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LEAD ARTICLE

COMPLEXITY AND SELECTION: IMPLICATIONS FOR ORGANIZATIONAL CHANGE[1]

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ABSTRACT: In this paper, we argue that numerous dynamic entities make up organizations and that their complexity can be described systematically. We identify three types of organizational complexity: environmental, component and hierarchical. We define the elements of the contingencies of cultural selection as they apply to organizations and propose that organizational change can be understood in terms of selection processes that are analogous to those of behavioral and natural selection.
Key Words: behavioral selection, cultural selection, metacontingency, interlocking behavioral contingencies

Organizations are complex things and they always change. What are organizations? What does organizational change mean? What are the causes of change? In this paper, we examine the nature of organizations as cultural entities that change as a result of two different kinds of selection: behavioral and cultural. We suggest that all organizations are cultural entities but not all cultural things are organizations. This is similar to saying that while we believe all verbal behavior is operant behavior, not all operant behavior is verbal. Further, although verbal behavior is operant and organizations are cultural, there is no reason to assume that verbal behavior and organizations cannot (or must) have characteristics peculiar to themselves over and above their inclusion in the general categories of operant behavior and cultural things.

In this paper we address two fundamental aspects of organizational change: complexity and selection. In the first section we review the nature of organizational systems and organizational boundaries and suggest a taxonomy of some types of complexity characteristic of many organizations. In the second section we attempt to explain organizational change as a function of cultural and behavioral selection

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contingencies. Throughout the paper, we use real examples, most of which pertain to profit-based organizations. We are confident that profit-based and other human organizations are as alike with respect to our analysis as soccer playing and reading are alike in operant analyses.

ORGANIZATIONAL COMPLEXITY

Most organizational change efforts are overwhelming because of the many ways an organization can change. To deal with organizational complexity, we assemble groups, spend countless hours in meetings, and too often make decisions that have no effect in the long run. Here is an example: In an effort to reduce lines in the checkouts, a retailer attempted to implement the "next-in-line rule" in stores that hold up to 2000 customers at a given time and have about 40 cash registers. The rule was that no line should have more than one customer waiting while a customer was being served at checkout. Associates at the stores attempted to reduce or eliminate long checkout lines but compliance failed because many variables affecting checkout efficiency were not considered—traffic volumes at specific times of day, the effect of weather conditions on shopping patterns, number of staff required to manage variable volume of customers, service demands in other parts of the store, and so forth.

Many dynamic variables affect organizations and our work in them. We suggest that understanding the nature of organizational complexity is essential, but not sufficient, if we hope to target meaningful change and avoid being overwhelmed by details. In the next sections, we examine the nature of organizational systems, define the boundaries of organizations, and distinguish various types of complexity.

The Nature of Organizational Systems

Behavior analysts working in the field of organizational behavior management must expand on the traditional activities of behavior analysts because their object of study is organizational behavior. As it turns out, "organizational behavior" means both the behavior of individuals in organizations and the behavior of organizations as functioning entities in their own right. What must be managed is the relation between the behavior of the individuals in an organization and the behavior of the organization as a whole.

Organizations consist of the dynamic interaction of human behavior and its products that affect the behavior and products of other humans. Behavior of all employees, like behavior in the experimental laboratory, is the result of *behavioral selection contingencies*, or behavioral contingencies for short. These units of analysis are relations between antecedents, behavior and consequences. Some behavioral contingencies make it more likely that behavior of the same kind will occur again. For example, a production schedule (antecedent) cues the worker in a plastic manufacturing plant to set the mold (behavior) for plastic parts. A mold setup is the *product* of this worker's behavior. The worker locates the mold, loads it on a forklift, carries it to the press and places it in the press. If the mold is fastened flush between the press doors, the task is completed

(consequence). If the mold isn't flush, the worker manipulates it until it is seated properly. The relation between his actions and the properly loaded press (contingency) affects how mold setup will be performed on the next occasion. Variants of the behavior that achieve properly set molds become increasingly frequent. The repetitions of mold setting behavior of this worker constitute a behavioral lineage. Mold setup is undergoing selection by *reinforcement*—a process by which a relation between behavior and its consequences increases the future likelihood of that behavior. Mold setup is *operant behavior* because it operates on its environment. An *operant lineage* consists of a sequence of operant instances that change over time as a result of behavioral selection contingencies.

Sometimes the behavior of Person A, or the product of that behavior, is the occasion for Person B to do something. B's behavior, or its product, then may set the occasion for Person C to do something. The behavioral contingencies of A, B, and C are intertwined. The same event or object (e.g., A's product) is a consequence of A's behavior and sets the occasion for B's behavior. For example, in manufacturing plastic parts, Worker A gets the mold from a tooling rack and sets it in the press. Worker B sets the dials on the press according to engineering specifications. Worker C molds parts. The behavior of each person becomes part of the environment entering into the behavioral contingencies for others. We call these kinds of relations among the behaviors of two or more people *interlocking behavioral contingencies*. They are the building blocks of cultural complexity.

The behavior of A, B, and C may be part of a more inclusive set of interlocking behavioral contingencies that, together, result in an *aggregate product*: molded plastic parts. These interlocking contingencies are repeated with each molding request; and the repetitions constitute a *lineage of interlocking contingencies*. Variations in the elements of the interlocking contingencies may result in variations in the quantity or quality of plastic parts. The interlocking contingencies determine the characteristics of the products; and the characteristics of the products determine the customers' acceptance of the product. Customer acceptance is the external environment contingent on the product of the interlocking behavioral contingencies.

