strategies, or exchange conditions and specify the functionality delivered by particular organizational forms.

Our theory is not the first to recognize that an organization's desired functionality often lies intermediate to that delivered by discrete organizational choices. The organizational paradox literature (e.g., Cameron and Quinn, 1988) highlights that managers often desire two diametrically opposed types of functionality—flexibility and control. While flexibility is delivered by decentralization, control is delivered by centralization. In our theory this paradox emerges because the desired set-point falls intermediate to the steady-state functionality delivered by alternative discrete modes. Similarly, the recent organizational literature on equifinality (e.g., Gresov & Drazin, 1997) asserts that organization design that addresses conflicting, but desirable, dimensions of functionality may be impossible to achieve.[11] This perspective implies that in many instances the desired functionality lies intermediate to the actual functionality that can be delivered by alternative organizational structures. Our model suggests that structural modulation may partially eliminate these paradoxes.

The application of our theory is limited to settings in which the organization's desired functionality lies intermediate to two discrete organizational modes. While our theory does not directly answer when such conditions will hold, it does provide clues. For instance, our theory is more likely applicable in environments where innovation and coordination are both strongly valued by consumers, perhaps due to both a large innovative opportunity set and strong competitive pressures. Our theory is also more applicable in settings where the difference in functionality delivered by alternative organizational modes is substantial. Indeed, without discreteness in alternative organizational modes and a sizable difference in the functionality they deliver, vacillation would not be efficient. Pinpointing more precisely those environments in which dynamic rather than static alignment is predicted remains largely a topic for future research.

Other theorists also have noted patterns of vacillation in organization modes. Duncan (1976) describes ambidextrous organizations that switch between centralized and decentralized structures. However, unlike our model of endogenous change, in Duncan's model this vacillation is triggered by changes in a firm's life cycle. At certain times, the firm may require innovation and therefore choose decentralization. At other times, commercialization of innovations is needed and the firm chooses centralization. McKelvey's (1997, p. 370) brief discussion of periodic attractors drawn from chaos theory provides a story that is potentially more consistent with our model. He alludes to periodic attractors which "[foster] oscillation … from one extreme to another" such as between "decentralization and decentralization of decision making, or functional specialization vs.

[11] An earlier concept of equifinality (e.g., von Bertalanffy, 1968; Rapaport, 1972, Katz and Kahn, 1978) is that open systems have a tendency to achieve a final state independent of initial conditions. This concept, while different from more recent definitions, is consistent with our theory in that we implicitly assume in our model that but steady-state functionality of any particular mode is independent of initial conditions

cross-functional integration." However, outside of the provided definition, the details of such a model developed for periodic oscillation between organizational modes has yet to be worked up in chaos theory.

Our theory ignores a range of other alternative explanations for vacillation. Fickle behavior may reflect management turnover. Changing environmental conditions provide another competing explanation for vacillation. Managers may periodically re-align organizational structure as the environment changes. Although we note that in the context of our model, a dramatic change in market strategy or environment may actually precipitate a long period of stability in the formal organization. A large environmental shift may trigger a dramatic change in formal structure followed by a long period of stability as the organization's functionality migrates slowly in response. However, the shifting environmental and strategic conditions seem more likely to trigger unidirectional change than modulating, bi-directional change, unless, of course, environmental conditions and market strategies are themselves modulating. Environmental change may, however, determine those periods during which modulation is efficient and those periods during which a stable structure is more efficient. Thus, modulation may arise not because environmental conditions oscillate back and forth, but because environmental conditions create a temporal window where modulation is beneficial.

Our theory provides new insights compared to other endogenous theories of organizational change. For example, Greiner (1972) proposes that firm's goes through five phases of growth. Within each phase the firm experiences evolutionary change in management practices but at the cusp of each phase the firm experiences a revolutionary change. These changes are endogenous given that one phase predates and gives rise to the next. Predictions from our theory differ in several respects. First, our theory is not predicted on growth. Thus, we predict that organizational vacillation can occur even when a firm is not growing. Second, Greiner's framework states that most large U.S. companies are in the fifth phase, for which he has no prediction about what might be the next revolution. In contrast, our model predicts that, if our assumptions are met, these firms will vacillate their organizational structures. Tushman and Romanelli's theory of organizational evolution (1985) offers another endogenous theory of organizational change or reorientation. They propose that reorientations can be triggered by exogenous or endogenous events. Restricting our discussion to endogenous sources of change, their theory proposes that "reorientations will be triggered by sustained low performance, major shifts in the distribution of power within the firms, or by discontinuous changes in product class conditions" (1985 :205). While these changes can be endogenous, Tushman and Romanelli's theory does not explain or predict why prior decisions or actions necessarily lead to these conditions. Moreover, they predict neither the direction nor type of reorientation that might arise endogenously. In contrast, our theory is explicit about the mechanism the gives rise to endogenous organizational vacillation. We also are explicit about the direction and type of reorientations.

