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## Informal Networks and Organizational Crises: An Experimental Simulation\*

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*This paper argues that organizations with a particular social network structure are more effective than most organizations in responding to crises. Further, it is argued that the effective structure does not occur naturally, but must be designed consciously and carefully. A theory is developed based on well-founded principles of social science, most notably work on formal structure, conflict, friendships, and organizational crises. The paper concludes with an experimental test of one of the four propositions deduced from the theory. Six trials of the experiment found significant support for this proposition.*

The importance of informal organizations has not escaped organizational theorists (e.g., Dalton 1959; Sayles 1958). Although the formal organization describes authority lines, much of the influence (Knoke and Burt 1983) and the actual work (Burns and Stalker 1961; Strauss 1962) is accomplished through the informal structure of friends, contacts, and accidental communications. Despite this recognition, recommendations for the design of organizations have been limited, for the most part, to formal organizations (cf. Daft 1983). Lawrence and Lorsch (1967a), for example, identified an integration problem in organizations facing uncertain environments. Their solution was to create a formal integrative role for an individual or department within the organization (Davis and Lawrence 1977; Lawrence and Lorsch 1967b).

A small number of researchers has called attention to the issue of the design of informal organization (Tichy 1973, 1981; Tichy and Fombrun 1979; Tichy, Tushman, and Fombrun 1979). Most of their normative statements, however, are not specific enough to be helpful for structure decisions. Tichy argues, for example, "People can be taught how networks operate, how to establish new networks, what networks already exist, how to improve existing networks, what kinds of relationships are desirable or undesirable . . ." (1981, p. 241). Yet he fails to offer a

set of criteria for deciding whether the existing networks need improving, what kinds of relationships are desirable or undesirable, and what an improved network would look like. In fact, there is no current theory that points to an optimal structure of the informal relations in an organization.

The purpose of this paper is to develop such a theory. It is argued here that emergent networks, left to themselves without the aid of conscious design, will form naturally in ways that are suboptimal, even dysfunctional, for the organization. Moreover, it is argued that the degree to which the informal organization is designed optimally is measurable. The argument behind this theory will be built up from a set of seven assumptions presented and defended below; the assumptions will culminate in a set of propositions. The first of these propositions is operationalized and tested in a set of organizational simulations. The results of these tests provide strong support for this primary proposition.

### THE STRUCTURING OF ORGANIZATIONS

Organizations are differentiated structurally into parts. Miller (1958), for example, describes how basic the process of differentiation is for organizational activity. Organizations are differentiated according to technology, spatial arrangements, and time sequencing. Miller examines the relationships among these three bases of differentiation, and emphasizes natural divisions based on task and on mechanisms of coordination. Breaking the organization into parts necessitates changes in coordination mechanisms and

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provides an explanation for the elaboration of management structure.

Differentiation produces work units at many levels in an organization. We will refer to formal subdivisions within organizations as "subunits"; these units may vary widely in size. Subunits usually are considered in terms such as department, unit, center, or work group. The characteristic that is important to the following discussion is that these units are recognized formally as differentiable from other units.

### *Friendship Patterns*

**Assumption 1:** Organizations tend to evolve into friendship cliques (dense friendship networks) primarily within subunits.

The assumption that friendship cliques occur within subunits is based on several social principles. Among these, it is well known that frequent interaction and propinquity between actors lead to friendships. Festinger, Schachter, and Back (1950) studied a group of students to determine whether a causal link between propinquity and friendship could be inferred reasonably. Specifically, married students were assigned to housing units according to when they applied to school. This order of application was independent of other factors that may have led to friendship, such as similarity of interests or college majors. Yet those living next door to each other were far more likely to become friends with each other than were other pairs of couples. Those who lived at the physical ends of the buildings were more likely not to have any friends in the complex.

Other researchers have found similar relationships. Several studies show that students who sat close to each other in classes in a boarding school were more likely to like each other (Byrne and Buehler 1955; Maissonneuve, Palmade, and Fourment 1952). Sykes, Larntz, and Fox (1976) found that those who bunked next to each other interacted with each other and liked each other more. In summarizing this research, Shaw (1981, pp. 84–85) notes that propinquity creates at least an opportunity for friendship formation: "Clearly, persons who are physically close to each other are more likely to form affiliative relationships than those who are more distant from each other."

Interaction in itself also tends to increase

the likelihood of interpersonal attraction. Many studies have found that interaction between members of different races increases the likelihood that mixed-racial friendships will form (e.g. Deutsch and Collins 1951; Stouffer, Suchman, Deviney, Star, and Williams 1949). Jahoda (1961) found that interaction with others of a different race reduced resistance to desegregated living arrangements. Even anticipated interaction can induce positive affect toward another (Tyler and Sears 1977).

Subunits usually are organized physically so that members are proximate to each other. More interaction during the work day occurs within subunits than between subunits; as a result, friendships are more likely to occur within than across subunits. Miller (1958) describes how subunits, particularly those based on territory and time divisions, develop group solidarities and inward connectedness. Obvious examples include individuals working in the same department or the manner in which workers on the same shift are likely to form relationships.

Such structurally constrained interaction also is likely to lead to some common perceptions of the units and the individuals in the organization. Subunits divided by technology often derive solidarity from what Selznick (1957) termed "distinctive competence." The arrangements of the task not only make them specialists but also give them a particular vantage point and perspective on the organization. To the extent that individuals are grouped by occupation, common points of view likely are due to the creation or maintenance of occupational communities.

The creation of common points of view also is strengthened by another force at work in the friendship network. Allocation of resources usually is made to subunits in order to facilitate coordination and control of resources within the organization. Monitoring and budgeting funds to subunits is much easier than monitoring and budgeting individuals. As a result, those in a subunit are viewed as allies in the battle of the budget, and those within a unit may see other units as competitors for resources in organizational decision processes. Such a view is explicit in the work of both Allison (1971) on decision making in the government and Pfeffer (1981) on organizational power.

In summary, organizations are structured in subunits, which have sufficient boundaries to

be structurally conducive to the formation of friendships with units. Although friendship links between individuals occur across sub-units, these ties occur at a lower rate than within-unit ties.

We now digress to introduce the idea of organizational crisis. It will be argued subsequently that crises create conditions in which the arrangement of friends becomes especially critical.

### *Organizational Crises*

Organizational crisis has been the subject of a variety of analyses which debate the definition of crisis itself (e.g. Billings, Millburn, and Schaalman 1980; Hermann 1969; Milburn, Schuler, and Watman 1983; Smart and Vertinsky 1978). Most discussions use Hermann's (1963) definition: a crisis is a stimulus (situation) that consists of a threat to desired organizational goals, in which decision time is short and surprise has found decision makers unprepared to act.

