

Organizations and Capabilities: The Role of Decompositions and Units of Selection

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1. Introduction

The defining mission of economic research is the analysis of how societies allocate scarce resources. This agenda suggests that consideration of the mechanisms of resource allocation should be central to economic research. While not silent on the subject, historically the field has focused its attention on a particular mechanism of resource allocation --- markets. Discussions of alternative resource allocation mechanisms in the middle of this century focused on the contrast between markets and centralized planners (Lange and Taylor, 1938; Lerner, 1946; Hayek, 1945). More contemporary discussions, building on Coase's seminal work (Coase, 1937), have contrasted the relative efficacy of firm and market organization. Despite a number of important contributions (Coase, 1937; Williamson, 1975), the question as to why economic activity is to a large degree carried out by formal organizations is still in many important respects an open question.

Given the agenda of understanding the allocation of scarce resources and, in particular, an interest in the most efficient mechanisms of allocation, answers to the question of why organizations exist and the scope of appropriate boundaries revolve around their efficiency implications. The emphasis in Coase's (1937) analysis is on the efficiency of exchange. The writing and execution of a contract may be less costly within an organization than in a market exchange. A central element of Williamson's contribution was the movement away from purely exchange considerations to the recognition that alternative forms of organization condition the incentives to invest in specialized assets. Thus, organization matters not only in economizing with respect to the transaction, but also in influencing productive capabilities.

Before continuing with a discussion of how alternative forms of economic organization may influence productive capabilities, it is important to clarify what is meant by the term

organization. Activity among individual economic agents may be viewed as “organized” even if no formal organizational structure is present. Individual agents may engage in repeated exchange relationships, develop reputations and expectations about each others’ behavior, and establish norms about appropriate behavior. These are all central properties of what is viewed as organizational (or organized) behavior (Weick, 1979). Even among traders in a bazaar (Geertz, 1963) or on the Commodities Exchange (Baker, 1984) such organized behavior emerges.

Apart, however, from these behavioral properties of organized activity are legal notions of what is meant by an organization. Central to legal notions of organization are issues of liability, which in turn allow corporations to be sued and to write meaningful contracts, and ownership of assets and incomes streams. Clearly there is overlap in these two notions of organization. Formal organizations tend to have the properties of informal organizational forms. In addition, while legal entities have discrete forms reflecting the rules of law within a given society, informal organizational structures may be present in varying degrees of structure.¹

Organizations are first and foremost a decomposition. Out of the vast web of economic interrelationships, an extraordinarily small subset are given special salience. This subset is, for most legal and economic purposes, treated as a collective entity by its external environment. Payoffs, rewards and responsibilities, accrue to the collective entity. The payoff to particular

¹This distinction helps clarify some of the debate in the literature regarding the characterization of intermediate forms of organization. Williamson (1991) has argued for the importance of discrete forms of governance. Such a view follows naturally from the centrality of legal structures in his argument. In contrast, writers such as Powell (1990) have stressed the importance of intermediate forms “between hierarchies and markets”. Powell, as a sociologist, focuses on patterns of interrelationships and the degree of trust and commitment associated with different relationships. From such a perspective, the world certainly looks much “grayer” than the “black” and “white” of legal forms would suggest.

subunits and individual actors within the organization is mediated by the collective's systems of allocation. Understanding the importance of organizations as a mechanism of resource allocation requires an understanding of the role of decompositions and alternative units of selection.

Section 2 of this essay generalizes the appropriability argument of transaction cost theorists (Williamson, 1975) to a consideration of problems of "credit assignment" (Holland, 1975). Problems of credit assignment exist independently of incentive conflicts and are driven by difficulty of linking outcomes to particular actions when there is an high degree of interdependence. A given decomposition of economic activity places considerable structure on the nature of credit assignment. The organization as a whole is rewarded with a profit or loss from product markets. Particular subunits of the organization obtain a performance outcome in part determined by the overall organizational performance and in part the result of internal allocations of performance accountability.

A given decomposition of economic activity has important implications for processes of adaptation, which are addressed in Section 3. Mutual adaptation will occur for activities within a common unit of the decomposition, where the common unit may be a firm or a some subunit of the broader organization. Decompositions influence adaptation in a more subtle manner by influencing the degree of variation sustained by a given system of economic activity.