Although not considered in our model, the frequency of change may have survival implications for the organization. Hannan and Freeman (1984) assume that structural reorganization produces a liability of newness that increases the likelihood of organizational failure. Thus, the greater the frequency of change, the greater the likelihood of organizational failure. In contrast, we argue that efficiency gains from mode vacillation provide benefits that may enhance an organization's survival chances. However, these two theories are not necessarily in opposition. Hannan and Freeman's theory (1977, 1984) focuses on changes in organization coincident with changes in market strategy and the environment, where our theory assumes managers vacillate between organizational modes without changes in strategy or in the environment. Each theory focuses on different types of change. Nonetheless, our theory also predicts that inefficiently rapid vacillation will dampen performance and heighten the probability of failure.

We contend that the concepts of structural modulation have rather broad application in organizations. While modulating between centralized and decentralized organizational structures provided the primary motivation for our paper, the logic applies to other discrete changes in structure and organizational boundary and more broadly to any discrete organizational choice. Within organizations, we observe frequent vacillation in organizational policies, procedures, incentive arrangements, and managerial emphases. Obviously, such a wide array of changes involves different units of analysis. To the extent that these different units of analysis involve discrete choices, our theory of fickle behavior and dynamic fit has application. While our analytical model involved a single discrete choice that shifted organizational functionality along a single performance dimension, managers can face a wide range of discrete choices and thus may involve cycling among discrete choices.

Revisiting our initial illustration in light of our model more clearly illuminates the phenomena. Although these illustrations should not be mistaken for empirical analyses of our model, we nonetheless believe the predictions of our model are generally consistent with the casual empirics offered by our HP and other illustrations. In light of our theory, HP's attempt to resolve coordination problems by minor refinements in structure in 1983-4 may have represented time and effort misspent, although our model clearly indicates it is better to delay change than change prematurely. Also, John Young may have been right in concluding that changing the organization in 1988, instead of 1990, might have yielded performance benefits at least temporarily. Nonetheless, we predict that such organization changes while initially beneficial, eventually would have led to declining performance and further organizational vacillation.

Our HP illustration provides insight into how empirical investigation of this theory might proceed. Organizational changes often can be identified through archival research. Similarly, archival research often can provide proxies for inertia, like organization size, age, and other demographic data. Event history analysis on a large sample of firms could be used to estimate the likelihood of organizational vacillation controlling for exogenous environmental shifts and to test the relationship predicted between inertia and switching time. Such data could also be used to assess the link between the predicted dynamic pattern of organizational change and performance.

In conclusion, our theory suggests that the manager's task is to optimally modulate these discrete choices in a manner that dynamically positions the organization in some optimal location in a multi-dimensional performance space. Of course, instead of deciding on a modulation rate it is more likely that managers monitor an organization and act when its actual functionality becomes increasingly distant from its desired functionality. Indeed, it may be the case that managers are only locally optimizing their organizational choices, which over time yield patterns of modulation. Managers may be largely unaware of the long-term efficiency of these patterns. Ideally, managers would monitor the movement of the informal organization and switch various discrete levers (e.g., change the organizing mode) to change the organization's trajectory, balancing the gains from organizational change with the accompanying costs of switching. Thus, the manager's task is choosing among discrete organizational forms to achieve dynamic rather than static optimization.