Billings et al. (1980) find this concept incomplete, and suggest the additional importance of the triggering event and the manner in which it is sensed. The stimulus needs to be considered in comparison with current standards of performance outcomes; otherwise there will be no apparent threat. A discrepancy would produce an evaluation of the probability that the organization would face a loss, and of the magnitude of that loss. Crises are most likely when required responses are uncertain and must be original (pp. 302-305).

In building a general model of organizational crisis, Milburn et al. (1983) add that a crisis may occur not only because of the opportunity to achieve desired goals but also because of a threat to those goals. They emphasize the organization's need to resolve the crisis and the likelihood that the "resolution strategy is uncertain" (p. 1144).

From the crisis research we can extract a working definition for this analysis. "Crisis" refers to a situation facing an organization which requires that the organization, under time constraints, engage in new, untested, unlearned behaviors in order to obtain or maintain its desired goal states. A crisis could result from events within an organization, such as a planned effort for change or the sudden loss of critical personnel, as well as from external sources.

In simplest terms, a crisis requires uncertain action under time pressure. When uncertain action is required without time pressure, the situation may be viewed as a problem rather than a crisis. When required actions and outcomes are known but when time pressure exists, organizations engage standard, albeit critical, procedures or routines.

The importance of friendship networks for organizational crises is revealed in the conditions that exist within an organization during a crisis and in the behaviors that are required to manage the situation.

**Assumption 2:** Crisis leads to a perception of uncertainty and threat of change.

This assumption follows closely from the definition of crisis itself. A threat or opportunity requires uncertain response, the outcomes of which are also uncertain. Billings et al. (1980) discuss the perceived probability of loss; Milburn et al. (1983) examine the stress that results from this uncertainty. Meyer (1982) provides one of the clearest statements in discussing environmental jolts: "When they are labeled crises, jolts infuse organizations with energy, legitimize unorthodox acts and destabilize power structures" (p. 553). The behaviors required are "unorthodox," unlearned, and untried; especially to the point, they have unpredictable consequences. Thus the power structures, which enforce order and stability, are challenged directly.

A wide range of threats to the current order must be acknowledged. Resources may be reallocated or changed in absolute availability. Perceived resource scarcity may increase. Power may be redistributed, and day-to-day organizational procedures may shift. Expectations of behavior and overall performance may change. Threats of change in the normative, political, and physical environments can arrive in widely ranging forms.

**Assumption 3:** Such perceived uncertainty and threat of change will result in conflict among subunits.

The perceived threat will lead units to defend their resource base and patterns of action. Hermann (1963) suggests that preexisting conflicts will be aggravated during crises. The internal allocation of resources will seem more like a zero-sum game. Milburn et al. (1983) argue that strategies of centralization tend to be applied in crises.

They believe that such strategies reduce the cohesiveness of the organization as a system. There will be a greater tendency for conflict to develop among units (p. 1171) and for cooperation among units to decline (Schein 1967). Milburn et al. (1983) posit a cycle of deepening crisis as a result. This argument leads to further elaboration of the nature of the conflict.

**Assumption 4:** Conflict will lead to two separate but commensurate outcomes: (1) increased commitment to the home subunit and (2) reduced cooperation with other subunits in the organization.

The effects of conflict on group structure, cohesion, and activity are discussed well. Simmel (1955) and Coser (1956) elaborate the issue for general social relations: intergroup conflict leads to increased group cohesiveness, a stereotyped image of other groups, an inability to cooperate, hostility, and clear formulation of group beliefs. Most of these hypotheses have been verified in experiments since the work of Sherif, Harvey, White, Hood, and Sherif (1961) (see also Schein 1967). Wheaton (1974) also shows that conflict can lead to increased group cohesion when members are forced to rally around a common set of principles, as one might observe within an organizational subunit.

Cooperation, in this case, entails the notion that people are willing to work with others, even though some of the behavior is not likely to benefit their unit to the maximum degree. In addition to the preceding discussion, Hermann's (1963) analysis of crises includes a similar observation. The centralizing tendency of crisis management reduces the use of normal channels to collect and disseminate information. As a result, cooperation and coordinating in general become more difficult. Centralization is an attempt to force integrated action by the subunits in order to manage the crisis. The ordinary level of differentiation of the subunits must be overcome temporarily.

**Assumption 5:** Adaptation to crisis requires increased cooperation.

Crises, by their nature, have uncertain outcomes; usually it is not clear who will benefit from the new required behaviors. Some of these behaviors require organization

and coordination across subunits; thus some of these behaviors must be cooperative.

Khandwalla (1978) discusses the response phase of crisis as one that involves increased collaborative relations and the establishment of integrative mechanisms. Solutions to major crises described by Starbuck, Greve, and Hedberg (1978) show the need for increased connectedness between units that previously were unconnected.

**Assumption 6:** Trust enhances cooperation.

In a trusting relationship, one imputes "honorable" motives to another. That is, if person A trusts person B, by implication A expects that B will not intentionally use information or engage in behavior at A's expense. To violate this expectation is to violate trust. Once trust has been violated, cooperation is diminished greatly; cooperation without initial trust is very difficult to implement.

Forced compliance to cooperative behaviors is not an efficient answer to the problem. As Kelman (1958) points out, forced compliance requires expensive and constant surveillance; it engenders distrust and negative affect. People are tremendously creative at undermining systems of control; the popular press often has highlighted examples of resistance, such as the now-classic case of the auto workers at Lordstown, Ohio in the early 1970s (Lee 1983).

**Assumption 7:** Strong friendship includes trust.

Although not isomorphic with trust, friendship implies trust. Without trust, friendship does not exist. As Bell (1981) observes in his research on friendship, "When we asked people to describe what was important to friendship, their most common answer was 'trust'. This was because close friendships are possible only if certain barriers are eliminated and the two people can come to an understanding. This further means that what they do and get from each other is based on trust" (p. 16).

These arguments suggest the reasonableness of the following proposition:

**Proposition 1:** In times of crisis, more effective organizations will be those with friendship links between subunits (as opposed to strong friendship links within subunits).

Insofar as strong friendship ties exist across subunit boundaries, more trust and cooperation will be possible. Uncertain solutions are

more likely both to be suggested and to be implemented. More cooperation will result in greater ability to adapt to the new situation created by crisis. The importance of this proposition lies not only in its prediction that the tendencies toward differentiation in organizations work against the existence of optimal conditions, but also in its contradiction of the general principle of impersonality as found in the traditional bureaucratic model, which advocates eliminating friendship ties as a strategy for efficiency.

Caution should be exercised in interpreting this proposition. It applies to crisis situations rather than to normal, routine operations. Though links among units still are important even in ordinary organizational functioning, ties within subunits improve normal performance by permitting coordination and cooperation in unit work tasks. Intraunit ties promote a more positive social environment for unit members who must spend most of their work day within the unit. This proposition is not intended to disregard the importance of internal group ties to ordinary group functioning. Rather, it emphasizes the extraordinary circumstances created by crisis conditions, which make an abundance of external ties more effective than internal ties.