Finally, Section 4 addresses the question of how a given decomposition is arrived out. Broadly speaking, one can view this as the result of a process of intentional design or as the outcome of an emergent process. Both sorts of processes are clearly important. Organizational "architects" based on their knowledge of the particular organization under consideration and their knowledge of other organizational models, make conscious choices about appropriate designs. In

addition, individuals engage in actions that have joint consequences and, over time, patterns of behavior emerge that have collective intelligence. These patterns may then be crystallized in the form of an organizational design, or a set of decompositions. The problem of design is unlikely to ever be fully solved. Even in a stable world, a given set of decompositions are likely at best to identify a local peak in a fitness landscape (Kauffman, 1993). Redesign and restructuring are an inevitable element of coping with highly interdependent economic agents.

2. Capabilities and the Logic of Appropriation

The modern literature on transaction costs, whether the verbal theorizing of Williamson (1975 and 1985) or the associated efforts at formalization (e.g., Grossman and Hart, 1986), is driven by the logic of appropriation. The willingness to engage in specialized investments is a function of the actors' ability to appropriate the return from such investments. Alternative governance mechanisms, in particular the choice of market or organization, are specified to enhance the ability of actors to appropriate the returns to their specialized investments.

Consider the logic of appropriation when actors are less self-conscious about the impact of their actions. In particular, consider a set of actors engaged in a highly routinized (Nelson and Winter, 1982) activity. The behavior of one actor triggers a response from others. The collective behavior results in some productive activity --- the replacement of inventory or a more complex phenomenon such as the production of an airframe.

The appropriation question remains. How is the value of inventory replenishment or a new airframe to be allocated among the various actors involved? Secondly, how do different systems of allocating reward influence the development of the capacity to perform these

activities?

Problems of Credit Assignment

These issues of the appropriation of rewards to particular actions and initiatives are particular manifestations of the more general issue of "credit assignment" (Holland, 1975). For a system to effectively adapt, whether it be an individual organization or the economy as a whole, actions that are associated with favorable outcomes need to be reinforced relative to those actions associated with less favorable outcomes. At the level of the economy, this is reflected in the flow of financial capital to organizations that succeed, or demonstrate the prospect of succeeding, in product markets. Within an organization, problems of credit assignment occur in the evaluation of the contribution of a particular function within the organization or a particular individual within the firm to the overall organization's success.

Credit assignment is made difficult by the degree of interrelationships among parts of a system. This typically is thought of in what can be termed issues of spatial interrelatedness. The attribute of one facet of a system effects other facets of the system. The effect may be in terms of eliciting a given behavior or in terms of the payoff associated with a given behavior.

Interrelatedness may also be temporal. Chess is a complex game primarily due to temporal interrelatedness. The value of moves is, in large measure, associated with their "stage setting" properties. How does a move position the player for subsequent moves and ultimately for the capture of the opponent's king. Similarly, investments and payoffs in skills and capabilities generally occur at distant points in time.

Appropriation and the Division of Labor

Smith (1776) recognized the importance of skill development for economic prosperity, rather than merely the logic of comparative advantage and the gains to trade. He noted that skill development was greatly enhanced by the division of labor. Furthermore, this division of labor was argued to be limited by the extent of the markets. While clearly an important observation, the division of labor is also limited by the degree of appropriability made possible by a particular governance structure. This latter observation has been highlighted by transaction cost theorists who have argued that limits to appropriability force many exchange relationships to take place within firms. However, these same issues of appropriability apply to capability development within firms as well. This can be readily seen at the level of individual investments in skill acquisition. The appropriability problem, however, is most telling in the context of collective activity. An automobile manufacturer may wish to enhance the quality (i.e., reliability) of its products. How can it motivate the wide set of actors involved in the production process to coordinate and enhance the process? It should not be surprising that the development of performance metrics are central to most quality improvement efforts.