In organizations, we are interested in the products of the interlocked behavior of multiple individuals; so the behavior of individuals remains the fundamental component of organizations. The evolution of an organization as a whole depends not only on its individuals' behaviors, but also on how those behaviors combine and form units of selection that evolve in their own right. Given the inherent complexity of organizations, the behavior of any individual can rarely be isolated and managed without consideration of its interactions with the behavior of others.

Organizational Boundaries

We might start our organizational analysis by establishing the boundaries of an entity we want to study. What constitutes an organization? In the broadest sense, an organization consists of a group of people who perform tasks that achieve a particular

product. An organization is defined by its products. XYZ manufacturing company consists of all the employees whose integrated activities result in XYZ's manufactured products. If an internal department provided travel services for XYZ employees, its existence would necessarily depend on XYZ's manufactured product. In contrast, a travel agency contracted by XYZ to provide travel services to XYZ's employees is a different organization than XYZ because the agency's existence does not *necessarily* depend on XYZ's manufactured product.

Organizations often comprise several systems that contribute to achieving their goals. The term *system* is used for a variety of relationships between many kinds of separate elements arranged as a whole to achieve an outcome. XYZ needs various systems to manufacture products, such as purchasing, sales, production and shipping. Each system generates a product that relates to the operations of one or more other systems and thereby contributes to XYZ's aggregate product. For example, products of XYZ's systems include purchase orders, purchased items, finished goods, and goods delivered. Each system is composed of subsystems. The production system could include molding, trimming, and packaging subsystems, each one producing a critical component—molded, trimmed and packed parts. A subsystem may have its own subsystems. For instance, molding includes plastic preparation, press set up and plastic injection, and these systems produce adequate plastic, proper set up and injected molds. The least complex cultural system in an organization is one formed by an interlocking behavioral contingency in which two individuals each perform at least one recurring behavior.

Organizations are not static entities. An organization as a whole and its systems are dynamic, always undergoing change. Alterations in internal systems result in changes in the organization as a whole. For instance, the interlocking behavior of a production team could be affected not only by the engineering team directly involved in production, but also by the purchasing, shipping, and other processes in the organization. In addition to the internal dynamics of any process, that process is also affected by alterations in the environment external to the organization, such as changes in the customer and provider organizations. The intrusions of parts of one system into the operations of other systems speak to the permeability of system boundaries. The dynamic interactions between systems elements and the permeability of their boundaries make complexity hard to analyze. Due to the permeability, boundaries of any system are somewhat arbitrary, but delineating boundaries helps to simplify overwhelming complexity.

Identifying boundaries does not mean that we can ignore the multitude of ongoing interactions between internal and external entities. It only means that we set aside the more remote influences and focus on the most direct dynamics. Systems analysis, no matter the size of the system, would require minimally the study of the dynamic interactions between its internal components, its relationships to critical systems in the organization, to the performance of the organization as a whole, and to customer demands. (For an account of systems analysis in organizational change, see Gilbert, 1996; Malott, 2001-b; & Rummler and Brache, 1995.)

For example, the behavior of the sales force of a pharmaceutical company is integrally related to other organizational systems. It would be short sighted to study only the behavior of the sales people and attempt to design new contingencies of reinforcement to increase sales. We could not know if our changes would have a desired effect on other processes and thus on the organization as a whole. So in addition to analyzing the behavior of the sales force, we must consider such things as the interrelations among sales forces in territories, districts and regions; the influence of marketing, product development, production processes; trends in customer purchases; and the impact of drug regulations on sales performance.

Taxonomy of Organizational Complexity

Organizations are like ecosystems, formed by a multitude of interdependencies. Ecology offers an orderly view of nature that simplifies the study of the relationships between organisms and their physical environments, including other organisms. Like ecologists, behavior analysts working in organizations need a way to order the complex interdependencies among organizational systems and their interlocking contingencies.

We have found it useful to consider three types of organizational complexity: environmental, component, and hierarchical complexities. In this section we review these three types of complexity and their implications for organizational effectiveness.

Environmental complexity

In order to target any area for change, no matter how small, we should understand the organization as a whole. The number of variables external to the organization that affect organizational performance determines *environmental complexity*. The environment outside of the organization is constantly changing in ways that affect internal organization. Some of the ways that the external environment can change are product and service development within an industry, government regulations, mergers, consolidations, bankruptcies and warfare. Other external variables, such as changes in competition, providers and weather patterns may also affect organizations. Figure 1 illustrates environmental complexity.

Product development. Millions of new products and services become available in the market every year, requiring changes in many internal systems of organizations such as production, quality control, training, and information technology. Failure to upgrade products and meet or surpass competition standards eventually reduces sales and market share, threatening the long-term stability of the organization.