*Dimensions of Network Characteristics:  
Operational Definition*

A network consists of a set of individuals and of the links among them. Links between pairs of individuals might represent a wide range of connections, including such activities as friendship, advice seeking, informational communication, and material transfers (cf. Tichy et al. 1979). Nearly any type of relationship between a pair of individuals in a set may be conceived as a network. Such a configuration might be displayed as a directed graph (Harary 1971) or as a matrix in which the rows and columns represent individual members of the set and the cells the existence and nature of the tie between each available pair of individuals.

In the model of crisis management proposed in this paper, the focus is on friendship as the link among members of an organization. Friendship ties (links) have been identified as both external and internal to organizational subunits. External links are friendship links between members of different subunits; internal links are friendships between mem-

bers of the same subunit. According to Proposition 1, for any given density of friendship relations, external links are more important for the management of a crisis. According to Assumption 1, however, internal links are more likely to form. An index of the relationship between external and internal links is required to evaluate the proposition. Therefore the E-I index is proposed as follows:

$$\text{E-I index} = \frac{EL - IL}{EL + IL}$$

where

*EL* = the number of external friendship links

*IL* = the number of internal friendship links

The possible scores for this index range from  $-1.0$  to  $+1.0$ . As the E-I index approaches  $+1.0$ , all the links would be external to the subunits. A score of  $-1.0$  would indicate that all the links are internal. If the links are divided equally, the index will equal zero.

Several facets of this index are worth exploring. One may note, for example, that the index is a measure of dominance of external over internal ties, not simply a measure of external links. Thus the index not only decreases with a decrease in external ties, as can be deduced directly from the theory developed here, but also can be decreased by increasing the internal ties.

The rationale for calculating the index as a ratio instead of as a simple count of external ties is threefold. First, on the theoretical side, the higher the density of internal ties, the greater the identification that members will make with the subunit per se. Such an identification will exacerbate the problem of increased commitment to the home unit (see Assumption 4 above). The lower the density of friends, the easier it will be to induce the organizationwide identification and commitment necessary for the cooperation required to face the crisis successfully.

Second, one may assume that individuals have a limited amount of time, energy, and need for the social interaction and intimacy which are demanded in maintaining friendships. Given this assumption, one will find, on the average, a tradeoff between the number of friends one can maintain outside

the subunit and the number one can maintain inside the subunit. In this sense, the more internal links one has, the fewer links one can foster outside the subunit. Thus internal links represent an "opportunity cost" to the subunit.

Third, there is a practical, methodological reason for including internal links in the E-I measure. The concept of "friend" is somewhat elusive; some people may respond to a specific question about what constitutes friendship (and therefore who their friends are) differently from other people. That is, some may have a high threshold of friendship (and thus report few such friends), while others may have a low threshold (and thus report many such friends). By comparing the external to the internal links, we are controlling automatically for this source of variation in the measure. Those with low thresholds will contribute correspondingly to both internal and external links; those with high thresholds will deprive, in a sense, both external and internal links. On average, then, in a ratio measure such as the E-I index the "overestimates" of externals would be balanced by "overestimates" of internals. Thus this measure is not so sensitive to such kinds of measurement error.

Other facets of this index are worth noting as well. As the organization grows larger, for example, the potential number of external links grows much faster than the potential number of internal links. This point can be demonstrated easily, as follows:

The maximum possible number of external links ( $E^*$ ) is a function of the size of each subgroup ( $S_i$ ) and the number of subgroups ( $N$ ). This relationship is computed readily as:

$$E^* = \sum_{i=1}^{N-1} \sum_{j=i+1}^N S_i S_j$$

If we assume that the size of all the subgroups is equal (i.e.,  $S_i = S_j$  for all  $i, j$ ), this formula reduces to:

$$E^* = \binom{N}{2} S_i^2 = \frac{N(N-1)}{2} S_i^2$$

The maximum possible number of internal links ( $I^*$ ) also is a function of  $N$  and of the size of each  $S_i$ :

$$I^* = \frac{1}{2} \sum_{i=1}^N S_i (S_i - 1)$$

Again, if we assume that the size of all subgroups is equal, this formula reduces to:

$$I^* = \frac{NS_i(S_i - 1)}{2}$$

The external possibilities are approximately proportional to the square of  $N$  times the square of  $S_i$ . The internals are approximately proportional to  $N$  times the square of  $S_i$ . In other words, the potential number of external links usually will be greater—by a factor of about  $N$ —than the potential number of internals.<sup>1</sup> Moreover, when the groups are of the same size, the potential number of external links exceeds the number of internal links approximately by a factor of  $N$ . In an organization of any reasonable size it would seem difficult to find an E-I index of less than zero because  $E^*$  outnumbers  $I^*$  so strongly. Of course, Assumption 1 argues that most links in organizations will tend naturally to be internal; thus it is our conjecture that negative E-I indices would be common, despite the handicap that  $I^*$  imposes relative to  $E^*$ .

Mariolis (1985) points to this problem and argues that such indices should be normalized against the maximum possible to give a true indication of the propensity to be dominated by external or internal relations. We have chosen not to do this for three reasons. First, calculating the number of possible external and internal ties is cumbersome, relative to the E-I index calculation. Second, if Assumption 1 is correct, it would be difficult to find examples of positive E-I values. That is, external links are more difficult to form and are costly to maintain. To normalize this already small number by dividing by the large number of potential external links would place too much constraint on the index. The observed index values would be very small (i.e., all the values would approach  $-1.0$ ) and difficult to interpret. Third, and most important, the theory rests in part on the degree to which members of subunits are

<sup>1</sup> Exceptions can be found, however, when the sizes of groups differ dramatically. Consider a hypothetical organization with two subunits, one of size 100, the other of size 1. In this extreme case,  $I^* = \binom{100}{2} = 4,450$ , while  $E^* = 100$ .

oriented inwardly (inside the subunit) or outwardly (to the organization as whole). An individual who has many ties to other parts of the organization, even though those ties represent a tiny fraction of the maximum "possible" ties, will share a wider, more organizational view of the world. He or she need not be tied to everyone else (an impossible task anyway, in most cases) in order to share that view. As long as most of those ties are oriented outward, the individual will be influenced toward cooperation. If all members of the organization tend generally to be tied to more members outside their subunit than inside, the E-I index will summarize that trend with a positive value. We seek to measure this trend, thus we prefer the simple, unstandardized E-I index to the more complex, more sophisticated alternatives proposed by Mariolis (1985).

This index allows the formulation of a specific hypothesis deducible from Proposition 1:

**Hypothesis 1:** Organizations with a high (positive) E-I index will be more effective in the face of crises than organizations with a low (negative) E-I index.

