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The Rolodex model: understanding relationship complexity as a precursor to the design of organizational forms for chaotic environments

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THE ROLODEX MODEL: UNDERSTANDING RELATIONSHIP COMPLEXITY AS A PRECURSOR TO THE DESIGN OF ORGANIZATIONAL FORMS FOR CHAOTIC ENVIRONMENTS

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ABSTRACT

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When a snail crossed the road, he is run over by a turtle. Regaining consciousness in the emergency room, he is asked what caused the accident. "I really can't remember," the snail replied. "You see, it all happened so fast."

From "Laughter, The Best Medicine," *Reader's Digest,* August, 1994.

THE EVOLUTION OF COMPLEXITY IN ORGANIZATIONAL FORM

The snail and the turtle anecdote above portrays the chasm in expectations between two classes of organisms that have very different speeds of movement and a very different range of flexibility. What appears slow and manageable to human perceptions may appear too fast and discontinuous for the turtle and the snail. They represent a class of organisms that cannot cope with that increased speed and apparent chaos. In order to successfully cope, they have few options beyond retreat into their protective shells. Although acceptable for passive herbivores in a stable environment with plenty of food nearby, this option is hardly appropriate for the predator, particularly in times of fierce competition. Otherwise, the snail and turtle would probably need radically different bio-genetic make-ups for generating biological forms that enable more dynamic modes of sensing, quick reaction, and movement. Furthermore, the more turbulent and complex the context, the more demanding the requisite flexibility and requisite energy of the organism will have to be. We believe that the extent of qualitative change needed in the organizational forms of business in order to survive the emerging environment of the 21st century are no less radical. In a decade or so, when we will look back at the prevailing models of organizational forms of today, they will appear to us as lethargic, passive and "out of synch" as the turtle and the snail. Most importantly, in order to build theories around those new forms we believe that the requisite paradigm shift in *how we need to think about* organizational forms and their complexity parallels the chasm in the anecdote.

This report seeks to help find new ways to think about organizational forms as both the business environment and the requisite organizational forms are becoming increasingly dynamic and complex. We first examine some of the key shifts in the emerging business environment and what that implies for requisite organizational forms and how we think about them. The report then develops the concept of relationship complexity in relation to organizational form, drawing from organizational scholars, management practitioners and principles from the physical world to develop an energy-based framework for analyzing dynamic organizational forms. This framework is useful not only in a descriptive role for explaining, categorizing and comparing existing organizational forms, but it also performs a generative role that can be used to predict and design new, active organizational forms of the future.

Shifts in Organizational Environment

Major discontinuities are being triggered by time compression, technological advances, and complex global interdependencies (Bettis & Hitt 1995). The emerging business environment of the 21st century has

been characterized as one that will be increasingly driven by hypercompetition. Hypercompetition is a condition in which strategic advantages are rapidly eroded by the speed and boldness of competitive moves and countermoves (D'Aveni, 1994). We are already seeing the early manifestations and corresponding preparatory measures: shrinking product lifecycles, time-based competition (Stalk & Hout, 1990), new industries appearing and growing in months rather than years, increasing research and development expenditures by market leaders (high technology companies such as Intel Corporation are cases in point), and widespread downsizing of large organizations to become lean and flexible. In hypercompetition there are many unknown and unplanned surprise events which require not only heightened awareness and fast, flexible response, but also the capability to adapt to changing rules and new contexts with new adversaries and allies. The implications for organizational forms is that there has been a shift towards forms that facilitate the rapid creation of new strategic assets (Thomas, 1996).

Second, increasing globalization and rapid knowledge creation are in combination increasing the compound interdependence between organizations. Global alliances and joint ventures are increasing rapidly and multiplying the complexity of interdependencies. The lines between competition and cooperation are blurring as complex organizations compete in some markets and cooperate in others (Moore, 1996). Traditional industry boundaries are disappearing and this compound interdependence is making for complex relationships among organizations. As organizations dynamically move in and out of alliances more rapidly, there is an increasing need for rapid reconfiguration of organizational form as opportunities appear.

Third, the complexity ensuing from both hypercompetition and compound interdependence are further heightened by the increasing intensity of information technology infrastructure and the rapid emergence of electronic webs. The rapid growth of electronic commerce and electronic enterprise integration are enabling new ways of organizational functioning that are generating a slew of new organizational forms that straddle both the physical world and cyberspace. The world wide Web is providing an infrastructure that is open, distributed, decentralized, transcends time and distance, and is highly interconnected. The Web has been identified as both child and parent of complex adaptive systems, both exhibiting and enabling their characteristics: self-organizing and facilitating of emergent order, large and intensively interconnected, constantly evolving, and exhibiting non-linear behavior (Sol, 1997). The Web and what it promises to be will change the structure and characteristics of the organizational environment space in ways that we have only begun to glimpse. The Web is for this coming era of complex change what the farm was to the Agricultural revolution and what the factory was to the Industrial revolution. It is a new organized space that generates new requirements for organizational forms that are flexible and enabled through information technologies. In combination, hypercompetition, compound interdependence, and electronic webs are creating new requirements for organizational forms and their underlying logics. We examine these below.

Shifts in Organizational Forms

Progressive managers do not wait for scholars to theorize when the change in business environment rapidly requires new modes of organization. As Daft and Lewin (1993) pointed out a half-decade ago, organizations were already experimenting with new organizational forms without the benefit of theory. Indeed, the traditional hierarchical organization with its vertically integrated tendencies had given way to new network forms with such names as shamrock organizations, inverted doughnuts, virtual corporations, orbital organizations, federations, hollow corporations, and cluster organizations (Handy, 1989; Lehr & Rodriguez, 1991; Davidow & Malone, 1992; Peters, 1992). The traditional M-forms (multidivisional corporation), U-forms (vertically integrated firms), and H-forms (conglomerates) that originated from the likes of Chandler and Williamson have been challenged (Bartlett & Ghoshal, 1993) in that they no longer fit the existing organizational forms of innovative and successful global corporations. We are also seeing organizations that simultaneously have more than one organizational form. One part of the organization is a hierarchy, the other a team-based matrix, a third a loose alliance of quasi-networks, and so on. This has been observed initially in large multinational corporations that operate in several markets and have been termed *heterarchies* (Hedlund, 1993). Thus, the organization adapts part of its form to the needs of the particular market or environmental niche to which it wants to respond. It is not difficult to see that the apparent complexity of organizational form has been increasing rapidly.

Advances in electronic networks and information technologies have furthered the shifts in organizational forms by breaking traditional assumptions. Information technologies enable simultaneous centralization and decentralization, rapid collaboration over far-flung geographical distances, and electronic brokerage effects (Malone et. al., 1989). This has shifted the organizational form more towards networks and extended enterprises (Thorelli, 1986; Konsynski, 1993) rather than just markets and vertically integrated hierarchies. It has also facilitated the virtual corporation form (Davidow and Malone, 1992), which is built around IT-enabled relationships that empower a corporation to quickly reconfigure its topology of trading partners to seize new opportunities. Furthermore, given the volatility of the environment in the electronic economy, enterprise architectures will have to be designed for dynamic stability (Ghemawat & Ricart i Costa 1993). Thus, an added element of complexity to the organizational form through information technologies is the capability of rapid reconfigurability when opportunities change. These have been termed platform organizations (Ciborra, 1996). With the platform structure, the organization is defined through not just the current form, but also the potential forms based on dynamic reconfiguration. The platform organization also can conceivably have an inter-organizational "plug-and-play" version in which the network of potential partners that can be rapidly accessed and assembled into an inter-organizational network becomes the organizational form itself.