Government regulations. Regulations also impose tremendous changes in internal processes. For instance, consider the impact of the 1994 food-labeling regulations designed to help consumers make healthful choices. The United States Food and Drug Administration and the Department of Agriculture required nearly all packaged food to carry a standardized food label indicating the amounts of calories, vitamins, protein, fat,

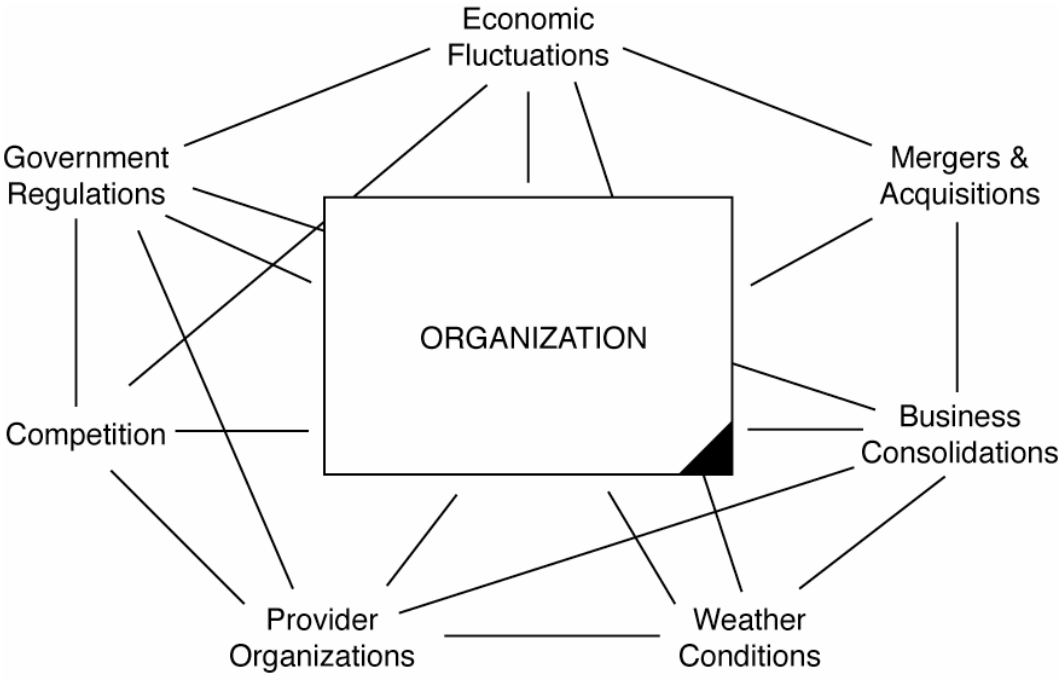

Figure 1. Environmental complexity.

and fiber per serving. Such regulations imposed changes in food manufacturing processes quality control, packaging, and others.

Mergers, consolidations and bankruptcies. Mergers and consolidations often revive failing businesses, reduce competition, or diversify product lines, thus altering the landscape of the environment and creating new demand. A merger is achieved when a company purchases the property of other firms, thus absorbing them into one corporate structure that retains its original identity. A consolidation is achieved when two or more companies dissolve in order to form a completely new company. Bankruptcies can result in the disappearance of competitors, vendors or clients.

Economy fluctuations. Fluctuations in the economy have a significant impact on the environment of an organization. In prosperity, production, employment, wages, and profits increase; more investments expand production. As the upswing continues, however, production costs increase; shortages of raw materials may hamper production; interest rates rise; prices rise; and consumers react to increased prices by buying less. As consumption starts to lag behind production, inventories accumulate, causing a decline in prices. Manufacturers make cuts, investment decreases, production decreases, and unemployment increases. Cycles of prosperity and depression affect most organizations.

Warfare. Warfare also has a significant impact on organizational environments. War affects economies, infrastructures of countries, development of military and intelligence systems, and so forth. Environmental changes do not necessarily imply that organizations must become more complex. Sometimes changes in the external environment force organizations to simplify their systems. For instance, demand for faster delivery of orders may require an organization to streamline its processes so larger volumes are delivered in less time.

Changes in the external environment drive alterations inside the organization, but changes within organizations also affect the environment. For instance, consider the impact on the economy of a single large merger, a company's hazardous waste, or a terrorist act. Environmental complexity cannot be ignored. Organizations that do not adjust to changes in their external environments are unlikely to survive.

Component complexity

The number of elements that constitute an organization determines *component complexity*. The elements might be related to each other as equals or they might be at different levels in a hierarchy. The smallest organizational units of interest are interlocking behavioral contingencies that generate critical products.

Organizations tend to be more complex when larger numbers of people participate in their processes. Small businesses of a few employees are generally less complex than large businesses with thousands of employees. Component complexity also depends on the number of processes each system subsumes. For example, in a manufacturing company, the production process might be more complex than the advertising process. This might be because production has more subsystems and/or larger numbers of interlocking behavioral contingencies. The manufacturing process might contain all the interlocking contingencies involved in receiving of raw material, preparation of equipment, scheduling, production, and inventory management.

A simple way to relate to component complexity is by looking at process maps. Think of a process map as a graphic depiction, where each box in the map represents interlocked behavior that generates a product. A process map might include the behavior of thousands of people (Malott, 2001-b). Processes with more boxes in the organizational chart are more complex than those with fewer boxes. Figure 2 shows the partial process of selecting retail items to be advertised.

Studying component complexity is critically important. Without systematic effort, organizations tend to increase in component complexity and become redundant and inefficient. Unnecessary component complexity could be counterproductive to the overall goals of any organization.