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Figure 1: HP Stock Price Divided by S&P 500 Index

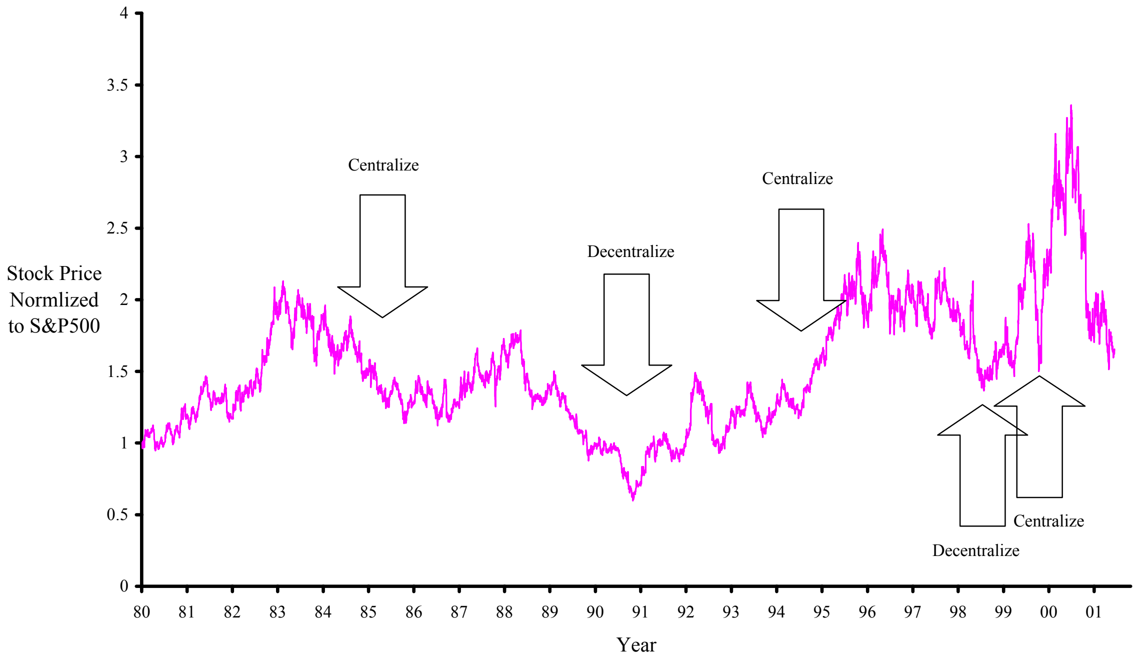

Figure 2: Feedback Model of Mode Choice

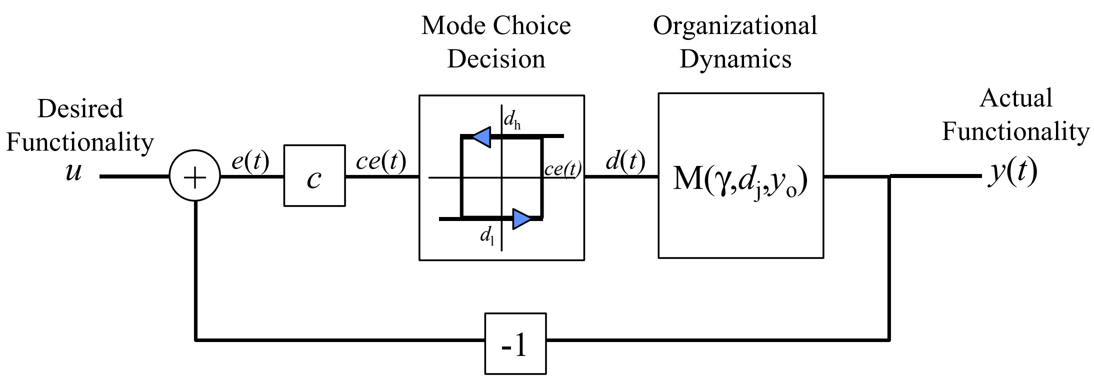