Shifts in the Underlying Logics of Organizational Forms

We have examined above some of the key shifts in the emerging business environment and how that has produced new organizational forms that are increasingly hybrid and heterarchical, more flexible and

dynamically reconfigurable, and more commonly IT-enabled (i.e., forms that are more complex and have new kinds of complexity). We argue below that this suggests a requisite shift in the underlying basis and logic through which we should describe organizational forms and generate organizational archetypes. Consequently, we need to reconsider the structural properties of organizations that are manipulated to produce new organizational designs under these new conditions. In other words, we will need to rethink the structural dimensions of organizational form such that they are useful to organizational design in this new environment. These shifts are summarized in Tables 1 and 2 and described below.

Table 1 Requisite Shift in Basis of Description of Organizational Form

Organization as Economic Entity	→	Organization as Complex Social Institution
Simple Transactions as Basis of Analysis	→	Complex Relationships as Basis of Analysis
Structure-Driven Constructs of Form	→	Process-Driven Constructs of Form
Internally focused Dimensions of Form	→	Inter-Organizational Dimensions of Form
Social Scientist Perspective	→	Manager Perspective

The notion of organizations as economic entities based on transaction costs appears to have run its course in terms of usefulness for these new conditions (see Table 1). Ghoshal and Moran (1996) argue very convincingly that organizational design prescriptions based on transaction cost economics are not only likely to be wrong, but also dangerous for corporate managers because of the assumptions and logic on which they are grounded. Most inappropriately to the emerging hypercompetitive environment, prescriptions are based on shielding managers from uncertainty. Other assumptions that fly in the face of the new business environment are that behavior is assumed to be exclusively opportunistic rather than also collaborative – and it confuses opportunism as an attitude and as a behavior (thus confusing the potential with the performance). The prescriptions of transaction cost economics assume that organizations exist because of their ability to attenuate opportunism through control when markets fail. Ghoshal and Moran argue that in this new environment it is exactly the opposite: markets are beginnings where organizations fail. They suggest that the organizational logic is that of purposive adaptation based on learning, and that such adaptation allows organizations to pursue dynamic efficiency, which creates new options and expands the scope of activities. Thus, in this new environment it is a much better assumption that organizations are complex social institutions rather than economic entities. Furthermore, simple economic transactions are no longer representative of the bulk of what goes on across organizational networks. Rather, the bulk of

interactions across organizations are better represented through multiple complex relationships (Nohria & Eccles, 1992).

Furthermore, the realities of managerial practice in progressive companies suggest that there is a need to shift from structure-driven constructs of organizational form (such as centralization, formalization, or divisionalization) to more process-driven constructs that are based on relationships and roles (Bartlett & Ghoshal, 1993). Stabell and Fjelstad (1998) have argued that the value chain model needs to be extended to include value networks and value shop models that go beyond linear waterfall forms. Ashkenas et. al. (1995) have also shown that the new organizational form is one that busts boundaries of all kinds: vertical boundaries up and down hierarchies, horizontal boundaries across traditional divisions, global boundaries across geographical and cultural distances, and external boundaries that link to customers, suppliers and other partners. There is thus a requisite shift from internally focused dimensions of organizational form to inter-organizational dimensions of organizational form. In addition to that, the new organizational forms are being generated through management practice rather than academic research. This has generated a growing movement that calls for theories and perspectives on organizational form that are deduced from the perspective of practicing managers who are on the leading edge – rather than the disciplinary premises of social scientists (Bartlett & Ghoshal, 1993). Thus, the structural dimensions of organizational form must be derived such that they capture the perspectives of practicing managers.

Table 2 Shift in Managerial Focus Underlying Organizational Form

Integration and Alignment	→	Renewal and Change
Vertical Administrative Processes	→	Creation of Horizontal Processes that add Value
Allocating Capital	→	Managing Knowledge and Learning
Minimizing Entropy	→	Maximizing Energy

Concurrently there has been a shift in managerial focus as the business environment has changed (see Table 2). In general there has been a shift from a "command and control" mode of organizing that centers around efficiency, resource allocation, and integration to a "sense and respond" mode of organizing that puts more emphasis on learning from the environment, seizing new opportunities, and renewing organizational capabilities (Haeckel & Nolan, 1991). In the 1990s the business process reengineering movement and the popularity of value chain analysis has shifted the emphasis to the creation of cross-functional horizontal processes that add value, and there has been a concurrent obliteration of vertical administrative processes that add overhead (Hammer, 1996). Furthermore,

intellectual capital, knowledge management, and the ability for faster learning have become strategic organizational capabilities for this new environment, and consequently have become foci of managerial attention (Nonaka, 1994). Strategic logic can be viewed as shifting towards value innovation in this new environment (Kim & Mauborgne, 1997).

The competitive enterprise of tomorrow cannot afford the luxury of selecting what it considers at the time to be the best, single organizational form and spend decades refining its operations. Unlike the snail and turtle anecdotally referred to above, the environment moves much too fast and is far too competitive for enterprises to remain static and depend on their protective shells for survival. This calls for change in managerial focus. No longer is gradual refinement through internal efficiency and organization sufficient—or even necessary—for competitiveness. The shifting business environment now calls for fast action and dynamic reconfiguration to seize new opportunities whenever and wherever they may arise, opportunities that are becoming ever more difficult to predict and plan for. Drawing useful concepts from Physics, these changes suggest that managerial attention must shift its focus from primarily minimizing entropy (minimizing the amount of disorder in the organizational system) to primarily maximizing energy (increasing the capacity of the organizational system to perform work and seize new opportunities as they arise). More than just useful analogy, we find that understanding the concepts of energy in the organizational world is helpful in understanding how dynamic, structural dimensions of organizational form can contribute to more effective organizational designs. Yet the concept of energy has generally been neglected in organizational theory. We introduce some novel concepts and take a few early steps toward integrative organizational analysis and design, which we hope will provoke more careful examination in conditions of change, innovation, and entrepreneurship.

We have argued above that the new organizational forms are more complex and have new kinds of complexity—increasingly hybrid and heterarchical, more flexible, and dynamically reconfigurable. We have also argued that we need to rethink how we conceive the structural dimensions of organizational form, and we have shown that these will need to be based on process-driven constructs, will need to capture the complexity of inter-organizational relationships, and may need to take into account the concept of energy. We have also argued that we need to consider the primacy of perspective of practicing managers. We use these ideas in the next section to define a model for dynamic structural dimensions that underlie organizational forms, which is suitable for the new business environment characterized by hypercompetition.

RELATIONSHIP COMPLEXITY AND ORGANIZATIONAL FORM

Historically a number of aspects of complexity have been examined in organizational studies: vertical complexity, horizontal complexity, and spatial complexity. These are all static concepts that are awkward at best for addressing dynamic reconfigurability required for future organizational forms. We have shown above that in the increasingly complex business environment a different aspect of complexity—

relationship complexity—may be more important as a dynamic structural element that underlies organizational form. We examine this more carefully in this section of the report.

We first exposit an inter-organizational relationship process model and draw some implications from that. We then develop a set of dimensions for relationship complexity through a managerial perspective that we term the Rolodex Model. Learning from physics, we show how the concept of energy can enrich our interpretation of relationship complexity and the Rolodex Model. We then use the dimensions of the model to explain existing organizational forms and to identify new ones, both static and dynamic. Finally we illustrate ways in which the model can be used for organizational design in the new business environment. We contend that understanding relationship complexity is a precursor to the design of dynamic organizational forms for hypercompetitive and chaotic environments.

An Inter-Organizational Relationship Process Model

Our search in the organizational literature for a process-based model that captures the complexity of inter-organizational relationships in a dynamic environment led us to a framework by Ring and Van de Ven (1994). Their framework focuses on the developmental processes of cooperative inter-organizational relationships in situations that cannot be fully specified or controlled by the parties in advance. Their framework examines how these relationships emerge, grow, and dissolve over time. But the Ring & Van de Ven framework focuses on the evolution of a relationship where the two or more parties are already identified. We extend their framework to better suit our conditions of dynamic reconfigurability—to include the search for potential partners to develop inter-organizational relationships with—and we also take into account potential relationships in addition to realized ones. The modified framework is shown in Figure 1.