Hierarchical complexity

Organizations are made up of systems that contain subsystems, which themselves might have subsystems, and so on. *Hierarchical complexity* is determined by the number

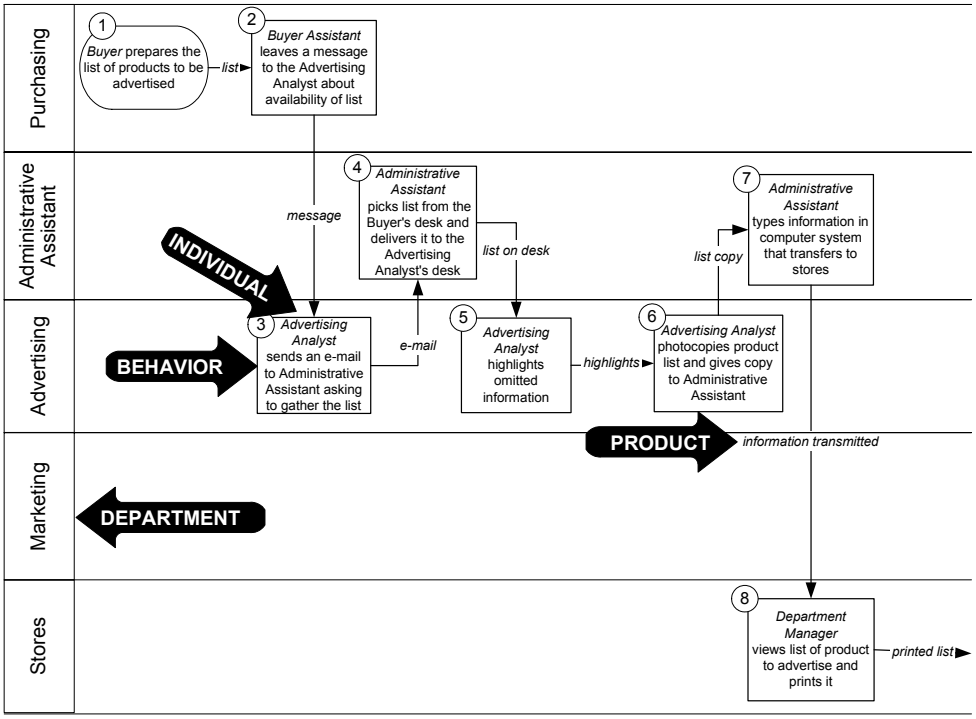

Figure 2. Component complexity.

of system levels in the organization, or the number of part-whole relations that constitute an organization. The levels of management in an organization are usually a good index of hierarchical complexity.

An organization increases in hierarchical complexity as it creates more layers of components. Therefore, component complexity generally affects hierarchical complexity. For instance, an organization that needs to increase production might acquire more plants; overseeing several plants requires another level of management. When the number of plants increases considerably, organizations need regional directors to manage specific geographical areas. As the company expands, the regional directors need more help to manage their territories, so they might create a new layer of management—district directors. Figure 3 illustrates hierarchical complexity in a pharmaceutical company.

Organization structures often reflect the way they assemble their components in hierarchies. The wholes might be defined by function (marketing-sales), geography (regions-districts), content (psychology, history, physics), form (cars and trucks), life expectancy (perishables-dry grocery) or seasonality (seasonal, non-seasonal).

Organizations often include multiple hierarchical layers. For instance, pharmaceutical companies sometimes arrange their sales forces by territories, districts and regions. They may also have layers of management grouped by product type. So