*Further Propositions*

The dominant theme in this argument is that the relative density of external friendship links is the critical determinant of effectiveness in facing an organizational crisis. It would be misleading, however, to suggest that this is the only contributing factor. As suggested elsewhere (Tichy 1981), one must pay attention to several contingencies in the design of organizations. Indeed, the theoretical discussion that led to Proposition 1 can be used to develop additional propositions regarding other such contingencies and design factors. (These propositions will not be tested in this paper.) Propositions 2 through 4, below, address some of these design issues. They are phrased specifically to retain the preeminence of the first proposition.

**Proposition 2:** If the E-I index is held constant, the number of subunits in an organization is correlated inversely with organizational effectiveness in the face of a crisis.

We stated earlier that subunits are any number of types of organizational units. They are distinct, and usually there is consensus in the organization about their distinctness.

From the earlier discussion it is clear that the fewer subunits exist, the fewer problems will be created by differentiation. In effect, the greater the level of organizational complexity based on the number of subunits, the greater the potential problem of insufficient ratios of external to internal links.

In addition to the dominance of external ties and the number of subunits, the distribution of external ties may be important, as suggested in the following proposition:

**Proposition 3:** If the E-I index is held constant, the variance of the distribution of links between pairs of subunits is correlated inversely with organizational effectiveness in the face of a crisis.

Variance is defined here as follows:

$$Var = \frac{\sum_{i=1}^{N_s-1} \sum_{j=i}^{N_s-1} L_{ij}^2}{\frac{1}{2} N_s (N_s - 1)} - \left( \frac{\sum_{i=1}^{N_s-1} \sum_{j=i}^{N_s-1} L_{ij}}{\frac{1}{2} N_s (N_s - 1)} \right)^2$$

where

$N_s$  = number of subunits in organization

$L_{ij}$  = number of external links between subunit  $i$  and subunit  $j$ .

This measure is simply the variance in the number of links ( $L_{ij}$ ) between all pairs of subunits.

Given a fixed number of subunits and a fixed number of external links, we can arrange those links in several different ways, but not all such arrangements would be equally effective in promoting the necessary cooperation. For example, if all the links were concentrated between two subunits and if no links were present between any of the other subgroups (i.e., if variance were high), one would predict trouble in cooperative behaviors among those other subunits. On the other hand, if the links were distributed equally across all pairs of subunits (variance = 0), potential for cooperation and cooperative attitudes would be distributed equally across the organization. Thus a high-variance condition (in which the links are concentrated in a few pairs of subunits) will not be as robust or as suitable to crisis situations as a low-variance condition (in which the links are parceled out equally among pairs of subunits).

**Proposition 4:** If the E-I index and the variance in external links are held constant, the match

between density of external links and needs for coordination of those pairs of subunits will be correlated positively with organizational effectiveness in the face of crisis.

One additional highly probable contingency follows from the preceding discussion: subunits will vary in the amounts of coordinative activity they require (Thompson 1967). Pairs of subunits that require such coordination will be sensitive to the extent to which external links exist to handle them. The creation of a high density of links is imperative to high needs for coordination (e.g., Lawrence and Lorsch 1967a). When two subunits have little need for coordination, the corresponding need for external links is attenuated. If the linkage pattern and the need for coordination overlap, greater human resources are available for crisis management.

We are not arguing that external links between pairs are unnecessary where coordination needs are low. Indeed, such links can prevent problems that might arise independently from technological or other demands. We simply are arguing that they are needed more where coordination needs are higher.

We turn now to a description of the empirical support found in an organizational experiment which we conducted to test this theory. Our intention was to test only Hypothesis 1 (and, by inference, only Proposition 1). Testing other parts of this model for the remaining propositions is left to future research.

#### METHOD

To test Hypothesis 1, we made six trials of an experiment. In each trial, two organizations were designed to be comparable in every way except for the arrangement of their friendship links. In one organization the number of friendship links between subunits of the organization was maximized at the expense of the number of links within any one subunit. In the second organization the number of links within the subunits was maximized so that there was a minimum number of links between subunits.

We simulated the "organizations" using Miles and Randolph's (1979) *Organization Game*. Other researchers also have found the game a useful device for simulating the complexities and demands found in real organizations (Cameron and Whetten 1981).

It provides a fertile ground for testing the hypothesis, for two reasons. First, it allows for experimental control of the design variable of interest, namely the pattern of friendship links.

Second, and equally important, the *Organization Game* is the epitome of crisis as we defined it above. This definition has several components, including the requirement that organizations "under time constraints, engage in new, untested, unlearned behaviors . . ."; the *Organization Game* meets these requirements. Consider the first condition, that of "time constraints." The game is divided into several periods, each lasting between 30 and 75 minutes, with the longer periods at the beginning of the game. Within these strictly enforced time limits, each participant must figure out what to do and then do it. With the exception of a few people who find out that they have nothing to contribute, all the "employees" discover that they are under pressure to complete certain tasks (gather and disseminate information, fill out forms, allocate resources) before the end of the session. The penalty for not completing these tasks varies but frequently affects the entire organization. Invariably some of these tasks are not completed on time.

The second condition in our definition of crisis—that the organization is required to "engage in new, untested, unlearned behaviors"—also is endemic to the *Organization Game*. Wealth is accumulated or lost over time through a complex formula that incorporates productivity measures and the quality of decisions about resource allocation (see Appendix A for more details). The formula was not given directly to the participants; most players learn it through trial and error and through the hints given in the participant's manual. Moreover, only a cursory skeleton of an organizational structure is provided. Even communication between units is restricted through a formal mechanism involving a limited number of passes. Some people are assigned to positions in the organization, but they must determine for themselves their formal and informal responsibilities in that position. If the participants do not organize themselves, allocate jobs, and begin to produce outputs, the indicators of performance will drop and the organization will fail. The ultimate creation of a hierarchic or centralized control structure also is a function of participants' decisions.



In reference to the definition given above, the initial crisis is a threat to the organization's goals of survival and performance; decision makers are surprised by the organization's complexity and operating rules, which dictate behaviors that are very different from the accustomed behaviors. The required responses are uncertain and original in their configuration. Some known and some unfamiliar behaviors must be organized in new ways to stabilize the organization. This initial crisis approximates the concept as developed by Hermann (1963), Billings et al. (1980), and Milburn et al. (1983).

Little stability or reduction in confusion occurs for at least three rounds of play (Stern 1974). After some stability has developed, periodic special events are introduced simultaneously into the paired games to initiate a further crisis condition. Such events have included simulations of disasters such as fires or earthquakes, the introduction of designated minority players who must be given positions of power within a certain period (thus current power holders must be replaced), competitors in the product market and takeover attempts by outside corporations, and government regulatory rulings. These crises, usually introduced during Session 5, approximate the environmental jolts regarded commonly as organizational crisis situations.

Thus the experience for each participant is one of chaos, of uncertainty about what to do or how to do it. Roles develop through time in the game, through negotiations, interaction, and agreements. Yet these roles change frequently because of political infighting or renegotiations, or simply because organizational goals were not being met. The *Organization Game*, then, amounts to a continuous, interunit crisis environment, where new, untested, unlearned behaviors emerge and then frequently are discarded in favor of new behaviors.