In this extended framework, relationships are dynamic concepts that cycle through four recurrent and overlapping stages: 1) the search for potential partners and their identification, 2) negotiations of joint expectations, risk, and trust, 3) commitments for future actions, and 4) executions of commitments through interactions. Concurrently, there is an ongoing process of assessment of the realized and potential relationships with the different partners. The detailed dynamics are similar to what is very well detailed by Ring & Van de Ven and we shall not repeat them here. However, we use the framework to draw some implications for how relationship complexity might influence the formation of complex organizational forms.

First, the framework shows that trust becomes an even more important variable in the formation of organizational forms in conditions of dynamic reconfigurability. For example, the manifestation of commitment is principally determined by the degree of trust between potential partners, and this degree is influenced by experience with execution. Thus, trust is viewed not as a dichotomous construct but rather as a variable on a continuum. Once a commitment is made, the parties attempt to execute the activities to which they have committed, and all parties assess the relative performance and benefits deriving from

execution. Good performance and positive benefits generally lead to increased trust between partners, whereas poor performance or negative benefits can cause trust to diminish.

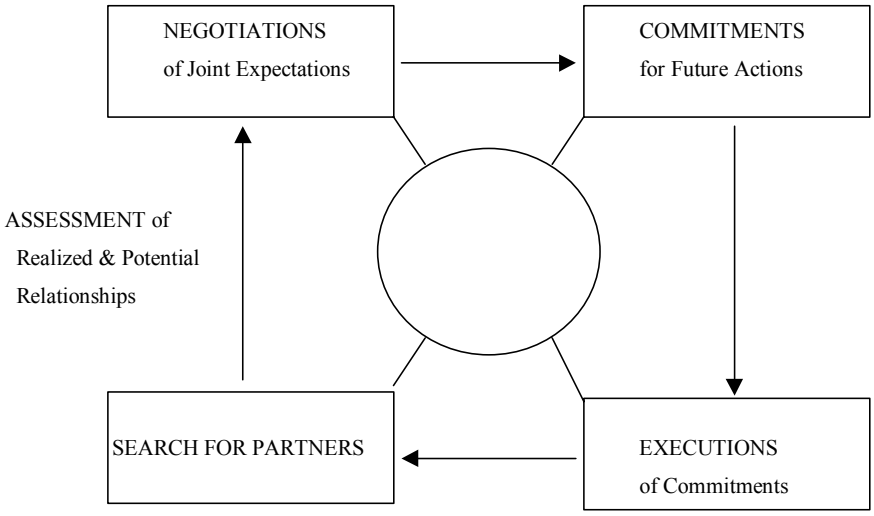

Figure 1 Inter-Organizational Relationship Process Model
(adapted from Ring and Van de Ven, 1994)

For example, an increase in trust derived from execution that is assessed favorably may lead partners to expand their relationship on the following joint activity. The expanded relationship may provide the basis for quicker negotiation (e.g., based on the same terms as the last venture), the parties may require a less formal commitment (e.g., handshake instead of contract), and they may enjoy a greater ability to resolve problems or disputes during execution (e.g., through a telephone call rather than litigation). This relationship between execution and trust forms the basis for the dynamics of the relationship process and consequently for the ensuing organizational form. Hence the relationship process helps to explain how different organizational forms may ensue depending on the degree of trust and the mode of execution with a partner. When multiple relationship processes are in motion with multiple existing and potential partners, the aggregation of this relationship process provides the basis for dynamic organizational form.

Second, the framework highlights the viability of the complex dynamic relationship as a unit of analysis for determining the structural dimensions underlying organizational form in this new business environment. Third, the extended framework—with the inclusion of the search for potential partners and their continual assessment in conditions of dynamic reconfigurability—reinforces the notion of maximizing energy rather than minimizing entropy as the main managerial focus. We further examine these aspects in the sub-sections that follow.

Dimensions of Relationship Complexity: The Rolodex Model

Building on the relationship process model and its implications, and drawing on the observations of management practitioner writings, we identify and define three core structural dimensions of relationship complexity: *reach, range*, and *reciprocity*. We also identify and define the concept of *reconfigurability* as a dynamic complement to these three dimensions. In combination we have called these the "Rolodex Model" as it has overtones of an organizational version of a manager's rolodex card file of contacts.

Reach: The dimension of *reach* is proposed to measure the number of *potential* partners to which an organization has likely access. The reach dimension conjures-up something of a rolodex model of accessible potential partners (Peters, 1992). To be included in the rolodex, some kind of relationship must be established; the relationship can be described in part by the level of trust that has been developed between potential partners through their previous interactions. As a variable, reach relates positively to the number of opportunities that a firm can potentially pursue; that is, in addition to opportunities that could be seized through the organization's own resources (e.g., capital and talent), more potential opportunities may be seized through collaboration with other firms (i.e., partners). The greater the reach of an organization the more venture partnerships it is able to form at short notice if an opportunity requiring it arises. It is able to draw on a broader repository of knowledge and advice, should it be needed. Alternatively, the enterprise with long reach need not carry the overhead, risk and inertia of large R&D departments, for example, which are vulnerable to critical missteps such as developing the wrong product for a market, developing the right product at the wrong time and overlooking promising new technological developments altogether.

The reach dimension is nurtured through the contacts of top executives, and through initiating relationships with customers and suppliers. It can also be nurtured through membership in technological consortia and professional associations. As a company will sometimes acquire another one just to get its customer network, the number of potential partners to which a company has access is an attractive asset that is becoming exceedingly important for success. It is not uncommon for global companies to form their strategies around their alliances and relationships (Schlender, 1993) and to show them off. For example, a global investment banking company (Lehman Brothers) runs an advertisement that says "Know Us by Our Relationships."

Range: The *range* dimension is proposed to measure the *variety* of partners within the reach of the organization. These are the partners with which the organization has the potential to collaborate in a venture of some kind. It is adapted from Keen and Cummings (1994) and draws on the theory of requisite variety (Ashby, 1956). Whereas reach refers to the *number* of potential partners (e.g., the number of "cards in the rolodex"), range pertains to the variety or *diversity* in core competencies among potential partners (e.g., different specialties, industries or technologies "listed on the rolodex cards"). Like reach, the effect of variety is that collaboration with partners offers the potential to seize additional opportunities, but the nature of collaboration extends beyond the combined numerical resources of reach; that is, variety

entails the complementation of core competencies. Variety allows more effective responses to the full spectrum of impacts and interactions required by an organization in a turbulent environment, which includes changing competitors, opportunities and other exogenous factors (e.g., legislation, technology, serendipity).

Reciprocity: The *reciprocity* dimension is proposed to measure in aggregate the strength and directionality of the relationship between the organization and the partners within its reach. It is based on trust and skewness of dependence and derives from Ring & Van de Ven (op. cit.), the resource dependence model (Pfeffer & Salancik, 1978), and the construct of intensity (Peters, 1992). Reciprocity represents the strength and versatility of the relationship. So, while unlike reach—pertaining to the number of (potential) partners with which the organization has established some kind of relationship—and range—pertaining to the variety associated with the (potential) partners with which the organization has established some kind of relationship—the reciprocity dimension pertains to the strength or intensity of the relationships with potential partners, and in whose direction it is skewed. Reciprocity in a relationship is stronger when there is a stronger will, dependence, and commitment from all parties to initiate ventures vis a vis the set of partners within reach and range. For instance, a relationship with a strategic partner for many years will probably have higher reciprocity than one with a minor supplier with which the organization has on a single occasion placed one order.