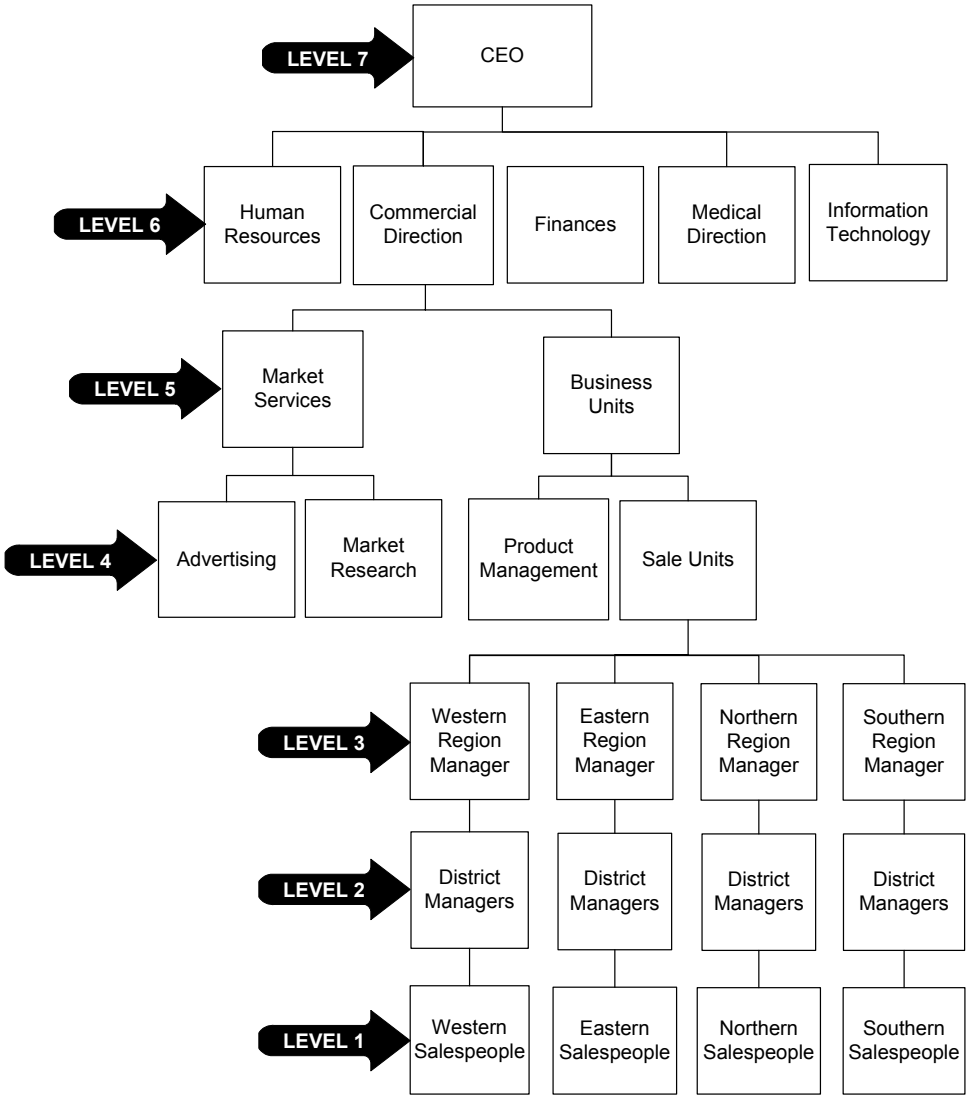

Figure 3. Hierarchical complexity.

they have product specialists for specific types of disorders, for instance, central nervous system diseases.

An important implication of hierarchical complexity is that as the levels of management grow, the behavior of those in higher levels becomes increasingly unrelated to critical components of the interlocking contingencies of the lower levels. Unfortunately, as levels of management grow in organizations, these disconnects between levels threaten the organizational success. The performance of the lowest level ultimately determines the success, failure, and survival of the organization. But what happens at the

TABLE 1. TYPES OF COMPLEXITY

Type	Definition	Examples	Effect	Management
Environmental	The factors external to the organization that affect organizational performance	Product and service development, mergers and consolidations, economic fluctuations, warfare	Threaten or enhance organization's survival	Align internal organization to external environment
Component	Number of parts that constitute the whole (Represented in process maps)	Molding includes turning press, checking plastic, drying plastic	Efficiency of processes	Streamline components by eliminating redundancies
Hierarchical	Number of part-whole levels (Represented by levels of management)	Sales behavior is part of sales team; sales team is part of territory; territory is part of district; district is part of region	Efficiency of processes	Simplify levels of management to eliminate disconnects and promote consistency between tiers

lower level depends on the behavior of managers at higher levels—mainly decision-making behavior.

Decisions at higher levels are often made without realizing the implications for the lower levels of the organization. Making decisions takes less time than implementing them. And making poorly thought-out decisions takes much less time than implementing them – even implementing them poorly. Managers usually ask for more change initiatives than can be realistically implemented. Table 1 shows the three types of complexity discussed.

In this section we attempted to introduce organizations as ecosystems and to describe interdependencies in organizations by pinpointing three distinctive types of complexity: environmental, component, and hierarchical. The next section addresses how organizations evolve through cultural and behavioral selection.

SELECTION IN EVOLVING ORGANIZATIONS

The biological characteristics of organisms, the learned behavior of individual organisms and the interlocking behavioral contingencies in organizations are very differ-

ent kinds of things, but they all change over time as a result of selection. Natural selection accounts for features of the organic world; behavioral selection for features of individual behavior; and cultural selection for features of organizations. Although natural selection does not appear to play a current role in organizational change, the process of natural selection is well understood. Therefore, we introduce the concept of selection by describing its role in biological evolution and its parallel to behavioral evolution.

Charles Darwin (1959) first suggested natural selection as a process that causes differential preservation of inherited (genetic) characteristics in a lineage of reproducing organisms. Organism/gene characteristics that better fit the environment recur more frequently than others in their lineage. For example, organisms of a particular species that live in a very cold environment may vary in their inherited propensities to grow thick fur. Those more likely to grow thick fur are, on average, more likely to survive and reproduce than others with inherited propensity for less furriness. So the average furriness of the organisms of this species increases in successive generations or reproductive cycles. The average furriness of Generation #5,000 may differ considerably from the average furriness of Generation #20,000, but the change between any two successive generations would be negligible.

In this example, the relation between organisms' furriness and ambient temperatures affects the likelihood of furriness in future generations. Similarly, the relation between a rat's lever presses and food deliveries affects the likelihood of future lever presses. In summary, relations between characteristics of organisms or behavior and their environments determine future frequencies of those characteristics. These relations have been called "contingencies of selection" (Skinner, 1981). Contingencies of selection may also involve relations between organizations and their environments. In the sections below, we attempt to provide a selectionist account of the evolution of organizations, where cultural selection and behavioral selection are both directly relevant.

Cultural Selection in Organizations

Organizations are cultural entities that change over extended time while retaining their identity as "the same" organization. In this sense, an organization is like a biological lineage. It is composed of repeating generations of events having features that change over time as a result of the way in which variants in the current generation are "received" by their environment. For example, since 1990 many organizations have become adapted to a commercial environment that includes electronic commerce (e-commerce). Before 1990 the environment of organizations with products to sell was one in which buyers and sellers exchanged and transported goods from one place to another. In the late 1990s, advancement of networked computer technology engendered an explosive growth in e-commerce. E-commerce allowed the exchange of goods and services over the world wide web, increasing efficiency and precision in commercial transactions. In North America business-to-consumer e-commerce transactions grew from $11.5 billion in 1998 to $44.5 billion in 2000. Organizations that were set up for e-commerce transactions got the

business of organizations by aggressively improving delivery times. Within a few years, airline tickets, hotel reservations, and all kinds of goods and services were available via the web. This rapid change in the external environment selected organizations with technology processes best able to respond to customer demands.