Each simulation was conducted as part of a class at one of two universities. Four of the trials used undergraduates (Trials 2, 4, 5, and 6) and two used graduate (MBA) students (Trials 1 and 3). The procedure for designing the organizations was as follows. Everyone in the class completed a questionnaire which asked them to rate every other person in the class as to how close a friend he or she was. The directions for this questionnaire included the following:

Please place a check in the space that best describes your relationship with each person on the list.

The names of everyone participating in the game were listed below, with five categories from which the respondent could choose: "trust as a friend," "know well," "acquaintance," "associate name with face," and "do not know." Only the first category, "trust as a friend," was used to assess the friendship links. The pattern of these links was used to assign individuals to positions in the organization.

Two organizations were created from each class. In the first organization, called here the "optimal" organization, we broke up friendship clusters by assigning the members to different organizational divisions and taking care not to put friends within the same division (there are four divisions in the *Organization Game*). In the second organization, called the "natural" organization, we maintained the cluster of friends by assigning as many friends as possible within the same division and as few as possible in different divisions. This organization was termed "natural" because it reflected how organizations tend to form in the working world (see Assumption 1).

The actual procedure for assigning subjects to groups was constrained by the need to maintain some friendship cliques and to break up others. The friendship checkoff procedure was used to identify cliques; these cliques were assigned randomly to the "optimal" and the "natural" simulations. Individuals then were assigned to one of the four units, depending on whether the clique was to be preserved within a unit or spread out across units. We began to place the members of the largest cliques first, then members of smaller cliques, then dyads; finally we assigned isolates to even out the sizes of the four units and the two simulations. This procedure did not guarantee that no friendships existed within units in the "optimal" organization or that no friendships existed between units in the "natural" organization, but it did result in organizations that approached these ideal conditions. In all cases the "optimal" organizations had positive E-I indices and the "natural" organizations had negative E-I indices (see Table 1).

The two organizations were run simultaneously in separate areas of the building. We took care to ensure that each organization was

Table 1. E-I Index of Organizations in Each Trial

Links	Trial 1 Spring 1983		Trial 2 Fall 1983		Trial 3 Spring 1984		Trial 4 Fall 1984		Trial 5 Spring 1985		Trial 6 Spring 1986	
	Natu- ral	Opti- mal	Natu- ral	Opti- mal	Natu- ral	Opti- mal	Natu- ral	Opti- mal	Natu- ral	Opti- mal	Natu- ral	Opti- mal
E	30	36	1	25	4	49	0	25	12	70	16	38
I	55	7	50	1	32	3	56	7	20	10	25	4
Index	-0.294	0.674	-0.961	0.923	-0.778	0.885	-1.000	0.562	-.250	.750	-.220	.810
Number of Participants	26	25	31	32	29	29	36	35	31	31	33	33

exposed to the same resources, enforcement of rules, time deadlines, and other variables that can affect performance of the organization. Each trial lasted from five to seven rounds, depending on the time constraints placed by the host institution. Total playing time for the trials ranged from seven to nine hours. Although individuals were not provided with any external incentives to motivate them in the simulation, they were asked to specify individual goals at the outset and to evaluate periodically how well they thought their organization was doing. Further, participants were aware that another organizational simulation involving their classmates was going on at the same time.

The dependent variables in these trials were the four *Organization Game* performance indicators, determined by rules given in the game manual. Each indicator, according to Miles and Randolph (1979), summarizes how well the organization is doing on one of four dimensions: 1) resource base (RB), or how effectively the organization is replenishing the resources it consumes; 2) total output (TO), or the effectiveness of the organization at producing goods and services; 3) internal

cohesion (IC), or the state of collaboration between individuals and groups in the organization; and 4) member commitment (MC), or how many members are satisfied with the organization's functioning, structure, and values. The total performance of the organization is determined by averaging the four indicators. The rules stipulate that if any organization drops to zero on any indicator, that organization is declared bankrupt (see Appendix A for details on calculating the four indicators).

## RESULTS

The means, standard deviations, and intercorrelations among the four performance measures are provided in Table 2. These measures were calculated in each session, but for reasons of clarity and brevity we report the data only for the first and last sessions. Our primary interest here is in the scores for the last session because these represent how well the organization coped with the various problems it encountered during the entire game.

The design of the study allows direct

Table 2. Means, Standard Deviations, and Intercorrelations of Four Performance Measures after First Session and after Last Session\*

	RB1	TO1	IC1	MC1	RB7	TO7	IC7	MC7
Mean:	76.25	72.0	67.333	73.0	58.25	110.333	64.417	90.667
Stand. dev.:	14.771	10.804	8.793	13.300	52.127	55.516	41.816	41.121
Correlations:								
RB1	1.0000	0.3121	0.4513	0.4053	0.5112	0.5389	0.5665	0.6210
TO1		1.0000	0.9300	0.9805	0.4174	0.1499	0.2603	0.3607
IC1			1.0000	0.9171	0.4817	0.2781	0.4117	0.4983
MC1				1.0000	0.4320	0.2254	0.3255	0.4238
RB7					1.0000	0.8971	0.8970	0.8875
TO7						1.0000	0.9331	0.9049
IC7							1.0000	0.9640
MC7								1.0000

\* A "1" following the performance abbreviation indicates that the score was measured after the first session. A "7" indicates that the score was measured after the last session.

comparison between the two paired organizations when we control for many extraneous factors that frequently affect the performance of such simulations. It is worth emphasizing here that the trials are comparable only in such a pairwise manner. In any given pair of games, the researcher would insert a "crisis" simultaneously into both organizations. Resources were dispensed or (more frequently) withdrawn at arbitrary times. Players were reassigned arbitrarily (through fake "affirmative action" dicta). We made every effort to minimize any differences in such resources or rule enforcements between organizations within an experimental pair. It was impossible, however, to control such differences from one administration of the experiment to the next.

Thus the appropriate analysis is a nested multivariate analysis of variance with four dependent variables, one blocking variable (experimental trials), and one treatment variable (the "optimal" versus the "natural" organizational design). We performed a MANOVA on these data, using a test of Pillai's trace as a test of significance of the independent variable on the set of final performance indicators. Pillai's trace was equal to 3.018, and the approximate  $F_{24,20} = 2.56$  ( $p < .018$ ). Thus the treatment variable (friendship link patterns) affected the set of performance indicators significantly.

We conducted the MANOVA because we expected that the four dependent variables would be intercorrelated, since their determinants shared common elements (see Appendix A). Indeed, as Table 2 shows, the four variables are related strongly in the last session of the simulation (generally they are

related less strongly after Session 1). The strength of these correlations provided an opportunity to perform a simpler, more straightforward analysis of the data. We combined the four dependent variables into one average performance score (Cronbach's  $\alpha = .89$  for the average scores calculated after session 1; Cronbach's  $\alpha = .98$  for the average after the last session). With a single dependent variable, the data lend themselves to a simple paired t-test. The results are shown in Table 3.