These three core structural dimensions of reach, range, and reciprocity characterize the relationship complexity of the organization in its environment. This dimensional characterization of organizational structure is inherently dynamic and these constructs can be used to generate multiple configurations that correspond to archetypes of organizational form, both existing and conceived (as we shall see later in this section). However, these three dimensions do not directly capture the capacity of the organization for purposeful rapid reconfiguration. Thus, we introduce the concept of *reconfigurability* as a dynamic complement to these three dimensions.

Reconfigurability pertains to the organization's capacity and ability to change the topology of its relationships (i.e., its capability to change reach, range, and reciprocity). Reconfigurability combines a speed component (how quickly can the organization reconfigure its relationships) with scale and scope components (extent of change that can be made to a relationship topology). For an organization to have higher reconfigurability in its relationship topology, it must also have higher energy available to shift to the new configuration and function effectively with it.

The notion of energy has not been sufficiently examined in the field of strategic management and we believe there is something to learn from other fields that have studied the concepts associated with energy. Drawing from what has been learned in the physical sciences, we examine the concept of energy

in the next sub-section and relate it to relationship complexity and the design of inter-organizational forms. Analogies and metaphors from physics are already common in discussion of organizations. For example, we regularly hear characterizations of organizations in terms of their *potential, speed, maneuverability* and like energy-related concepts. Clearly, however, many physical analogies and metaphors do not match well to the organizational domain (e.g., temperature, magnetic flux). Because energy concepts are already part of the organizational lexicon, their employment in the sections that follow should not appear too abrupt to either the strategic scholar or practitioner. We move to better formalize these organizational adaptations from the physical world.

Learning from Physics: Energy and Phase Space in the Organizational World

Energy is one of the most fundamental concepts of physics. It is on par with distance, time, and temperature in terms of centrality to physical models and explanatory ability. Energy is defined in the physical world as the capacity to do work. Energy is also a pervasive concept in physics because of its ability to convert from one state to another, which allows mapping between heterogeneous domains. Thus, for example it is the same energy construct in Newtonian mechanics (work done by a physical system), electricity (power supplied by an electrical system over time), and thermodynamics (heat produced through a chemical reaction). Also, energy is related to other fundamental concepts. Einstein's famous equation $E=mc^2$ relates energy to both mass and the speed of light (mass speeded up). In the physical world, the energy of a system cannot be increased except through work or some other influence external to the system. Thus, in physics, the principle of conservation of energy maintains that energy can neither be created nor destroyed—it is simply transferred or transformed. This is known as the First Law of Thermodynamics.

The Second Law of Thermodynamics states that without an infusion of energy a system can only be transformed to a state of increased disorder or disorganization (i.e., higher entropy). We have already alluded to the different managerial objectives pertaining to energy (i.e., maximization) versus entropy (i.e., minimization); here we concentrate on the energy associated with physical systems in order to gain organizational insight into the principles of energy storage and transfer, both essential for dynamic reconfiguration. Specifically, we examine energy principles as they are revealed through two physical systems: 1) the spring-mass system and 2) the elevated-mass system. We also introduce the notion and usage of phase space for later examination in our analysis of reconfigurable organizational forms.

Learning about Energy from Spring-Mass Systems

The spring-mass system is interesting and applicable because it reveals insight into the storage and transfer of energy in physical systems. The dichotomy between potential (stored) and kinetic (transferred) energy may be useful for conceptualizing the potential of an organization and using energy to explain or predict its manifest actions, for example to seize new business opportunities or to reconfigure its relationship topology. Some key uses of energy are listed in Table 3 and discussed below. For this physical system,

potential energy can be stored in the coils of an extended (or compressed) spring, and when released, this stored potential is transferred to kinetic energy associated with action through the motion of some mass (e.g., a block) attached to the spring; conversely, the kinetic energy associated with this motion can be used to do work by compressing (or extending) the spring in the opposite direction. Although systems within this class are quite simple, they are well understood and the associated physical models are very powerful in terms of explanation and prediction.

Table 3 Key Uses of the Energy Concept in Physics

1. Equate energy for potential action with manifest behavior
2. Explain and predict motion and system behavior
3. Differentiate between qualitative system classes
4. Classify system archetypes by inspection
5. Guide system design

For example, choosing a suitable coordinate system, even a simplistic model with only one equation can explain and predict the complete behavior of a spring-mass system (potential as well as manifest). Further, two different concepts of energy—potential and kinetic—can be treated equivalently and interchangeably—within the proper framework and coordinate system—as the dynamic spring-mass system changes in configuration; that is, potential energy and kinetic energy just represent different forms of the same energy concept.

Further, we can use this model to make qualitative statements about different systems. For example, one spring-mass system with greater potential energy than another will be capable of propelling a block to a higher speed than can the other, lower-energy spring-mass system (*ceterus paribus*). Likewise, all other factors being the same, a spring-mass system with lighter mass will also propel a block to a higher speed, as will one with a spring further extended or another with a stiffer spring. Considerable design guidance—to produce a fast-moving block, for example—is available through this coordinate system and simple model, as is the ability to measure various configurations, explain differences between systems and predict their differential performance in advance of implementation.

Moreover, we understand from this model that an investment in work (external to the system itself) is required to stretch (or compress) the spring initially (i.e., impart the potential energy required for subsequent motion) and that when we release the spring, the block can move in only one possible direction: such that stored energy is released from the spring (i.e., not further stretched). This represents a Second Law prediction. We strive toward a capability for similar design guidance and predictability in terms of organizational forms.

Learning about Energy from Elevated-Mass Systems

Think of Newton's apple. In a gravitational field, an elevated mass has potential energy just like the mass that is attached to a coiled spring; that is, when the former mass is released from its elevated position, motion in the direction of the field (i.e., toward the ground) results. The same principle of potential energy being stored and transferred into kinetic form can also be represented by a simple model with a single equation. Similar to the spring-mass system, this simple model also satisfies the five uses of energy identified in the table above. Likewise, we understand that an investment in work is required to elevate the mass, and that the mass will move in only one direction when released (i.e., down and not up). Further, because the same energy concept appears in both models, the two can be combined to compose what we might call an elevated-spring-mass system, in which the potential energies associated with the spring and elevation can be *combined*.

Proceeding in this manner of composition, potential energy can be used explicitly as a design variable, and tradeoffs between energy supplied by the spring and elevation can be assessed. This approach may introduce useful new perspectives in the context of designing organizational forms. For example, in an organizational reconfiguration context, the total energy can be shown to equal the sum of the energy used for three purposes: 1) to reconfigure (i.e., effort expended in organizational change), 2) to carry out the work of the organization while maintaining the configuration, and 3) potential energy available for future work and future reconfiguration. Thus, there is an energy trade-off between reconfiguring the organization and carrying out its other day-to-day work. That could provide insights related to the maximum extent of reconfiguration that an organization can reasonably withstand while still continuing to have sufficient energy to release and expend for day-to-day work.

Phase Space

The geometry of dynamical systems takes place in a mental space that has been termed a phase space. Phase space is different from regular physical space and is the space of the possible (i.e., it contains not just what happens but what might happen under different conditions; Cohen & Stewart, 1994) and thus bears the "what-if" flavor of comparing design alternatives. In this graphical technique that is employed for the analysis of complex dynamic systems, one variable such as *position* is plotted contemporaneously against another such as *velocity* for all time points along the trajectory of the system. The rendering of a specific two-dimensional phase space plot is often referred to as a *phase portrait*. Of course the technique is not limited to position and velocity, but this choice of coordinate dimensions has proven to be very useful for analyzing the energy associated with a broad array of dynamic systems, including the simple models above. Similarly, our identification of the three coordinate dimensions in the previous section—reach, range and reciprocity—may prove to be useful for analyzing the energy associated with dynamic organizational systems that reconfigure frequently.