Metacontingencies

Metacontingencies are relations between interlocking behavioral contingencies and their selecting environments (Glenn, 1989). Together with behavioral contingencies, metacontingencies account for cultural selection and evolutionary change in organizations. In organizations, metacontingencies have three components: interlocking behavioral contingencies, their aggregate product, and their receiving system. The receiving system is the recipient of the aggregate product and thus functions as the selecting environment of the interlocking behavioral contingencies (cf. Brethower, 2000). Interlocking contingencies will cease recurring if there is no demand for their products. Figure 4 illustrates the concept of metacontingency.

Analogous to operant reinforcement in individual behavior, the external environments of organizations deliver selecting consequences. Customers "buy" (or don't buy) the organization's products, shareholders buy or sell their stocks, granting agencies award grants or don't, government regulators award passes or levy penalties, and so forth. Most of these consequences are contingently related, however imperfectly, to the products of the interlocking behavioral contingencies.

Consider a restaurant as an organization. The aggregate product of the restaurant's interlocking behavioral contingencies is the food served, and the receiving system is the

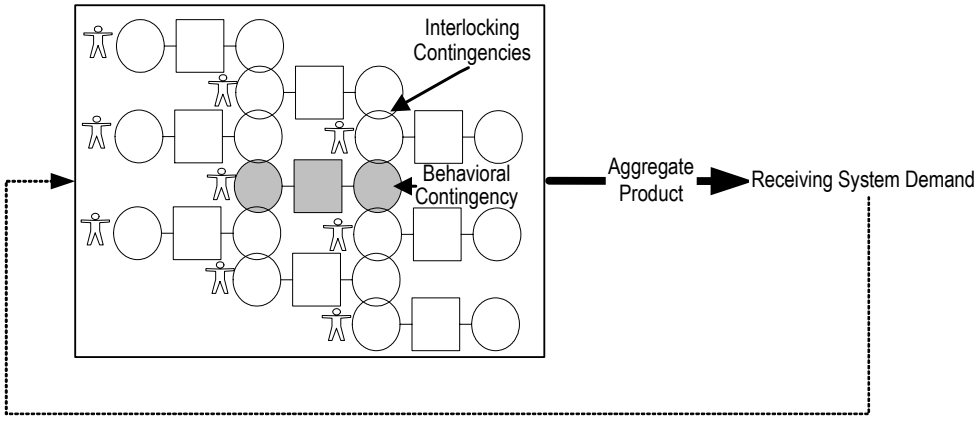

Figure 4. Components of a Metacontingency.[2]

[2] From Paradox of Organizational Change, by M. E. Malott, 2003. Copyright 2003 by Context Press. Reprinted with permission.

consumers. The restaurant will survive only if its food and its physical features (ambience) meet the requirements of the selecting environment (people who eat there). The food and the ambience may change as the restaurant's external environment (customer preferences or competition) changes. The systems that contribute to the restaurant's product include purchasing, food preparation, service, financial management, and property maintenance. Each process involves one or more metacontingencies. Serving meals represents one set of interlocking behavioral contingencies involving several people's behavior: the wait staff's turning in the order, the chef's providing instructions, the cook's preparing food and placing it where the wait staff can pick it up. The behavior of each individual is related to that of others in the interlocking contingencies. The aggregate product of these interlocking contingencies is meals served. If the meals are well adapted to demand, consumers are likely to continue patronizing the restaurant.

Other metacontingencies that have different aggregate products also affect consumer demand. For example, the interlocking behavior of the wait staff affects timeliness and quality of service. So multitudes of metacontingencies exist inside the boundaries of the restaurant. The behavior of any individual, as well as the makeup of any of the interlocking behavioral contingencies may contribute to the fitting of the organization's products to the restaurant's environmental demands.

An organization as a whole can evolve, or change, as repetitions of its internal interrelated metacontingencies occur over time. The aggregate products generated by the interlocking contingencies vary over time, and the environments in which they exist differentially select those variations. Figure 5 is a diagram of a cultural lineage. It shows three repetitions of the same metacontingency over time. The participants in the metacontingency change across repetitions (illustrated by different shading of the human figures).

Consider a metacontingency in which interlocking behavioral contingencies produce a restaurant's most popular specialty. Systematic variations in the product might result from slight differences in the interlocking contingencies that occur at lunch and at dinner. As a result, lunch orders may decrease while dinner orders may increase or remain high. If these variations in interlocking contingencies have similar effects on other meals, a discerning manager will attempt to analyze the differences in the interlocking behavioral contingencies and arrange contingencies differently for the lunch shift.

The major parts of an organizational ecosystem are its core systems. In the ecology of an organization, the output of one system directly affects the functioning of other systems. In organizations, *core systems* are essential parts, directly responsible for generating the aggregate product. For example, food preparation is at the core of a restaurant's success. If the food is bad, no matter how good the service might be, the restaurant likely will fail in the long run. Production is a core system in a manufacturing company; merchandising is a core system in a retail company; sales is a core system in a marketing company (Malott, 1999).