A graphic representation of these results appears in Figure 1. The graph shows the difference in average performance scores between the paired optimal and natural organizations. Points below zero represent more effective performance by the natural organization; those above zero represent more effective performance by the optimally designed organization. Scores were plotted at the completion of each simulation session.

In reviewing Table 3 and Figure 1, one can see that neither the natural nor the optimal organizations have a significant edge over their counterparts after the first round. That situation would be expected at the start because everyone is still learning the rules and no one has figured out yet what is required to make the organization succeed.

By the last round (indicated by a circle in Figure 1), however, each of the optimal groups outperformed its natural counterpart. The paired t-test indicates that those organizations designed with a high density of friendship links across subunits did significantly better than the organizations in which most friendships are within the subunits. These significance levels were attained de-

Table 3. Results of Organization Game Experiment

	First Session		Session #	Last Session	
	Natural	Optimal		Natural	Optimal
Trial 1	78	83	7	127	150
Trial 2	49.25	67	6	11	77.5
Trial 3	63	62	7	50	62
Trial 4	74.75	72.75	7	79.5	161.25
Trial 5	82.75	78.75	6	34	45
Trial 6	72.5	81.5	5	75	98
Significance Test:					
Paired t*		1.16		2.94	
df		5		5	
1-tailed p-level		NS		$p < .02$	

\* A paired t-test was used here because the organizations were matched in each trial on several important dimensions. These dimensions included size, type of participant (undergraduate, MBA), degree of enforcement and interpretation of ambiguous rules, number and length of game sessions, and, perhaps most important, the precise timing and character of the artificial "crises" that were introduced into the organizations.

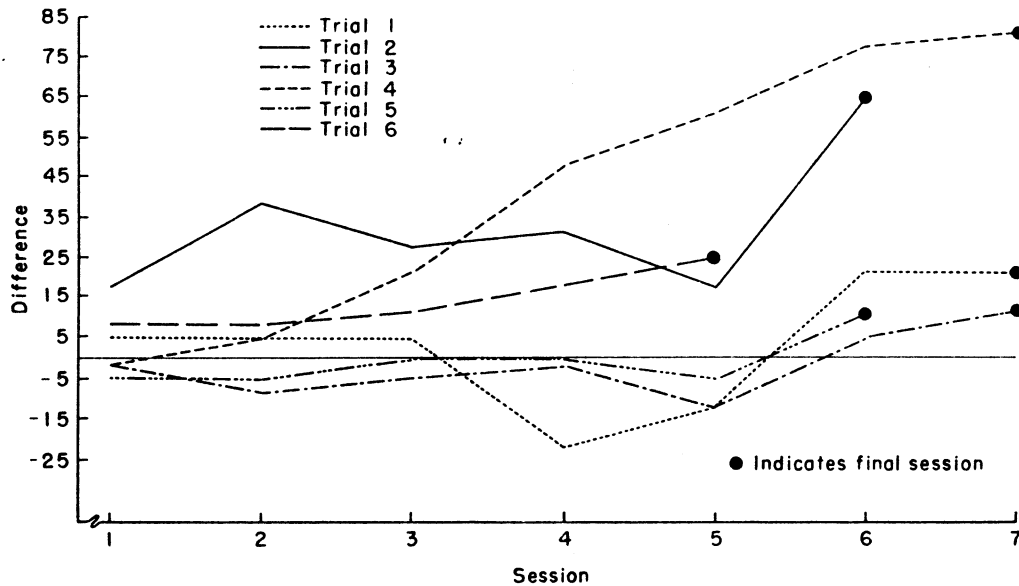


Figure 1. Difference between Optimal and Natural Performance Indicators for Each Session in Each Trial

spite the small number of observations (six trial pairs). In addition, an acute observer will note the frequent occurrence of inflection points at Session 5, when the secondary, external crisis was introduced into the organization. At this point in Trials 1, 2, 3, and 5, the optimal organizations begin to demonstrate substantially better performance than the natural groups.

#### COOPERATION AND CONFLICT PROCESSES

The results described in the preceding section are reasonably strong and convincing when we consider that a minimum number of experiments was conducted and that the focus was on only the first hypothesis in the theory. The size of the differences, on the whole, was substantial and relatively consistent. The conclusion one draws from these results is that the structure of friendship patterns in such situations was an important contributor to organizational success.

It is important to note, however, that the theory as described in the introduction to this paper has not been tested in full. This experiment is only a surrogate for organizational phenomena; the simulation lacks the history and the resultant culture that characterize most organizations. Such cultures could act to moderate the effects of friendship links (or the lack thereof). That history and culture

also might include greater centralized authority than participants create in the organizational simulation; the experiment uses a relatively young organization.

In addition, the performance indicators give little insight into the processes that produce cooperation, trust, and success or their opposites in the game. Even so, observing the participants' activity provides a means for interpreting the levels of internal cohesion and resource accumulation that develop. Observation of participants also produces support for the process implied by the assumptions in the model.

During the experimental trials, participants' patterns of activity were observed, and each participant kept a diary describing events and reactions to those events. Entries were made after each session, and the diaries were submitted to the instructor as part of the class assignment. Frequently, those in the optimal organizations were seen to cooperate with each other in the face of the dilemmas that they encountered. Divisions in the natural organizations, however, frequently directed participants' attention to protecting or enhancing the resources of their own division rather than those of the entire group.

Some examples will help to illustrate this difference in cooperation. At the close of the first session in Trial 1, the Red Division in (coincidentally) both organizations failed to turn in some necessary forms. The penalty for

failing to do so was reasonably severe for each organization, although those in the Red Division would bear the brunt of the penalty. In both cases the members of the Red Division felt disillusioned, embarrassed, and angry, but the responses of those in the other divisions differed markedly between the two organizations. In the natural organization, the people in Red were blamed for the oversight; they were labeled as incompetents who were going to ruin the organization and were isolated from the rest of the organization. Future attempts by those in Red to help the organization were met with suspicion.

In the optimal organization, a delegation of representatives from the other divisions (who were friends of those in Red) approached those in Red to ask what had happened. Red replied that they were simply unaware of the rule that had required the forms to be turned in. (The same lack of awareness was responsible for Red's mistake in the natural organization.) The group asked if there was anything it could do to help Red at this point. It was decided jointly to spread out the penalty in such a way as to minimize the impact on the organization as a whole, rather than to let Red suffer the penalty alone. By the middle of Session 2, those in Red were integrated into useful roles throughout the organization.