Figure 2 shows a typical phase portrait with position and velocity for purposes of exposition. Four classes of dynamic physical systems can be differentiated through inspection of the phase portrait. Notice

that the stationary point "S" represents an extreme (with zero energy) value for both the dissipative and driven systems. The intuitive explanation is that a dissipative system will eventually stop and that a driven system ultimately starts from some point of rest. We know that the conservative system depicted by ellipse "O" (i.e., neither dissipative nor absorptive) maintains a constant level of energy, with the notion of a physical oscillator (e.g., spring-mass system, pendulum, etc.) simply transferring energy back and forth between potential and kinetic forms (i.e., position and velocity).

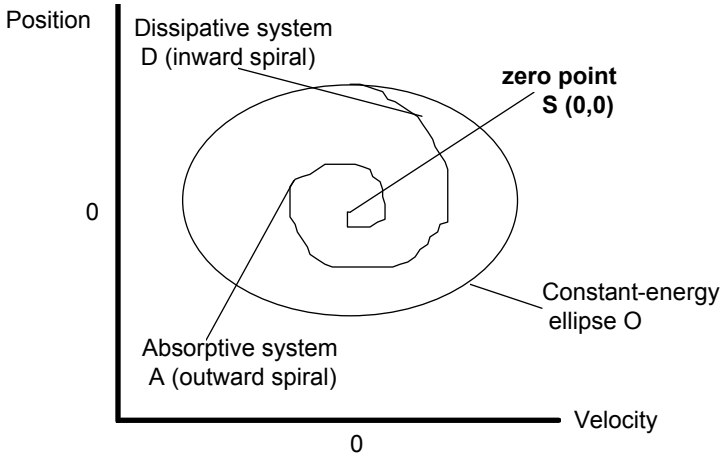

Figure 2 Phase Portrait

- A static "equilibrium" system is represented by the stationary point labeled "S"
- A (conservative) oscillating ("cyclical") system is represented by the elliptical limit cycle labeled "O"
- A (dissipative) oscillating ("stagnating") system is represented by the inward-spiral trajectory labeled "D"
- A (driven) oscillating ("absorptive") system is represented by the outward-spiral trajectory (actually the same spiral in the opposite direction) labeled "A."

This example highlights four key points. First, by selecting useful dimensions, this graphical technique can be used to quickly differentiate between various classes of systems (or archetypes) with direct links to energy. For example, we can easily show that the trajectory lines of a conservative system (i.e. with constant energy) will never cross in phase space. Second, the phase portrait captures the dynamics of change in energy—not only changes in energy *levels*, (e.g., increase (decrease) of driven (dissipative) systems), but also changes in energy *forms* (e.g., cycle between potential and kinetic). For example, notice that the conservative system plotted ("O") achieves its maximum velocity to coincide with minimum (i.e., zero) position and vice versa. Third, trajectories in the phase portrait are explicitly related to the energy of systems in direct proportion to their *distance* from an appropriate origin (i.e., zero energy point). For

example, the energy of the conservative system ("O") exceeds that of its static counterpart ("S") and remains constant (elliptical geometry), unlike the dissipative (decreasing radius) or driven (increasing radius) systems. Fourth, through the informed choice of coordinate dimensions, the diverse, complex *dynamics* pertaining to a multitude of different systems can be analyzed (graphically) through a phase-space *structure*, which simplifies the analysis by an order of magnitude or more. With this we begin to gain insight into the power of the coordinate system introduced above through its ability to characterize and compare alternative organizational forms in high reconfiguration situations.

Using the Rolodex Model to Explain Existing Archetypes of Organizational Form

Explanation and prediction represent two fundamental objectives of theory (Bacharach 1989). In our present model-building context, explanation has two modes of particular interest: 1) using the Rolodex Model to explain existing archetypes of organizational form, and 2) using the model to identify new archetypes (i.e., organizational forms). The first necessarily addresses organizations that exist and operate in the business world today and is descriptive in nature, whereas the second supports the capability to systematically search for novel forms that may be possible and is constructive in nature. With sufficient conceptual and theoretical development, the model may also serve in a prescriptive role. Together, these modes highlight a number of potential uses and utilities for the model.

Like individual people, plants and snowflakes, every organization in the real world is unique at the detail level, but they all share similarities and can be classified using archetypes according to various schemes (e.g., governance and contracting through hierarchies vs. markets). Like class-level problem solving in artificial intelligence (see Rich and Knight 1991) or class-level design for object-oriented systems (see Booch 1994), working with archetypes allows one to abstract away from a great many details and idiosyncrasies that do not make a strong contribution to the discussion, and to focus on the more general, dominant characteristics and patterns that contribute toward explaining the phenomena of interest.

Recall from the spring-mass system, for example, that we discussed only the macro-level concepts of energy, motion and position associated with the spring and block, purposefully ignoring factors such as the texture of the horizontal surface (e.g., wood table, cement floor) on which the system moves—along with the associated friction—or the temperature and pressure of the surrounding atmosphere—along with the corresponding drag on the moving block; we also purposefully omitted all discussion pertaining to details associated with the spring itself (e.g., its length, diameter of its coils, metal or other material from which it is constructed, etc.) or the block (e.g., its size, color, wood or material from which it is constructed, etc.). Still we are able to capture many key system elements in the spring-mass model above (esp. energy and motion) to explain its static and dynamic behavior. Further, this parsimonious model is sufficient to support qualitative distinctions to be made with other classes of systems such as the elevated-mass system, and we are able to both explain and predict the complete behavior of the system. Our motives for abstraction and parsimony are comparable here.

Hierarchy: We begin using the Rolodex Model by describing the most common inter-organizational form, the hierarchy. For purposes of illustration and exposition, we restrict this discussion to the hierarchy for a single-product (or service, information, core competency, etc.) organization that reflects complete vertical integration; that is, the organization is entirely self-sufficient, requiring no input from suppliers or any entity outside its corporate boundaries. Further, the organization has no interest or forces of change toward the use of the marketplace for supplies, nor does it contemplate a partnership to pursue new business opportunities (i.e., this form or configuration is stable). Clearly this description represents an idealized organization, for few (if any) organizations are *totally* self-sufficient; yet the qualitative distinctions between this and alternative forms—such as a market-based organization or strategic partnership—should be lucid.

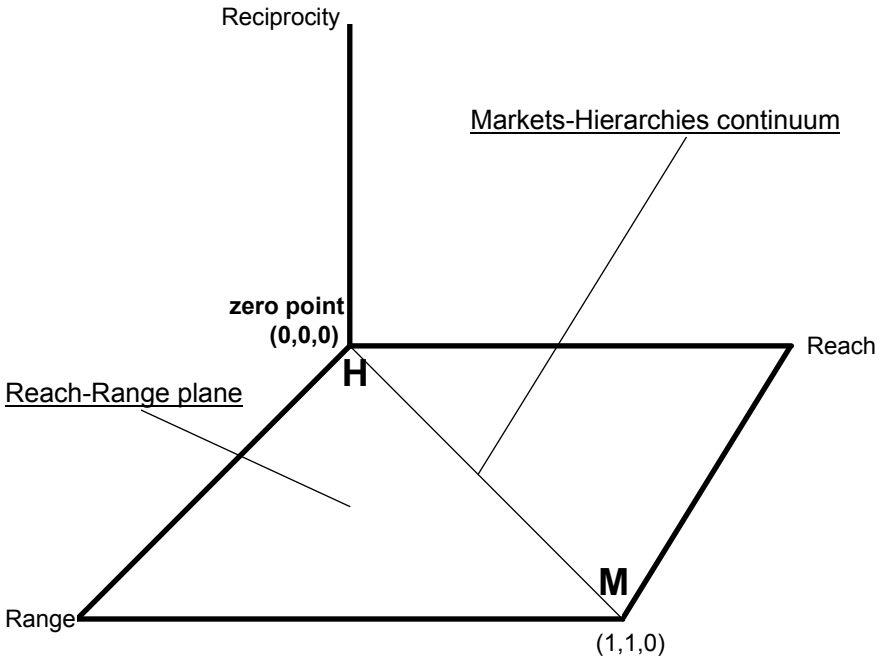

Figure 3 Market-Hierarchy Continuum in Relationship Coordinate Space

By definition, this single-product/service organization has no relationships (not even potential ones) with other enterprises, so its position on the reach axis would be at zero. It possesses only a single capability (i.e., offers only a single product; performs no R&D; etc.), so its position on the range axis would also be at zero. And, because it maintains no inter-organizational relationships, there can be no strength or intensity in terms of trust, so we place this archetype at the zero point on the reciprocity axis as well. Hence, the single-product hierarchy (point "H") rests at the origin (0,0,0) of our three-dimensional coordinate system (see Figure 3).

