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PREFACE

This volume is the first in this series. In considering papers, I searched for works which are both creative and relevant to ongoing issues in the field. As is clear from the contents, I have tried to make sure that there would be a wide scope to the volume. The concerns of the papers clearly vary. The volume includes methodological pieces such as the paper by Richard Alba on Network Analysis, as well as theoretical pieces such as the paper by David Knoke and Christine Wright-Isak on Individual Motives and Organizational Incentive Systems. Some of the papers build upon and expand current substantive areas of concern in organizational theory. Included here are the paper by James Lincoln on Intra- and Inter-Organizational Networks, the paper by Allen Bluedorn on Theories of Turnover, and the paper by Richard Daft on Innovation and Change. Other papers introduce relatively unexplored areas, such as the Finney and Lesieur paper on Organizational Crime. Papers offering totally new perspectives for examining organizational processes, such as the paper by Judith Stewart dealing with Changing Structure and the Social Composition of Occupations In Organi-

zations, further expand the scope of this volume. Finally, a paper such as that by Janice Beyer on Power Dependencies and the Distribution of Influence is a piece of research which both suggests new measurements and different conceptualizations of previously examined processes such as power.

This series affords authors the opportunity to develop important theoretical and empirical concerns in more depth and detail than is possible in a journal article. This means that the papers, in general, enable authors to integrate their material in a broader context of organizational research than is often the case. This in-depth development and integration of ideas should help to advance the scientific analysis of organizations.

In working on this volume I have been assisted by an editorial advisory board consisting of Howard Aldrich of Cornell University; Janice Beyer, University of Buffalo and Stephen Mitchell, Cornell.

Samuel B. Bacharach
Series Editor

CONTENTS

INTRA- (AND INTER-) ORGANIZATIONAL NETWORKS

James R. Lincoln

ABSTRACT

This paper explores the utility of network concepts for the study of intra- and (to a lesser degree) interorganizational structures. Basic concepts in network analysis are reviewed and some implications for organizational study are noted. The relevance of network thinking to classical models of formal organization is discussed. Other applications of network analysis to problems of internal organization are considered in a treatment of the effects of organization size, vertical differentiation, and horizontal differentiation on such network properties of whole organizations as density and connectivity. Societal processes of bureaucratization and cross-cultural variations in organizational forms are recast in network analytic terms. The last topic in internal organization concerns career mobility flows in organizations as a structure of network ties. Then interorganizational networks are discussed as interpersonal networks which branch across and in the process define organizational boundaries. The concluding section calls for a new series of large sample comparative studies of organizations in which structural properties are reconceptualized in network terms.

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The characterization of social arrangements as networks has had wide appeal, if the volume of recent work making reference to network properties or processes is any indication. In organizational research, the network concept figures most prominently in studies of configurations of relations among whole organizations. Indeed, theoretical treatments and empirical investigations of inter- organizational networks have proliferated in the 1970's, making this a dominant contemporary mode of organizational inquiry (for recent reviews see: Aldrich, 1979 and Laumann, et al., 1978). Yet it would appear that interest in relational structures *within* organizational boundaries has declined over the same period. I will argue not only that this inattention to the network properties of individual organizations is itself unfortunate—for such study may yield rich insights into organizational structures and processes—but also that networks where organizations are the nodes cannot properly be understood without an appreciation for the patterns of linkage within them. Because of this imbalance in the distribution of scholarly attention between intra- and interorganizational networks, I focus mostly on the former topic in this essay. However, the discussion does extend at points to cover relational patterns that span organizational boundaries and thus the question of interorganizational ties is to some degree dealt with as well.

In the following sections, I address a range of topics in social network and organizational studies with the aim of showing that many key concerns of organizational sociologists may be united under the rubric of network analysis. The treatment, then, is eclectic and roams widely over what may at times seem disconnected issues. Yet this reflects my view that there are numerous fronts on which a network analytic approach to organizational study might profitably proceed. These should be identified even at the risk of failing to do any one topic justice in the rush to cover as much relevant terrain as a single review paper can reasonably accommodate.