The fact that the optimal organization outperformed the natural one in this trial is particularly interesting because, as was discovered during the postgame debriefing, one person in the natural organization had had a copy of the solutions to production problems in the game. This person was part of the Yellow Division, which was responsible for producing solutions to puzzles (for which the organization received profits). The ability to solve these puzzles was one of the primary ways in which the organization made money and increased its various performance indicators, especially resource base and total output. Having these solutions put the organization at a tremendous advantage. The advantage was not sufficient, however, to overcome the disadvantage that the natural organization suffered because of its suboptimal informal design.

Trial 2, which ended after six rounds because of the bankruptcy of the natural organization, illustrates the process involved in cooperation and speaks to the strength of the assumptions of our model. The descrip-

tion focuses first on the action of the production units, which were solving word puzzles as their production activity, and second on the way in which these units interacted with the other units in their respective simulations.

Production in the optimal organization was not confined solely to efforts of the assigned production units. An integrative form of subcontracting developed in which the Red Division, job- and resource-poor, was given puzzles to solve on commission. Red borrowed funds from other units to supplement what little money they owned, and had the production units buy them puzzles. The return on solved puzzles was split among the production units and the Red Division. In the fourth round of this trial, several diaries show that staff units loaned funds to the production units to purchase raw materials. Units in the optimal game also began to pool resources for reinvestment in the firm as early as Round 2. They cooperated in an effort to deal with the unexpected absence of a unit head, which could have cost the entire group available resources and opportunities.

This cooperative effort contrasts sharply with events in the parallel natural organization. Two production units that must cooperate were merged through the actions of one of those units and then changed their name to Supercomtin. One member's diary for Session 3 says, "I really do think we are the most important (unit). We are really tight now. We have decided to stay together no matter what. It is also evident that the rest of the organization is against us."

The head of the super production unit was quite explicit about these views. In Session 3 a member of another unit came to ask whether the production group would contribute to reinvestment in the organization. The head of Supercomtin wrote in his diary:

They never invested any money in us to buy puzzles and they kept giving money to Routin [the other production unit] which was less successful than we were at production. We just felt that we were supposed to support ourselves.

This theme continues in the next session (Session 4):

Although we did well, there was a lot of inter-group tension. I think people were jealous of us and were p . . . off at our attitude. We felt we didn't need the rest of the organization and showed it in our relationship with the other group. Because of this, we had a meeting

between the leaders of the groups. I, however, chose not to attend.

During this trial, both groups were presented with a high-risk opportunity to expand their markets and to make a substantial improvement in performance indicators. Chance of success was only 50 percent, however, and failure meant a major decline in the indicators. In the optimal organization, the unit heads sent delegates to a meeting arranged by the communications unit and decided that they were doing well enough and should not take the risk. The natural organization proceeded in a dramatically different manner. The unit with information on the current indicator levels decided that for the "good of the organization" the market expansion should be attempted. The members of the unit drafted a statement which they read to other units, telling them that the group could afford to take the risk and would be all right even if the attempt failed. In order to persuade the other units, the communication group presented false information to the others regarding current indicator levels.

One diary describes this episode by saying, "Crunode [communication] was lying about some of the indicators in order to get the other units to contribute to the investment." Then she points out that there was "complete lack of trust and sympathy between Emrel [personnel], Crunode and Comtin [production] which I understand since Crunode has been totally dishonest with us all until now."

The dynamic described here points out the individual-unit-centered activity in the natural organization and the integrative intergroup activity in the optimal structure. One member of the natural organization provides a succinct summary for Sessions 1 and 2: "There was a lot of cooperation within the Blue division. However, when members of other divisions came into the room, there was deception and non-cooperation." Figure 1 shows dramatically the effects of those differences. Session 5 of Trial 2 shows the adverse effects of the efforts devoted to the decision on the high-risk option. The difference in Session 6 demonstrates the clear superiority of the optimal organization's treatment of this issue.

One additional example from Trial 4 illustrates the differing dynamics of the games. Several members of both organizations became idle permanently because they had no job or income for two consecutive

sessions. These members were sent back into the games as "government observers" in Round 4. In Round 5, they regained active status as "minorities" who had to be given positions of responsibility. In the optimal organization, the Board of Directors met and decided on a position for each "minority" member in the organization. The person currently occupying that position was given compensation including a vacation, a permanent salary, and a bonus. In the natural game, the "minority" member went from division to division asking for work (the group received a penalty if the person did not find a job). After a substantial effort, an arrangement by written contract was made with one unit. When the next round of play began, however, that unit said that the deal was a lie, made up only to avoid the penalty. Substantial conflict erupted immediately.

One of the "minority" members who moved from an ordinary player in one game to a "minority" in the other characterized the two situations in terms of his own enjoyment. "In Ingot [natural] it was fun screwing over the environment and other people. In Extol [optimal] it was fun making decisions in a corporate manner with results that reinforce your belief in yourself."

Differences between the organizations also are reflected in the personal assessment forms collected in Trials 1 and 3 (these forms were not collected for the other four trials). One question on these forms asked how well participants thought the organization was doing. The response options consisted of a three-point scale: 1 = the organization is not doing well; 2 = the organization is doing fairly well; and 3 = the organization is doing very well. After Round 1, the average responses in the natural organizations were 2.25 and 1.87 respectively for Trials 1 and 3. These averages were slightly better than in the optimal organizations, whose corresponding scores were 2.11 and 1.61 respectively. By the end of the last round, however, the self-evaluations were decidedly different. The naturals had dropped their average evaluations to 2.06 and 1.47 respectively in Trials 1 and 3. The optimals, in contrast, raised their evaluations to 2.71 and 2.44.

#### DISCUSSION

While descriptions of game events and diary entries tend to support the contentions

of the major proposition of the model, they also contribute to the viability of the set of assumptions underlying the model. In the model, assumptions such as conflict leading to commitment to the home unit (Assumption 4) were taken as axiomatic, and we did not undertake a test of such statements. The participants' diaries, however, give evidence that the players saw the work in ways that were consistent with Assumptions 3 through 7.

Resource scarcity and uncertainty about game rules led initially to conflict over proper strategy. Groups sought to ensure the security of their home units, and attended to attainment of unit goals in the initial sessions. The learning of roles clarified the need for distribution of resources, and units began to approach one another. Efforts at interunit cooperation resulted where friendship links extended across groups, but concentrations of within-group friendships produced cooperation only within single units. The outcome was differential performance on the overall levels of performance that required organizationwide cooperation.

Several particularly observant participants noted aspects of this effect in their diary entries:

[Trial 2, Session 5, optimal] We are all participating in investments and sinking money into buying puzzles. At the start of the game, this never happened. Every department was concerned with their (sic) own success and didn't discuss matters of an organizational nature. Now it seems like everyone is out for the good of the organization. I think we have established a trust based on competency and effectiveness.