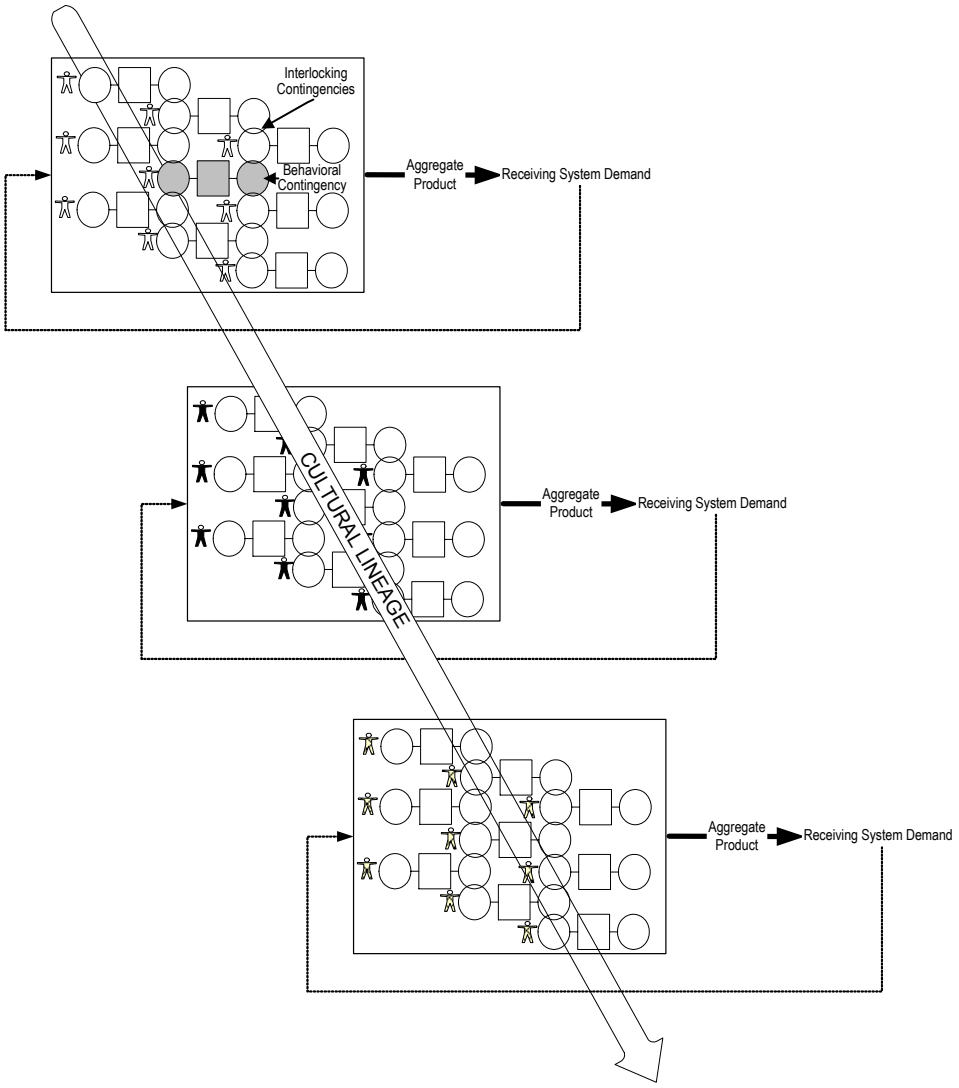

Figure 5. Cultural lineage.

The relations among the systems and their subsystems in an organization constitute a web of interlocking metacontingencies. Whether the organization as a whole meets the requirements of the external environment depends almost entirely on the characteristics of these interlocking metacontingencies. The greater the component complexity of any subsystem, the more interlocking metacontingencies are likely to exist. Hierarchical complexity increases with the number of subsystem levels. In this web of interlocking metacontingencies, any significant mismatch between product generation in a system (or subsystem) and the environmental requirements of a related system (or subsystem) is likely to be detrimental to both systems.

If an organization's systems result in products that match poorly with their external environments, either the environment or the systems must change to sustain the organization over extended time. Because the environment of an organization's subsystems is managed internally, the environment of a subsystem can change so its products better support the organization.

Consider, for instance, a manufacturing company that produced plastic components for the automotive and telecommunication industries. To fill a product niche in the health industry, the company started manufacturing plastic connectors used in infant heart transplants. The customer had precise specifications for the product, which required a pollution-free manufacturing environment, imposing significant changes in the production system. A special area was set up for pollution-free molding, unique safety gear was incorporated in the system, the dress code of the workers was altered, and new production specifications were added to the manufacturing information system. Because a poor product could cost the life of an infant, other internal systems were adjusted. For instance, legal agreements with the customers and shipping requirements were changed.

The interlocking metacontingencies in an organizational ecosystem ultimately determine the course of an organization's continuing evolution. If, over time, a manufacturer's goods are not bought in sufficient quantity to sustain production and invest appropriately for the future, then the organization becomes increasingly less viable in a relatively stable environment. A change in the external environment (e.g., disappearance of a competitor, or reduction in cost of raw materials) represents a change in metacontingencies that can avert extinction and make recovery possible (at least temporarily).

A fortuitous change in the external environment may result in an adequate match between an organization's systems and its selecting environment. Such a "saved by the bell" outcome is not typical and organizations do not count on such lucky changes in their external selecting environments. Rather, they focus on changing their internal environments. The more complex those internal environments are, the harder it is to react quickly to changes in the external environment. The safest course of action is to continually monitor the fit between the organization's products and the external environment, to identify current (and predictable future) requirements for continuing adaptedness, and then to plan and rearrange internal metacontingencies.