This model also extends naturally to capture hierarchies that possess a range of diverse capabilities and offer a multitude of products and services, but the range for such hierarchies would clearly be greater than that of the simple, single-product organization characterized above (i.e., non-zero range).

Market: As with the single-product hierarchy above, the market form archetype also represents an idealized organization that serves for illustration and exposition. Here let us consider a large government organization that has diverse needs (i.e., a wide range of products, services, information, core competencies, etc.) and has no internal capability to satisfy its own needs. Further, say that the behavior of this organization is regulated by socio-economic legislation that mandates the use of the marketplace, prohibits anything other than near-term, arms-length transactions, and compels its procurement process to be open and accessible to any and all potential bidders, qualified or not. Idealized, yes, but anyone experienced with contracting in the large with the U.S. government will observe great similarity to this archetypal profile.

Regarding the number of potential inter-organizational relationships as defined by reach, this organization is mandated to establish the potential for a contracting relationship with every organization in its relevant markets, and publishes guidelines and regulations that prescribe exactly how such contracting is conducted; hence, its reach is practically unlimited, and to avoid the unnecessary complication required to quantify this value, we simply position the market archetype as an extreme point along the reach axis and assign it a unit value (i.e., 1) to denote some sort of zero-one scale. Alternatively, to operationalize the construct for a particular organization, we can simply count the number of potential suppliers in its relevant markets.

A similar line of reasoning applies to the range dimension, for we said that this organization needs to acquire everything from the marketplace. Likewise, we would also plot the market archetype as an extreme point along the range axis and assign the same unit value (i.e., an extreme point on a 0-1 type scale). This construct can also be operationalized through a simple count of the number of *unique* capabilities associated with its relevant markets; however, in a design context, the relevant count is the number of such unique capabilities *that are required* to seize a potential new business opportunity (i.e., the requisite variety).

The inter-organizational relationships associated with this market-based enterprise are numerous and reflect wide variety, but the corresponding procedural, near-term, arms-length contracting based on standard contracts and inflexible rules for source selection, contract performance and termination does not have the connotation of building strong or intensive trust-based relationships. Again returning to the government acquisition case in point, this enterprise often has difficulty not *re-competing* business away from well-performing organizations with which the organization is delighted! Hence, this form reflects minimal strength or intensity of relationships, and we position the market archetype at the zero point along the reciprocity axis. Combined with the two dimensions above, this places the market archetype (point

"M") at the ”far corner” of the reach-range plane (1,1,0), which lies on a diagonal that is coplanar with the hierarchy archetype (0,0,0); that is, in the three-dimensional coordinate system, the market and hierarchy both lie in a horizontal plane.

Notice from Figure 3 that the diagonal between the market and hierarchy coordinates forms a continuum along which many intermediate points (e.g., “hybrids”) can be located and measured. Interestingly, without this three-dimensional coordinate system for reference, the diagonal and its two extreme points would simply appear as end points along a one-dimensional continuum in some analytical space; this characterization matches much of the prior work that addresses organizational form (esp. the work patterned after Williamson 1975).

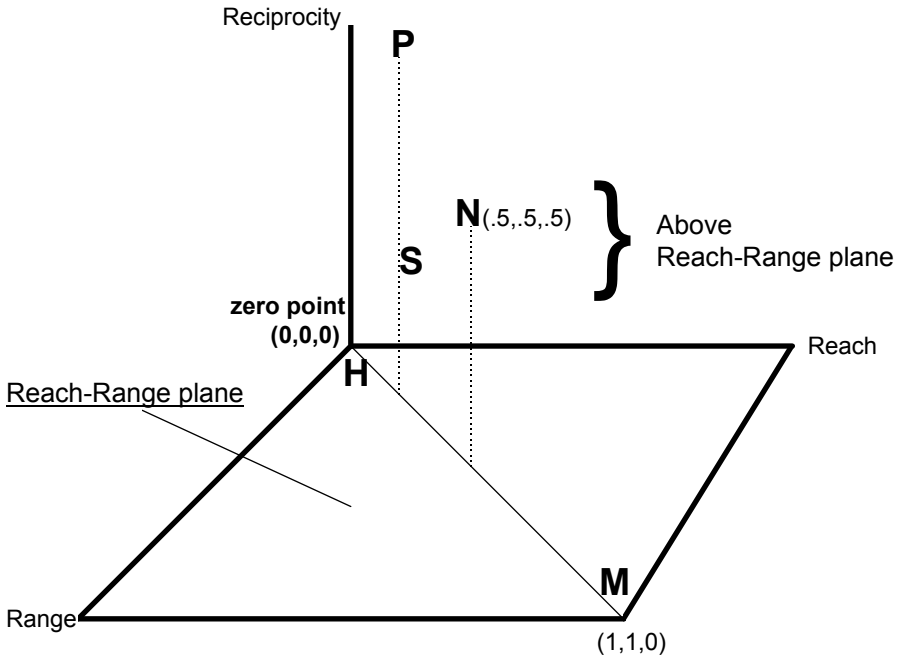

Figure 4 Reciprocity Forms in Relationship Coordinate Space

Network: The network represents a third illustrative form that combines aspects of both market and hierarchy and reflects the added dimensionality and complexity associated with relationships. For purposes of discussion, let us focus on an idealized strategic network, which is comprised of relatively few, stable, enduring partners that share strategic interests, profits and activities, and that involves a relatively small set of core competencies. It should be clear that this organizational form lies somewhere in between the extremes above in terms of both reach (e.g., only a few partners) and range (e.g., only a few capabilities), probably closer to the hierarchy than the market along these axes. The notion of a stable, enduring, strategic partnership between a small number of organizations implies considerable trust and relationship strength, however, so the strategic network organization is plotted well *above* the reach-range plane that contains the market and hierarchy points. Because the strategic partnership requires very strong or intense

inter-organizational relationships, we will assign the unit value to this organizational form (point "P") along the reciprocity axis (on a 0-1 scale). Unlike the simple counting approach to operationalizing the reach and range constructs above, however, the empirical measurement of inter-organizational trust is unclear at this point, except that we can confine the values of such trust to the levels observed between the strategic partnership on the high side and those corresponding to standardized market contracting below. Empirical measurement for this dimension represents an area for future research.

For illustrative purposes, we also plot a *general* network in the exact center of the coordinate system—depicted as "N" and plotted at (.5,.5,.5) as shown in Figure 4—to show that the reciprocity level is below that of the strategic partnership and above that of the syndicate—designated "S" and plotted below the partnership but well above this reach-range plane. Other forms such as the *kiretsu* can also be plotted, but the idea should be clear from the few points in Figure 4.

Using the Rolodex Model to Identify New Organizational Forms

We can also use the model to identify new organizational forms. As a first look at this space of possible new forms, notice that a model specified through three dimensions has a total of eight vertices associated with it. In geometric terms, our three-dimensional model can be viewed in the figure above as filling-out the volume of a cubic shape, which has eight corners (i.e., extreme points). From the positioning of symbols in the figure below, we see that only two of its eight vertices correspond to the plot positions of archetypes: 1) hierarchies (0,0,0) and 2) markets (1,1,0)—the strategic partnership is *close* to (0,0,1), but has definite non-zero reach and range. The question arises, what forms are represented by the other vertices?