[Trial 2, postgame, natural] Together with friends the members didn't need to trust those they didn't know because they already had a network of trust built in. They could communicate with and depend on each other so there was no need to reach out beyond their original circle of friends. Since people tend to choose friends who are similar to themselves, those in the same group thought alike and would go along with any ideas that came up—even if it should have been discussed more thoroughly and subjected to differing opinions. Each group thought only of how they (sic) could benefit themselves and their friends.

These two participants illustrate the importance of preexisting friendship ties, the formation of cohesive, within-group interests, and the difficulty of cooperating across units.

The latter example focuses on the difficulties created by strong within-group ties; the former exemplifies the benefits of ties between groups. The importance of external links is demonstrated by the superior speed with which the optimal groups raised the performance indicators and solved unexpected problems presented during the simulations (e.g., Figure 3, Trials 2, 3, and 5). The qualitative observations and diary records enhanced our faith in the validity of the model by illuminating the process that led to these results.

#### *Future Considerations*

We do not expect that this theory will be universally applicable. Not all organizations will benefit from friendships that cross division boundaries; such friendships may incur costs (cronyism, for example). Another issue is whether all organizations require the same amount of cooperation, even during a crisis. When the organization, such as a bank, is facing pooled interdependence, very little coordination is required across subunits to be efficient. That is, some crises may be restricted to single units or may require much less coordinated effort because of the technology employed by the organization or the limited scope of the crisis itself. In such cases the cooperation that results from friendship links between subunits may be less useful. In any event, finding the boundary conditions and the associated moderating variables will be an important part of the development of this model.

Let us ask a related question: is there a linear relationship between the E-I index in the organization and the cooperation between subunit pairs? Perhaps the cooperation reaches a maximum asymptotically with relatively few links between the pairs of subunits. Answers, even speculation, await further research.

#### *Issues of External Validity*

As with any laboratory experiment, questions arise as to how far the results can be generalized to "real-life" situations. We have tried to emulate an organization in chaos and crisis, but there are significant differences between these simulated organizations and typical business organizations. In our organizations, for example, no hierarchy of divi-

sions or centralized authorities were imposed on the players. Part of their task was to create their own hierarchy or centralization, if they chose to do so. It is possible that a centralized, hierarchic structure would respond to crises differently from organizations without such central authority. Another similar argument could be raised about the existence of formal communication links that cut across divisional boundaries. These links may not be based on friendships, but it could be argued that such formal channels might facilitate a cooperative effort in the face of a crisis.

We have no formal basis for discounting such objections. Indeed, organizations often have more centralized authority and more formal communication channels than those in our experiment. Yet, as mentioned earlier, the literature on crises indicates that these formal, routinized links often are abandoned during crises and may be ineffective. Informal, nonhierarchic ties become more prominent. Nonetheless, it would be interesting to test whether the density of friendship ties across work-unit boundaries has as great an effect on performance in highly centralized firms as in decentralized firms.

This simulation also has other limitations that prevent us from generalizing too quickly into the field. The performance indicators of necessity are objectively quantifiable—and consequently somewhat arbitrary. Although arbitrary indicators of performance often exist as well in the real world, they do not necessarily take the same form as in our simulation. Absences, for example, carry some cost to an organization, but to state that they deplete “total output” by precisely two points each may not reflect most organizations’ assessment of such costs. In fact, if the right people were absent, the organization might enjoy increased efficiency and output.

As arbitrary as these indicators are, they are also known to the players of the *Organization Game*. Our intent here was not to mimic exactly the performance and reward system of the “real” world. Rather, we created a complex system of performance indicators that the players would have to work to fathom, unravel, and deal with—just as they would in the real world. In our current design, however, we cannot attest whether the results reported here are sensitive to these arbitrary reward structures. Again, this is an area for future research.

## CONCLUSION

Organizations are cooperative systems by nature. We have suggested here that the friendships that exist in all organizations can either hinder or facilitate that cooperation in times of crisis, depending on whether those friendships cut across subunit boundaries. In particular we argue here that organizations, left to their natural progression, will develop dysfunctional structures that concentrate friendships within subunits. Effective friendship structures, then, must be designed consciously.

The theory would suggest that more attention be given to organizing informal relationships and nurturing their development across organizational subunits. Organizations that must deal with crises should encourage personal relationships outside their immediate work unit. The existence of a dense network of cross-unit ties may result in the resolution of complex situations before they escalate to the point where organization members define them as crises. That is, external ties may affect the magnitude and frequency of crises in the organization. In contrast to the view that impersonality is preferred in organizations and that personal relationships are dysfunctional (Merton 1957), we believe that personalized ties are a reserve resource which provides the potential for the coordination needed to meet rapidly changing circumstances.

The structure of the informal organization is revealed again as a critical issue for organizational design. Moreover, the results of the six trials testing the major proposition of the theory demonstrated that such careful designing pays off.

## APPENDIX A

### *Detail on the Calculation of the Performance Indicators*

The performance indicators are functions of actions taken by game participants. All four indicators are set initially at 100. The following *Organization Game* rules stipulate how each indicator is calculated after each session:

**Resource base.** RB is a function of natural decline ( $-10\%$  of RB in prior session), investments in organizational improvements ( $+20\%$  of the amount invested), production raw materials purchased ( $-1$  or  $-2$  per unit, depending on type), new job assignments ( $+1$  per assignee), absences ( $-2$  per absence), job quits and firings ( $-3$  per action), vacations ( $-1$  per vacation), temporary unemployment ( $-1$  per person), producing an accounting report ( $+2$  if produced,  $-3$  if not).



**Total output.** TO is a function of natural decline (-10% of TO in prior session), investment in organizational improvement programs (+10% of amount invested), and human resource development programs (+10% of amount invested), production (+3 or +4 depending on type), new job assignments (-1 each), absences (-2 each), firings and quits (-3 each), vacations (-1 each), temporary unemployment (-1 per person), production of management consulting report (+2 if produced, -3 if not).

**Internal cohesion.** IC is a function of natural decline (-10% of IC in prior session), investment in human resource development programs (+20% of amount invested), interunit cooperation in production (+2 per unit produced), new job assignments (-1 each), absences, firings, and quits (-3 each), vacations (-1 each), permanent unemployment (-3 per person), temporary unemployment (-1 per person), producing a report on organizational communication (+2 if produced, -3 if not).

**Member commitment.** MC is a function of natural decline (-10% of MC in prior session), investment in human resource development programs (+20% of amount invested), overall production (+2 per unit), absences (-2 each), firings and quits (-3 each), permanent unemployment (-5 each), temporary unemployment (-1 each), production of a management consulting report (+2 if produced, -3 if not).

These adjustments to the indicators are applied at the end of each session of the simulation in which they occur, except for certain investments that are delayed one round pending actual implementation of the appropriate program. Finally, players in certain positions are given a "salary," the size of which depends on how well the organization is doing (as defined by the above performance indicators). These funds can be used to invest in programs, buy raw materials, or pay for other items; such decisions affect the performance scores in succeeding rounds.

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