I. BASIC CONCEPTS IN NETWORK ANALYSIS

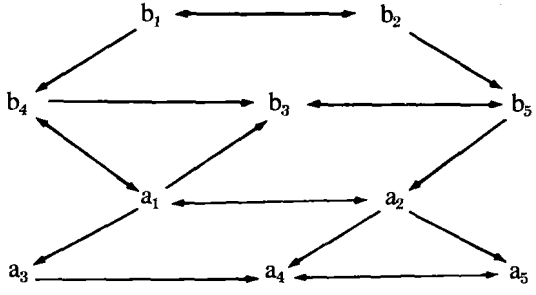
A. Background

Papers focused on the vocabulary or methodology of network analysis are considerably more common than new theoretical or substantively-oriented empirical inquiries. My review of basic concepts is therefore abbreviated, intended only to supply the uninitiated reader with sufficient background to follow the discussion. As compared with an array of disagreements on other issues, there appears to be considerable consensus as to what a social network is: a well-defined set of actors—individuals, groups, organizations, even communities and whole societies—which are linked to one another through a set of social relationships. While Mitchell (1969:2) adds the property that "...the characteristics of these linkages as a whole may be used to interpret the social behavior of the persons involved," this seems more a prescription for how the network analyst should proceed than a defining criterion as such.

Graph theory is commonly used to portray networks schematically (Barnes, 1972; Harary, et al., 1965; Mitchell, 1969:16). A network is cast as a set of points or "nodes" and the lines or "arcs" which connect them. An example (to be discussed in greater detail later) appears in Figure 1. Graph models have proven fruitful in two key respects. First, they permit a precise charting of the sequences of direct and indirect ties that relate pairs of actors in a single network. Secondly, in binary marix form (see Figure 1b), graph representations have lent themselves to a variety of manipulations which yield measures of connectivity,

Figure 1. Digraph and Matrix Representations of an Intra-/Interorganizational Network.

(1a)



(1b)

	a_1	a_2	a_3	a_4	a_5	b_1	b_2	b_3	b_4	b_5
a_1	0	1	1	0	0	0	0	1	1	0
a_2	1	0	0	1	1	0	0	0	0	0
a_3	0	0	0	1	0	0	0	0	0	0
a_4	0	0	0	0	1	0	0	0	0	0
a_5	0	0	0	1	0	0	0	0	0	0
b_1	0	0	0	0	0	0	1	0	1	0
b_2	0	0	0	0	0	1	0	0	0	1
b_3	0	0	0	0	0	0	0	0	0	1
b_4	1	0	0	0	0	0	0	1	0	0
b_5	0	1	0	0	0	0	0	1	0	0

distance, clustering and other structural and dyadic properties. However, graph theory has some critical limitations as well. In general, it forces a conceptualization of ties as binary (present or absent) and as based on single contents. Thus, the "strength" and "multiplexity" of ties—two relational properties of considerable theoretical significance—are not easily captured by graph models (Harary, 1959), although some recent work on these problems portends their future resolution (Doreian, 1974; Feinberg and Wasserman, 1979). Furthermore, there has been considerable recent interest in inferring role structures from network data—by first determining "blocks" of structurally equivalent actors and then mapping the interrelations of such positions through different kinds of ties and across multiple sequences of actors. As White, et al. (1976) observe, this kind of inquiry demands techniques not subsumed by graph theory.

Three levels of analysis are appropriate for understanding social networks: network, dyad and node. The distinction between properties of dyadic ties, evaluated separately, and global properties of whole networks is particularly important. While networks are built from the configurations of ties between pairs of nodes, most analysts view the whole, in this case, as irreducible to the sum of its parts. Global network patterns, that is, can be only partially understood as aggregations of dyadic ties and the pair-level processes which produced them. Indeed, one often finds network researchers speaking disparagingly of dyadic investigations which contrast with a truly network analytic approach that is focused on system-level phenomena (Aldrich, 1979:291; Burt, 1978; Wellman, 1980:12). Given the infancy of substantive network research on either local or global processes, such purism seems premature. Yet the dyad-/network dichotomy is a meaningful one, and theoretical propositions can usefully be cast at both levels. Finally, individual nodes can be characterized in terms of their positions in the network. Position, in this sense, is taken to mean the way a particular node is embedded in a pattern of ties.