Because the systems in the organizational ecosystem continually affect one another, core systems in a web of organizational metacontingencies must co-evolve for the organization to thrive. *Co-evolution* is the joint evolution of two systems that have a close ecological relationship. In co-evolution, change in each system is matched by change in the other so that the two systems evolve in relation to one another. Take, for instance, the use of contemporary cash registers in retail establishments. Cash registers now calculate the total sale when a customer purchases several items; maintain a record of each sale and the department in which it was made; record whether the sale was by cash or credit; print the details of the sale on a sales slip, which serves as receipt for the customer; and keep track of the sales tax. This technology could not be adequately implemented without altering several other subsystems, including inventory management.

If contingencies of competition exist between core systems, one core system will suffer at the expense of another. By definition, all the core systems are essential to the organization's survival, so in designing metacontingencies in which related systems participate, care must be taken to insure co-evolution rather than competition between systems essential to the organization's capacity to meet the requirements of the selecting environment. Unfortunately, most core systems compete with other systems for resources; and core systems often develop redundancies with other systems in the organization to accomplish their work. For instance, information technology departments typically do not serve the organization's core systems because they are often overwhelmed with convoluted and fractionated technology infrastructure. As a result, core systems, like production in a manufacturing company, often hire computer experts to facilitate the production process. Training departments are similarly redundant in many cases because their personnel are too unfamiliar with critical aspects of the core systems to train employees adequately (Malott, 1999).

Metacontingencies are the units of analysis in organizational ecosystems, and their interlocking behavioral contingencies constitute the *cultural* entities that evolve via selection. However, their constituent behavioral contingencies can be analyzed as units of analysis at the behavioral level. Any intervention designed to better adapt an organization to its external environment requires changes in the interlocking metacontingencies. And interventions in the interlocking metacontingencies require changes in behavioral contingencies for the individuals involved.

Behavioral Selection in Organizations

No organization could exist without operant behavior. As we said earlier, an operant is behavior that has an effect on its environment. It is acquired during the lifetime of individuals. Its frequency, form, timing, accuracy or duration changes when behavioral contingencies change. Although behavioral selection contingencies account for behavior of people in an organization, those contingencies occur in the context of the interlocking contingencies required by the system's external environment. The complexity of organizations makes it hard to identify where behavioral change can best benefit an organization or where unrecognized changes in behavioral patterns may harm it. However, the selection contingencies accounting for the behavior of individuals cannot be ignored because the entire ecosystem depends on them.

Not all behavior occurring within the boundaries of an organization is part of the systems that define and sustain the existence of that organization. In fact, organizations change, sometimes in seemingly chaotic ways. Take, for instance, an accounting department that produces reports that no one understands. Although the reports have no function with respect to any other behavior in the organization, a supervisor may continue asking for them. Behaviors like this can go undetected for indefinite periods, surviving because the receiving system (supervisor) maintains the interlocking contingencies that result in the product (the report). Organizations can make significant improvements and

reduce costs by constantly analyzing the relevance of the products of individual behavior and of interlocking contingencies to overall organizational performance.

Behavior that seriously impedes the systems critical to the organization's survival is worse than wasteful. An example is a milk processor whose employees fail to wash their hands before milking the cows or who add water to the milk in order to get larger volumes and higher pay. The results of such behaviors result in milk contamination or low quality milk. If these behaviors are widespread among employees, the organization can fail. All of the aforementioned types of behavior are maintained by contingencies of behavioral selection, even those behaviors that have a harmful effect on the organization. More milk results in more pay for the individual, regardless of the milk quality. Only changes in behavioral contingencies can mitigate problems such as these.

Although not every behavior considered a "problem" is a threat to an organization, all organizational problems involve behavior. In solving "behavior problems", we should consider their impact on the products to which they contribute. Our first priority should be behavior problems that affect core systems, which in turn affect the performance of the organization.

SUMMARY OF IMPLICATIONS FOR ORGANIZATIONAL CHANGE

Organizations are conglomerates of dynamic systems that constantly change. The organizational boundaries as well as the boundaries of their internal systems are permeable. Organizations are also complex in several different ways. We identified three types of complexity: environmental (variations in the environment outside of the organization), component (number of organizational components and their relations), and hierarchical (number of levels and their relations).

What are the implications of complexity for managing organizational change? Although we can't eliminate complexity, we can manage it. We can manage environmental complexity by aligning the internal systems to the environmental demands. We can manage component complexity by analyzing the sets of interlocking contingencies and their products and eliminating redundancies and disconnects. And we can manage hierarchical complexity by attempting to simplify the levels of management, or reduce the disconnect between tiers.

Organizational change means alterations of metacontingencies and behavioral contingencies. Metacontingencies are relations between the demand for aggregate products and the interlocking behavioral contingencies that produce them. Behavioral contingencies are relations between environmental consequences and operant behavior of individuals. The causes of organizational change are cultural and behavioral selection contingencies.

What are the implications of environmental selection for managing organizations? First, because organizations evolve over time, any analysis of an organization is merely a snap shot of interrelated metacontingencies at a given time. Repeated analyses allow us to understand the course of an organization's evolution. Second, we alter metacontingencies

at all relevant levels of the organization, and implement contingency management for behavior critical to the organization's survival.

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