Point C: For example of exposition, in Figure 5 we have plotted the symbol "C" at (1,0,1) to represent one of these unidentified forms. This vertex—which lies at the maximum position in the reach-reciprocity plane, but reflects minimum range—corresponds to a reach that spans the entire marketplace *for one particular product, service or core competency* (i.e., no range in terms of core competency), and intensive, trust-based relationships with every organization in this market. What organizational form is represented by this configuration? Perhaps an idealized cartel. For example, say that OPEC included all oil producers (i.e., reached the entire marketplace for oil production), and that all of the partners had developed intense, trust-based relationships with one another. This organization of oil producers has but a single core competency (oil production), which represents the definition of "zero range." Hence, we can add the perfect cartel to our list of archetypes.

Note, however, that the cartel is not entirely "new"; that is, as a class of organizational forms, cartels certainly exist, as OPEC represents a clear example (although hardly an idealized cartel). But does a cartel represent a market or a hierarchy? Can the cartel even be effectively described using Transaction Cost Economics? Doss the reduction of transaction costs even represent a rational objective when

organizing as a cartel? No. If we accept for the moment a definition of organizational energy expressed in terms of *the capability to seize potential new business opportunities*, the cartel represents an extreme organizational form in energy terms, which has the capability to seize *all* business opportunities within its single product/core competency area. Notice too that this extreme archetype also lies at an extreme point in our coordinate space in terms of distance from the origin.

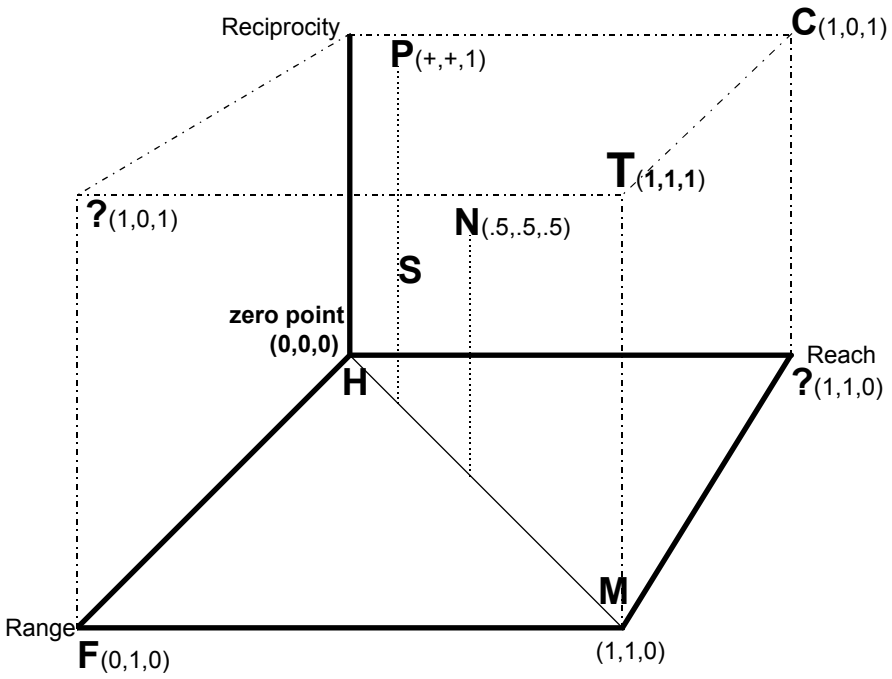

Figure 5 Extreme Forms in Relationship Coordinate Space

Point F: As another example, consider the organization represented by the point "F" (0,1,0), which lies at the extreme end of the range dimension, straight down the axis from "H" point (i.e., the single-product hierarchy). This idealized organization represents the same basic hierarchy as described above (i.e., no reach or reciprocity), but is clearly extreme in the range of its capabilities/core competencies; that is, through this form the organization possesses complete variety as defined for its relevant markets, but its operations are also completely internalized within the hierarchy. We tend to think of this form as something of an idealized conglomerate. This represents an extreme hierarchical form with no limits in terms of requisite variety, but it is absolutely limited in terms of reach and range. In many ways this represents a perfect opposite of the cartel at point "C," where great energy or power exists but the form is vulnerable because of (potentially) insufficient variety. For example, if the industrialized world is able to shift to an alternative energy source (e.g., fuel cells driven by air and water; solar panels driven by sunlight; nuclear power), then the advantage of the cartel quickly diminishes. This is explained well in terms of insufficient variety (i.e., minimal reach). Here in the case of point F, the variety supported by its extreme range represents a strength (vulnerability), but the conglomerate has no reach or reciprocity in this

framework. Hence, it is entirely on its own for seizing potential new business opportunities, and is forced to develop new capabilities through internal processes (e.g., R&D) or outright acquisition.

Indeed, relative to the two-dimensional diagonal linking markets and hierarchies on the reach-range plane, the three-dimensional diagonal linking points "C" and "F" is actually longer (Euclidean distance). Interestingly, this latter diagonal passes through the general network configuration at point "N," signaling that points "C" and "F" may actually represent a more useful continuum for describing inter-organizational forms that its hackneyed counterpart for markets-hierarchies. Notice too that the archetypes represented by points C and F are equidistant from the hierarchy coordinate; that is, both forms (C and F) possess the same *amount* of organizational energy, but the *state* of such energy is very different because of their divergent inter-organizational forms (i.e., maximum reach-reciprocity, minimum range versus maximum range, minimum reach-reciprocity). We are reminded of the energy equivalence between the spring-mass and elevated-mass systems discussed above. This aspect of the model mirrors the First Law of Thermodynamics, which addresses the conservation and exchange of energy and ties directly to our relationship process model.

Point T: Finally, point "T" (1,1,1) merits some discussion, for it represents the most extreme inter-organizational archetype along all three coordinate dimensions. From the figure, one can observe that it is very cartel-like in terms of reach and reciprocity, and quite market-like in terms of reach and range, but notice that its position at the vertex also denotes strong or intense relationships with every potential partner in its relevant market, which require an investment in work to develop. Referring back to the dynamic relationship model, the inter-organizational configuration represented by point "T" requires more *combined* trust than any of the other points; that is, more potential partners are involved (i.e., greater reach), possessing a greater variety of capabilities (i.e., greater range) with more intensive relationships than with any other configuration (i.e., point in the coordinate system). This appears to represent a particularly powerful organizational form, for it essentially integrates the most extreme capabilities of all other forms.

Indeed, relative to the other archetypes, the form represented by point "T" would appear to have the best prospects for seizing potential new business opportunities. The "T" form possesses (possibly complementary and synergistic) capabilities that cross a wide range of products, services, information and core competencies. With an expansive reach of intensive trust-based relationships, the "T" form should be able to organize a broad array of different partnerships, consortia and ventures, and to leverage existing inter-organizational trust to form such enterprises quickly. With an hypercompetitive objective—the ability to seize potential new business opportunities—we can assert that the "T" form is arguably superior, as we relate this superiority to the concept of organizational energy and distance in the relationship coordinate space.

Using the Rolodex Model for Organizational Design: "What Ifs" in Phase Space

We have shown above that the Rolodex model can explain existing archetypes of organizational form and also identify new ones. The examination so far has focused on the structural properties associated organizational form, and in this section we examine dynamic reconfigurability. In the Rolodex Model, reconfigurability pertains to the organization's capacity to change reach, range, and reciprocity. It has two dimensions, the speed of reconfiguration and the scope (extent) of reconfiguration. For an organization to have higher reconfigurability in its relationship topology, it must have higher energy available to shift to the new configuration and to function effectively within it.