Figure 3: Dynamics of Mode Switching

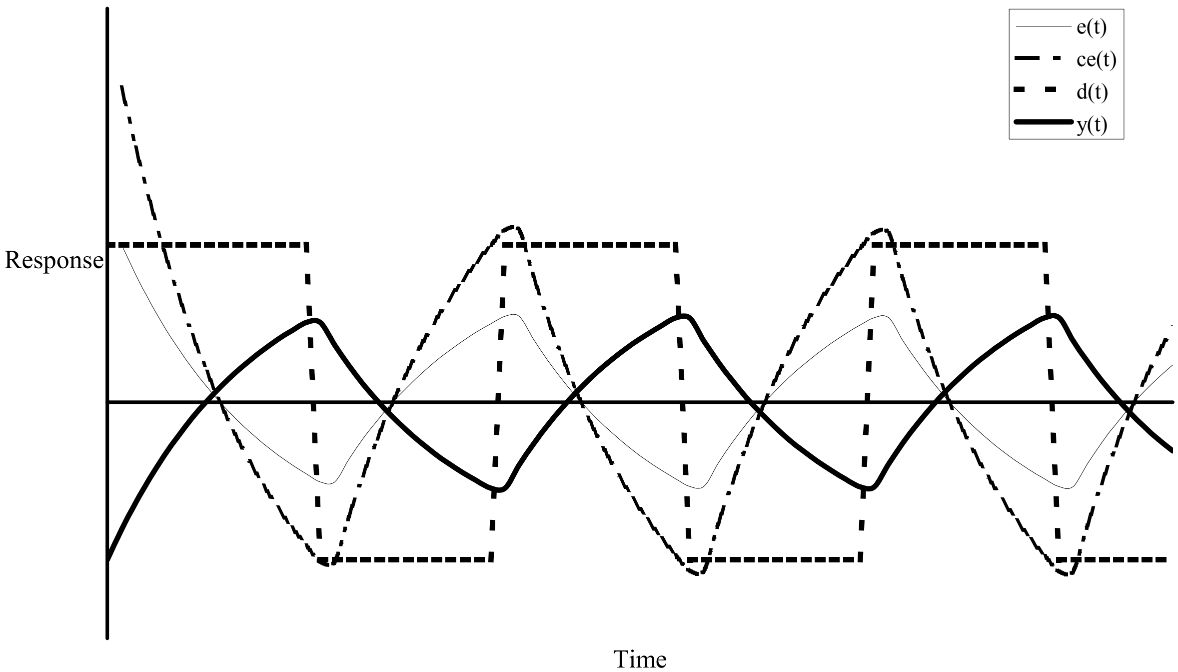

Figure 4: Optimal Switching Interval

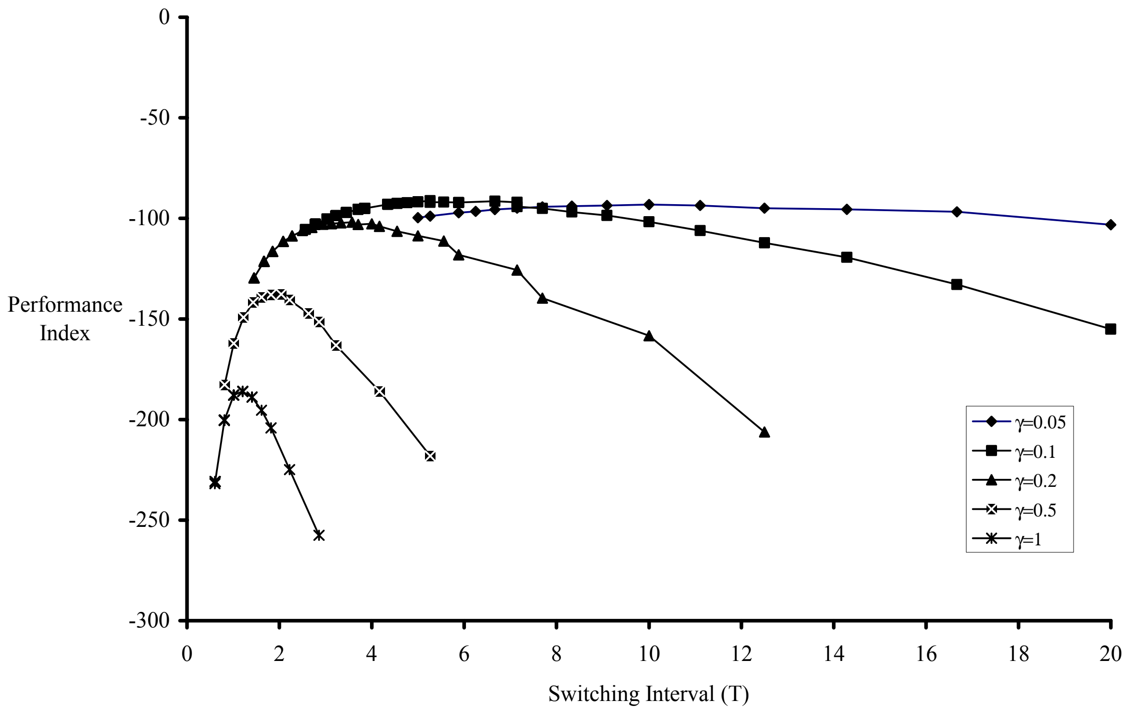

Figure 5: Sensitivity Analysis