If issues of credit assignment are present both internally and externally, what importance do organizational boundaries have? Organizational boundaries influence the unit of selection. In the context of economic activity, the unit of selection refers to the level of aggregation at which the market evaluation (i.e., profits and losses) operates. In a relationship between two independent economic agents, the unit of selection operations on the exchange. This is the sort of analysis adopted by transaction cost researchers. However, business organizations engage in a wide variety of exchange relationships, as well as a large number of non-exchange activities. The

survival of the entity is not likely to be tightly linked to the efficiency properties of anyone of its exchange relationships. From the perspective of the issue of credit assignment, an aggregation of economic activities means that the returns (both positive and negative) to a given outcome within the organization will be borne by the overall organization.

3. Decompositions and Adaptation

Analogous to the issue of selective intervention within the transaction cost literature (Williamson, 1985: Chapter 6), one is faced with the issue of 'artificial' as opposed to natural units of selection. Natural selection is taken to mean the selection forces of the market operating on the firm as a whole. Artificial units of selection, in contrast, are taken to mean performance measurement within an organization. These maybe divisions or smaller units such as project teams.

What are the fundamental differences between these 'artificial' and 'natural' units of selection? First, any decomposition of economic activity demarcated by a boundary, whether that boundary is an external one separating the firm from the broader market or an internal one separating one facet of the organization from another, is a falsehood. No economic unit is wholly decomposable from the broader economic system of which it is a part (to paraphrase Dunne, no economic unit is an island unto itself).

We are left with the issue of why the falsehood of decomposition is more telling for the artificial boundaries within an organization than the 'natural' boundaries across organizations. Three sets of arguments are suggested. One relates to the inherent tendency for within organizational decompositions to be a greater falsehood. Two sets of activities may be treated as

distinct, but they are still common elements due to the 'natural' firm-market decomposition. Furthermore, processes of mutual adaptation while operating in a more telling manner at the level of the distinct organizational subunits, still operate to some degree at the level of the overall organization. As a result, the degree to which a given decomposition is a false representation of the true extent of interdependence is likely to be greater in the case of 'artificial', within firm decompositions. The second argument pertains to the adaptive properties of a given economic entity and a population of such entities. The degree of variation sustained within an organization's boundaries is far less than that sustainable in a population of organizations. Finally, it is argued that the implications of a given 'falsehood' of decomposition is more telling for within organizational decompositions.

Decompositions and Mutual Adaptation

Adaptation can take place at a variety of levels. Recent work in the sociology of organizations (Hannan and Freeman, 1989) has pointed to the importance of adaptive processes at the population level via processes of differential selection and birth of diverse organizational forms. Clearly, organizations themselves may adapt as well. Adaptation at one level may substitute for adaptation at another (Levinthal and March, 1993). When a set of activities are linked as a result of being placed within a common decomposition, one is more likely to observe a process of mutual adaptation. For instance, why is location, whether geographic or organizational, held to be so important (Krugman, 1991)? Co-location has been argued to facilitate mutual adaptation in the form of shared communication structures (Arrow, 1974), values (Van Maanen and Schein, 1979), beliefs about the world (Weick, 1979), and competencies

(Brown and Duguid, 1991).

Structure, imposing or facilitating the patterning of relationships among actors, effects the development of capabilities in a variety of ways. First, the shift from a set of widely diffuse interactions to a smaller set of more frequent interactions facilitates the emergence of cooperation (Axelrod, 1984). Using Axelrod's imagery, the "shadow of the future" looms far larger when the likely frequency of future interactions increases.

Frequent interactions also enhance the ability of actors to exchange information among themselves. Arrow (1974) notes that organizations tend to develop their own, distinct linguistic codes. In Cohen and Levinthal's (1990) terms, there is a relation-specific element of absorptive capacity. Just as prior involvement in a given technological domain facilitates the understanding and interpretation of subsequent information within that domain, prior information sharing with a given individual enhances the interpretation of subsequent information exchange. The particular "dialect" of different actors will be more effectively decoded.

Finally, sustained interactions facilitate the emergence of routinized behavior (Cohen and Bacadayan, 1994). Clearly, the development of cooperation and communication suggested above are important pillars of such routinized behavior. Understanding and trust are useful lubricants for the routinization of collective behavior. Such arguments turn the usual transaction costs argument of governance on its head. In the view offered here, governance mechanisms are important in their ability to *induce* relation-specific attributes, rather than their role in controlling for the dependency relationships that these relation-specific attributes imply.