B. Properties of Dyadic Ties, Whole Networks and Individual Nodes

In this section, I review some network properties at each level of analysis and briefly allude to their theoretical significance for organizational study. This is not a comprehensive accounting; more exhaustive discussions of relational properties are readily available elsewhere (e.g., Mitchell, 1969). Moreover, Tichy, et al. (1979) likewise provide an inventory of network properties with an eye to implications for organizational study.

1. *Dyadic Properties*

a. Symmetry. Whether a relation is symmetric (a kinship link) or asymmetric (a power relation) is an important distinction, both substantively and methodologically (Barnes, 1972; Wellman, 1980). Networks of asymmetric relations are

considerably more complex than networks of symmetric ties, first, because they contain twice the number of links; secondly, because the necessity to order nodes within a pair affects one's conceptualization of how attributes of the pair (or of the network) might shape the nature of its members' relation (Lincoln and Miller, 1980; Mitchell, 1969:24).

b. Reciprocity. Reciprocity has no meaning for symmetric ties, but for asymmetric relations it is often important to determine whether a tie directed by one member of a pair toward the other is likely to be matched (either instantaneously or after a time lag) by the reverse exchange (Lincoln and Miller, 1980; Tuma and Hallinan, 1979; Holland and Leinhardt, 1980). In social exchange processes, of course, reciprocity is often assumed to be a governing norm. Ties need not be reciprocated in kind, however. Power relationships, for example, emerge as persons exchange compliance and deference for resources controlled by others (Blau, 1964). In organizational hierarchies, superordinate staff are believed to exchange control and direction for their subordinates' feedback information on workflow operations (March and Simon, 1959).

c. Multiplexity. This is a particularly important relational property, which figures significantly in theories of bureaucracy and about which much will be said in this essay (Barnes, 1972; Mitchell, 1969:22). It refers, as noted above, to whether a tie has single or multiple contents. Of long-standing interest to organizational analysts, for example, is whether ties of organizational comembership, work-role interlock, and official super-subordination overlap with those of kinship, friendship and property relations (Bendix, 1971).

d. Strength. The strength of ties is an inclusive property which reflects the degree to which a link is stable, binding and demanding of an actor's time and resources (Granovetter, 1973; Liu and Duff, 1972). It would encompass Mitchell's (1969) properties of frequency, intensity and duration. The strong-/weak distinction has a number of important theoretical implications for organizational research. Much attention, for example, has been directed to its significance for information transfer processes. Strong tie networks are believed to circulate old and redundant information, whereas weak ties to peripheral nodes are more likely to serve a boundary-spanning function, permitting the exchange of information and resources between different networks. Mitchell (1969) also notes that weak ties require regular activation in order to be maintained at all, whereas strong ties such as kinship may be preserved indefinitely without being mobilized for some specific end. Assuming that formal networks in organizations are intendedly instrumental, this observation speaks to some key issues in organizational studies.

e. Direct versus Indirect. It might be argued that indirect ties, being sequences of direct ties, are better thought of as referring to the locations of actors relative to one another in a network and not as a property of a dyadic link per se (which if not "direct" is absent). Or one might argue that whether a relation is direct or indirect is simply another dimension of "strength," with similar impli-

cations for information and resource flows, levels of commitment and investment, etc. (Granovetter, 1973:1370). Yet the direct/indirect distinction seems to warrant separate treatment for two reasons. First, the concept of an indirect tie blurs the distinction between "dyadic" and "network" properties. The pattern of mediated linkages reflects the embeddedness of dyads in the network as a whole. Secondly, networks within organizations are very much determined by the interwoven chains of indirect relations through which information, resources and control move in enabling the organization to act with some degree of unity. Because of the formal and prescribed character of indirect connections in organizations, there is little reason to suppose that such ties are transitive, even though transitivity does characterize networks of personal sentiment relations (Davis and Leinhardt, 1970). Indeed, classical models of formal organizations were often premised on the assumption that an indirect tie (e.g., "through channels") would *preclude* rather than precipitate a direct link between vertically or horizontally distant positions (Urwick, 1943).

f. Structural Equivalence. A dyadic property to which attention has only recently been directed is structural equivalence: the extent to which two actors' patterns of relations are identical (under a strong criterion) or at least similar (under a weak one) (Burt, 1976; Lorrain and White, 1971). Structural equivalence taps a sense in which a pair of nodes is similarly placed in the network which is quite different from that implied by the dyad being closely linked. Through transitivity and other processes, actors with the same ties to others may, of course, become connected, but this is a causal, not a logical, association (Burt, 1978). Identical sets of ties are possible even when the dyad in question is not directly linked (although such equivalence does imply indirect linkage).