From the extant literature we are already very familiar with such reconfiguration in the markets-hierarchies plane. For example, the growth and expansion of the single-product hierarchy through R&D, merger, takeover and the like represents a dynamic reconfiguration limited to one dimension (i.e., along the range axis toward point "F" in Figure 5). The outsourcing of incidental internal operations such as food or janitorial services to the lowest-cost supplier represents another such reconfiguration in the markets-hierarchies plane. But what about outsourcing *vital* internal operations such as the information systems function, which we understand requires considerable trust and extra-market relationship to be effective? Clearly such a reconfiguration involves movement above the markets-hierarchies plane. Consider also the recent trend among major corporations toward decreasing the number of suppliers while increasing the degree of coupling and interaction with this reduced set (e.g., through electronic data interchange, just-in-time deliveries, supplier-managed inventories), which also represents reconfiguration above the markets-hierarchies plane.

Although the model includes no limitations to movement from any point in the coordinate system to any other point, it is important to note that some movements are *more difficult* than others. Specifically, movements that *increase* reach, range or reciprocity are modeled to be more difficult than those that seek less-extreme points along these dimensional axes. This aspect of the model mirrors the Second Law of Thermodynamics, which addresses the flow of energy between states and ties directly into our relationship process model. Stated differently, an organization at some given energy level can use its stored energy to move from one configuration (archetype) to another of equal or lower energy, but reconfiguration to higher energy levels requires an investment in work. In the organizational domain, such work dynamics are specified by the relationship process model and require the building of trust-based interorganizational forms.

Let us return to point "T" in Figure 5 as an example. Like climbing uphill, it is much easier to slide down the side than to reach the top. In energy terms, the top of the hill represents the highest potential energy state, which implies that (once this point on top is reached) sufficient energy exists to reach all other points on the hill. Analogously, we said that point "T" represents the highest organizational energy state. This similarly implies that sufficient energy exists to reach other points in the coordinate system. However, reaching point "T" in the first place may represent a challenge. In other words, once point "T" is reached (i.e., the "top of the hill"), an organization can move to become a cartel simply by shedding capabilities

(i.e., decreasing the variety inherent in its range). Similarly, from point “T” the organization can move to become a market simply by diminishing the intensity of its relationships (i.e., decreasing the trust). Further, from point “T” or either of these other coordinate positions (i.e., “C” or “M”), the organization can move to become a hierarchy simply by internalizing the operations (e.g., through buyouts and mergers). But rebuilding a multitude and variety of trust-based relationships (i.e., going back "uphill") would be far more difficult and time-consuming.

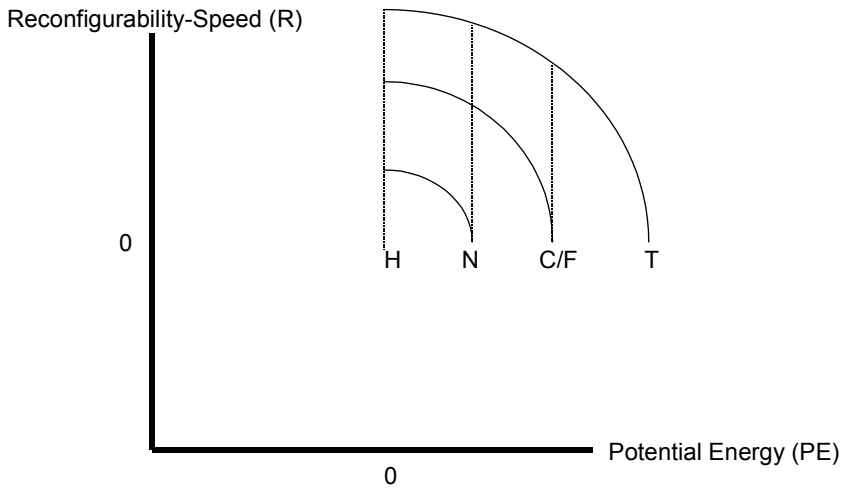

Figure 6 Phase Space of Organizational Form Archetypes

The phase space diagram serves to map the space of possibilities related to the speed and scope of reconfigurability vis-à-vis the amount of potential energy available for reconfiguration (and requisite organizational changes). Unfortunately, we do not have the benefit of well-understood energy dynamics and equations as with the physical models above, but it is insightful to at least examine the qualitative characteristics of such dynamics through area in the phase space.

In Figure 6 we plot potential energy for each archetype of organizational form (measured by distance from the hierarchy point (0,0,0) in our coordinate system) on the horizontal axis and the speed of reconfigurability on the vertical. This is analogous to the phase portrait above that uses position and velocity for the dynamics of physical systems. We see that point H has minimum energy, N, C and F have intermediate levels, and the extreme archetype represented by point T has maximum potential. The notional arcs are used to suggest the transfer of energy from a potential state to one of manifest action. In this plot,

such manifest action is effected through the reconfiguration of inter-organizational form, and the arcs clearly differentiate the reconfiguration speeds (R) attainable by each of the archetypes; that is, higher-potential archetypes are capable of faster reconfiguration because of their greater energy values. Also, the dotted lines denote "drop zones," at which the potential energy (PE) corresponds to that of a lower-level archetype. Notice that the value for R (reconfiguration speed) is higher at each potential energy level. The implication is that even at the same level of potential, the higher-energy archetypes are capable of moving faster than their lower-energy counterparts. A similar phase diagram can be drawn with the scope of reconfigurability as the y axis. These phase diagrams help to show the energy levels expended in reconfiguration and various trade-offs in organizational forms.

CONCLUSIONS

The Rolodex model has provided a different model of the structural topology that underlies organizational form – one that that is more suited to the shift that the emerging business environment is bringing to organizational forms and their underlying logics. We have shown that the dimensions of relationship complexity that the Rolodex Model introduces are suitable for both existing and new organizational forms. We have also attempted to show how the Rolodex Model can be used to provide guidance for reconfiguration of organizational form through the concepts of energy and phase spaces. We realize that much more work needs to be done to further develop and operationalize those ideas, and we have barely scratched the surface.

At the same time, we also believe that understanding those issues of energy and dynamic reconfiguration are precursors to the design of organizational forms in conditions of hypercompetition and chaos. How can we understand chaotic behavior without understanding how energy is expended, stored, renewed, and dissipated in organizations? How can we comprehend dynamic reconfiguration when we do not understand the trade-offs between expending energy for on-going work versus expending energy for organizational reconfiguration? How can we carry out strategic management in a world of interorganizational interdependence and apparent chaos when our dimensions of complexity are still centered on static structural decomposition boxes that were developed for internally-focused command-and-control organizations? How can we deal with organizations as dissipative energy structures that are constantly changing and far from equilibrium if we do not even have the energy concepts related to how organizations reconfigure their structures at equilibrium?

In 1824 the French military engineer Carnot derived the Second Law of Thermodynamics, which made it possible to frame the whole of thermal dynamics and understand the theory of heat—and after that undergird the whole of physics, chemistry, and quantum mechanics. Before Carnot, heat was thought to be a ubiquitous elastic ether—how could they discuss heat without the concepts of calories, work, friction, and energy ? There appears to be a similar phenomenon with understanding chaos and complexity theory in the social and natural sciences. For example, while biologists have jumped into chaos theory, there appears to be an alleged gap in their understanding:

"Biology, (however,) has no grand theory. The joke currently making the rounds of complexity researchers is that biological science today is "Waiting for Carnot." Theoretical biologists feel equivalent to the 19th century thermalists just before the advent of thermal dynamics. Biologists talk about complexity without having a measure for it. …." (Kelly, 1994*)*

Perhaps strategic management is still in the pre-Carnot period with respect to dynamics and complexity of organizational form in chaotic environments. We hope that our report is a small step that helps prepare the theoretical groundwork.

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