The choice of boundaries must tradeoff the advantages of local learning versus the fallacy of any given decomposition. The development of routines and higher-order capabilities depend

on patterned ways of engaging in activities that are inherently driven by particular, actor-specific, feedback. However, the imposition of a decomposition implies the absence of interaction effects across boundaries. The advantages of local, actor-specific learning may outweigh the falsehood of a given decomposition in many circumstances. To the extent that actor-specific feedback is not important, and indeed perhaps dysfunctional, decompositions themselves may become dysfunctional. For a commodity-based product, it is better to react to the diffuse, economy-wide feedback of market price not the valuation and supply of local actors.

These various processes of mutual adaptation occur at a variety of levels of aggregation from individual work groups to nation-states. Clearly, the force of this process is greater the smaller the unit of aggregation and the more intense the set of interactions. While organizational designs may impose more fine-grained divisions within the organization's boundaries, those boundaries still remain and processes of mutual adaptation will be greater within those boundaries than across them to a broader set of market interrelationships.

Parallelism and Adaptation

It is natural to argue that full appropriability occurs when there is a single organization responsible for all economic activity. In such a setting, there would be no public goods (and bads) only private goods (bads). While such logic may carry through in a static world with a given set of productive possibilities, it does not hold in a dynamic setting in which production possibilities are endogenous to the actors' behavior.

In particular, consider the adaptive properties of such a 'global' organization. Suppose some actor in one facet of the system modifies their behavior so as to enhance the effectiveness of

the overall system. How would such an 'experiment' be evaluated? The natural basis of comparison would be a contrast of performance before and after the change. However, even if the external environment was kind enough to remain stationary during this period, other actors within the organization are likely to have engaged in their own experiments. The results of these contemporaneous experiments will confound one another. Alternatively, if the organization restricted itself to engaging in a single 'experiment' in a given time period, the pace of adaptive advance would be glacial.

For a complex system to adapt within reasonable time spans, it must engage in an high degree of parallel experimentation (Holland, 1975). Complex problems typically have a vast number of possible solutions, whether the issue is what move to make in a chess game or where a new production facility should be located. If the solution space is searched in a sequential manner, adaptation would occur at a glacier-like speed (even if one ignores the fact that the solution space itself is likely to be changing over time in most economic contexts). Therefore, an effective adaptive system must be capable of running a wide variety of experiments simultaneously --- i.e., of parallelism. As a result, timely and effective adaptation requires economic activity to be partially decomposed to smaller units of aggregation.

What are the implications of this property of parallelism for the organization of economic activity? At first blush a reasonable answer would be none. Experimentation could be carried out across firms or within a single firm. Thus, while parallelism might be a desirable property, it is not clear what it says about the relative role of markets and organizations.

However, behaviorally a remarkable feature of organizations is their difficulty in sustaining variety within their boundaries. There are a number of processes underlying this phenomenon.

First, there is the tendency for successful organizational trajectories, both technical and administrative, to be reinforcing. Such reinforcement processes have been labeled competency traps (Levitt and March, 1988) and, from a rational choice perspective, can be thought of in terms of opportunity costs. Furthermore, it is difficult for organizations to sustain multiple selection criteria when evaluating potential initiatives.

Variety Within and Across Organizations: Opportunity Costs

The cost of experimentation is an opportunity cost --- the foregone opportunity to exploit alternatives that are known to be attractive. This opportunity costs of experimentation can, in part, explain the reluctance of successful enterprises to explore alternative bases of action. This opportunity cost explanation of inertia lies in contrast to explanations within the economics literature that revolve around issues of cannibalization of product markets (Reinganum, 1989). The focus on cannibalization within the economics literature reflects the broader tendency, noted by Nelson and Winter (1982), to focus on product *choices* rather than production *capabilities*. Thus, while inertia may emerge as the result of firm strategizing with regard to product market competition, there is a simpler economic justification for lack of experimentation based on the more basic construct of opportunity cost. Furthermore, the opportunity cost should be interpreted broadly to reflect not just the return on physical resources but the full set of operating capabilities and, in particular, the scarce resource of managerial attention.

In the literature on complex systems, this notion of opportunity costs is conveyed by the idea of the trade-off between exploration and exploitation (Holland, 1975). Exploitation refers to the use of existing wisdom, while exploration refers to the search for new alternatives and new

wisdom. However, an executive responsible for the profitability and survival of a single organization will think about this problem differently than a social planner responsible for the overall efficiency of a population of such entities. Successful organizations will find it attractive to exploit their relative wisdom. Less successful organizations will be motivated to search (March and Simon, 1958). Such organizations also face the challenge of near-term survival as well as a longer-term challenge of relative fitness. The cost of exploration looks quite different to an individual actor than to an orchestrator of a Darwinian population process.

Variety Within and Across Organizations: Variation in Selection Criteria

Organizations have difficulty sustaining a variety of perspectives regarding a given technological opportunity. In part, this may stem from the greater intensity of socialization processes within an organization than across organizational boundaries (March, 1991). More central though is the tendency for resources to be allocated by a singular authority structure within the organization (Bower, 1970). Thus, while a large organization may have sufficient resources to make multiple "bets", those individuals who control resource allocation decisions are unlikely to be of multiple minds. There may well be considerable diversity of opinion within the organization, but there is typically a dominant political coalition (Cyert and March, 1963; Tushman and Romanelli, 1985) and the perspective of this ruling group will drive the resource allocation decisions.

Contrast this setting with a population of organizations. Even if an individual organization is making a singular "bet" with regard to a given technological opportunity, there may be tremendous diversity across the population of organizations. While there may be some pressure

to conform to the perspective of other, respected organizations (DiMaggio and Powell, 1983), individual organizations receive highly differentiated feedback from their environment and this distinct feedback may lead them to different views of the same technological opportunity.²

Indeed, the motivation of entrepreneurs to leave their prior organization seems as much driven by their inability to convince their prior firm to pursue an opportunity that they feel has tremendous promise as it is associated with an incentive to appropriate for themselves the returns associated with the pursuit of that opportunity (Tilton, 1971).

Attribution Bias and Perceived Appropriability

Not only will organizational boundaries tend to be chosen so as to minimize the falsehood of decomposition between the firm and the external economy, but individuals will react differently to the falsehood of internal and external decompositions. In terms of individuals sense-making of their world, the economic notion of appropriation can be re-interpreted in terms of the psychological notion of attribution (Kelley, 1971; Staw, 1980). When an outcome is experienced or observed, individuals act as 'lay' social scientists (Nisbett and Ross, 1980) and make judgements about the cause of these outcomes. In engaging in this attribution process, individuals

²For instance, computer disk manufacturers were highly responsive in pursuing technological opportunities that yielded benefits to their existing set of customers (Christensen and Bower, 1994). However, by the same token, these firms ignored other opportunities that were not critical to the immediate needs of these current customers. In particular, the leading manufacturers of 5 1/4" disk drives were well aware of the possibilities associated with the development of smaller drives with lower requirements for electric power. However, their current customers who were producing desk top machines and were not particularly concerned with size and power requirements. Thus, depending on the set of manufacturers to which a disk drive developer was most closely tied, the organization developed a different set of beliefs regarding technological opportunities.

are subject to a basic and pervasive bias of self-serving attributions (Miller and Ross, 1975).

Individuals tend to over-attribute favorable outcomes to the actions they themselves have taken; in contrast, adverse outcomes are over-attributed to external causes. These external causes may be the actions of other individuals or broader social forces such as the overall macro-economy.

These attribution biases compound the intrinsic difficulties of dis-aggregating responsibility within an organization. As a result of these pervasive psychological biases, members of an organization will tend to view an accurate system of credit assignment, if such a system were in fact possible, as wildly unfair. In their view, their successes would be significantly undervalued while their failures would lead to an unfair burden of responsibility.

While the same attribution biases are present across the 'natural' decomposition of the organizations and other elements of the economic system, its effect on perceptions of fairness and its disruptive impact on subsequent efforts at cooperation are far less. If an outside organization believes it is under-valued, it doesn't lead to internal dissension. Indeed, the sense of unity may be enhanced by the perceived mistreatment by external actors. Furthermore, the dissatisfaction with the relationship may be expressed by exit (Hirshman, 1970). In contrast, subunits and individuals within an organization are likely to be called upon to cooperate with one another in subsequent time periods. The sense of inequity from prior allocations of responsibility is not likely to provide a promising basis for future interdependent action.

4. Organizational Structuring versus Organizational Design

Decompositions and Evolutionary Building Blocks

How might higher-order capabilities³ evolve from a population of individual agents? How is it that automobiles, that embody a wide array of complex technologies and require sophisticated process technologies to produce, run off production lines with such apparent ease? How is it that a retailer such as Wal-Mart has been able to develop such an extraordinarily efficient system of logistics? These tasks involve large numbers of people with a wide variety of skills. Some of these economic actors reside in a common organization, while many of the participants in the production process operate in distinct organizations.

Higher-order capabilities, by definition, involve multiple actors. Through their collective behavior they generate outcomes of which the participating actors are not individually capable. But how is this collective intelligence to emerge? Broadly speaking, one could imagine two sorts of processes. One would be a process of design. To take the over-worked example of Adam Smith's pin factory, a social planner or entrepreneur (for the present purposes there is no clear distinction between the two roles) could assign individuals to various stages of the production process. This act of design would not in and of itself result in the development of distinctive, collective capabilities. These capabilities would emerge over time as the individuals acquired greater skill in their particular roles. Thus, the capability development that occurs with time is

³By higher-order, I mean capabilities that go beyond the capacity of a skilled individual. Thus, the distinction is analogous to the one Nelson and Winter (1982) make between individual skills and organizational capabilities. I wish to refrain from prejudging how these collective tasks are organized and therefore use the institutionally neutral term higher-order capabilities instead.

one of individual skill development. The achievement of collective capabilities is not an emergent property of the system.

This story of collective design and individual skill development, while interesting, seems rather distant from discussions such as Nelson and Winter's (1982) of organizational routines. The division of tasks do not seem to be preordained in the Nelson and Winter characterization of organizational capabilities. Rather, the spirit of the discussion seems to be more that individuals engage in actions that have joint consequences and that, over time, patterns of behavior emerge that exhibit collective intelligence. Thus, in contrast to the characterization of the pin factory, not only do individual skills evolve as agents repeatedly engage in similar tasks, but patterns of interaction emerge. Cohen and Bacdayan (1994) provide a powerful demonstration of this in the context of their laboratory study of collective problem-solving.

When the contrast is made between the ability of markets and social planners to achieve effective solutions to the problem of the design of collective action, there now seems to be a global consensus as to greater efficacy of markets. By the same token, one should be equally skeptical of social planning solutions to complex design problems of a micro, organizational variety. This is not to say that there is not a role for intentional design, but the scope of efforts is inherently limited.

How are more complex problems of design to be solved? Past wisdom must be retained as the basis for future action. As a result, effective adaptation must use as building blocks elements of existing practices (Holland, 1975). This is just the role of organizational routines that Nelson and Winter articulated. Routines serve to institutionalize past knowledge of a higher-order sort (i.e., involving multiple actors); furthermore, they have suggested that existing routines

serve as effective building blocks for novel forms of collective action.

Decompositions and Artificial Peaks

Whether a particular organizational policy, such as new work practice, is performance enhancing is likely to depend on a variety of other organizational policies (Ichniowski, Shaw, and Prennushi, 1994; Milgrom and Robert, 1990). The fact that organizational effectiveness depends on policies in a highly interdependent manner implies that the space of organizational forms may be thought of as a rugged fitness landscape (Kauffman, 1993; Levinthal, forthcoming). An organization may possess an array of characteristics such that a shift in a single attribute might degrade performance whereas an appropriate shift in a broad array of attributes might enhance performance. As result, the landscape of organizational forms (i.e., a mapping from the array of organizational attributes to performance) is likely to be multi-peaked with a large number of local optimum.⁴

Consider the effect of artificial decompositions of interactions effects, as implied by departmental and organizational boundaries, using this framework of rugged landscapes. Actors within an organizational subunit will struggle to identify a peak in the fitness landscape. Such a peak, however, need not be a global peak in the overall landscape. Indeed, such a peak may not even be a local peak from the overall organization's perspective. What is identified is a peak with

⁴Building on the prior footnote regarding views of organizational forms as being discrete or continuous, this notion of rugged landscapes provides a rationale, apart from the discrete distinctions imposed by a legal system, for the presence of discrete forms. Incremental movements away from a given "local" peak (i.e., a cluster of organizational properties) will tend to degrade performance and appear unattractive. As a result, the population of organizational forms will tend to correspond to some subset of the local peaks in the fitness landscape (Levinthal, forthcoming).

respect to the local interaction effects within that subunit. To the extent that there are interaction effects across subunits, it is unclear how the discovery of a partial peak⁵ relates to the overall fitness landscape.

New decompositions are offered by organizational designers (top managers and their assistants in management consulting firms) not only because of changes in the environment, but also because shifts in decompositions themselves may be useful. Over a modest period of time an organizational subunit is likely to have discovered, what is being termed, a partial peak in the fitness landscape. Improvement in organizational fitness can only occur by movement off of inferior partial peaks. A shift in decomposition shifts the set of interaction effects incorporated by the various organizational subunits. Such a shift will induce new search efforts and, associated with that, movement off of the prior partial peak. This process allows for experimentation between the properties of partial peaks that are the outcome of a particular decomposition of organizational relations and the broader fitness landscape. Search is renewed by the imposition of a new decomposition. Given the correlated nature of a fitness landscape (Kauffman, 1993), a set of "partial peaks" is likely to be a useful starting point for subsequent search efforts.

The presence of interaction effects poses difficult challenges for the design of organizational activity. Structural differentiation within organizations imposes a particular decomposition on organizational activity. Such a decomposition may be more or less faithful to

⁵The term partial peak is used to reflect the fact that this peak is defined by abstracting from, or partially out, all policy variables outside the subunit's boundaries. Note that even though the subunit is ignoring the possible benefits of manipulating these other policy parameters, these other parameters influence the topology of the "patch" of the fitness landscape (Kauffman, 1993) that the department is attempting to climb. The subunit is engaged in finding an attractive set of parameters for the N' variables under its control conditional on the other $N - N'$ parameters in the organization.

the underlying set of interaction effects. Decompositions have the virtue of facilitating mutual adaptation of the actors within a given unit. A virtue whose cost is borne by the neglect of other interaction effects and the associated potential for other bases of mutual adaptation.

4. Conclusion

Decompositions, whether an organizational boundary or differentiation within those boundaries, matter. It forms the basis for credit assignment --- the linking of payoffs to actions --- and, in turn, provides the basis for adaptation. Adaptation that takes place in the form of mutual adaptation within an unit of the decomposition. Adaptation that takes place at an higher level of aggregation in the form of parallelism across units.

Some decompositions are the result of conscious design efforts; others reflect, and perhaps institutionalize, the emergent behavior of a set of actors. Just as paved roads may reflect the travels to market of livestock, organizational structures may reflect the revealed pattern of interaction among actors. Both paths to structure are important. The former represents an effort to induce a set of interactions and to internalize to a subunit the impact of these interaction effects. The latter is an effort to crystallize, and perhaps legitimate, a set of behaviors that have proved useful.

The problem of appropriate decompositions is unlikely to be fully solved by conscious design. Indeed, it is just the sort of combinatoric problem that tends to be unamenable to optimization efforts (Garey and Johnson, 1979). That is not to negate the importance and value of design efforts. Furthermore, it is consistent with the pattern of continual design efforts one

observes within organizations (Eccles and Nohria, 1992). Obviously, re-design may be provoked by changes in the environment. However, even in a stable, but complex world design efforts may be a re-occurring phenomena. Given the falsehood of any decomposition, at best a given structure results in the identification of a set of “partial peaks” in the fitness landscape. The shift to a new set of policy choices that may have more desirable global properties requires a new decomposition, a new structure.

While admittedly sketchy in detail and couched at an high level of abstraction, this essay has tried to identify some fundamental properties of organizations and to provide some structure with which to explore these properties. A virtue of this high level of abstraction is that it frees the discussion from a particular paradigm, such as neoclassical economics or the sociology of organization. As a result, it can contribute to a common footing for these large and diverse set of writings. A common footing that it is hoped will facilitate the development of our theories of organization.

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