Notions of structural equivalence have played central roles in recent efforts to operationalize the sociological concepts of position and role in purely relational (versus cultural) terms (Boorman and White, 1976; White, et al., 1976). A position may be understood as a "block" or cluster of actors with structurally equivalent relations to others, while their role is captured in the form and content of those relations. As organizations are hierarchically and functionally differentiated configurations of positions which are linked through complementary role relationships, these developments hold considerable promise for network studies of organizational structure.

2. *Global Network Properties*

a. Density. The ratio of actual ties to potential ties. The density of ties in a network is a key structural property which has absorbed much attention of both methodologically and substantively-oriented scholars (Mitchell, 1969; Granovetter, 1976). A matter to which some treatment will later be given is the extent to which internal network density depends on organization size and how density, in turn, conditions the quality of dyadic relations and the level of system integration.

b. Connectivity. The degree to which members of the network are linked to

one another through direct or indirect ties. A fully connected network is one in which every actor can "reach" every other actor through some sequence of ties (Doreian, 1974; Harary, et al., 1965). Note that a maximally dense network (no. of actual ties = no. of potential ties) is fully connected but full connectivity is also compatible with low density. The minimum possible frequency of ties in a connected network is n-1, where n = number of nodes. This circumstance would obtain where all members are joined through common links to a single coordinator but no other links were present. Attempts to model optimal communications structures in organizations have focused on the possibility of maintaining connectivity while reducing complexity by limiting direct ties to a key liason role (Bavelas, 1951).

c. Clustering. Ties in networks may be distributed homogeneously (where every node is linked to every other), randomly (where density is less than 1.0 but no pattern is discernible), or they may be clustered (where some sets of nodes are closely and densely joined but the links between such sets are sparse and weak). Clustering is the basis for inferences concerning cliques, transitivity and other much studied properties of small-group networks (Davis, 1970). It is of special interest to organizational analysts, since patterns of dense subsets connected by weak links are characteristic both of intra- and interorganizational structure. Patterns of clustering, especially where the ties have a noninstrumental content, furthermore, are often believed to affect organizational macro-integration and goal attainment (Roethlisberger and Dickson, 1939).

d. Hierarchy. Also of key importance for organizational studies is the tendency for ties to be sorted into patterns connoting status hierarchies (Davis, 1970). Structures where lower status members direct unreciprocated ties to high status members are common in network data (Guetzkow, 1965; Lincoln and Miller, 1979), although most such research pertains to informal, nonprescribed relations. Organizations typically mandate ties in accordance with an overall design, so that some actors are "central" nodes even though their formal rank is low. But organizations which force ties through low status personnel often inadvertently create latent power/status structures which sometimes challenge the formal hierarchy of authority and rank. Excellent illustrations may be found in Blau (1955), Mechanic (1962), and Crozier (1964).

3. *Properties of Nodes*

a. Centrality. Centrality is the only individual-level network property considered here, although several distinct dimensions to it may be discerned (see Lin, 1976: Ch. 17). Perhaps the most widely accepted meaning is the extent to which a single node is the object of dense, short chains originating from others. Harary, et al. (1965:188) measure this as follows: $\Sigma\Sigma_{ij}$ Pij/Σ_{i} Pij; where Pij is the distance from node i to node j. The numerator in this equation is the sum of the distances (where distance is the shortest chain of links from i to j) in the graph while the denominator is the sum of distances to j. Alternatively, a common

measure of centrality which ignores indirect links is sociometric status: the number of direct ties to j. In most networks, the two should be correlated, although the correlation need not be high.

Note that very different substantive implications are conveyed if centrality is determined in terms of ties or paths leading *out* from j. In this case, one considers the rate at which j emits ties to others or j's ability to reach others through intermediaries. No implication is conveyed concerning j's capacity to "attract" ties from others. Yet both interpretations of centrality ("in" and "out") tap the extent to which relational chains are focused on a given individual, and, of course, where ties are symmetric there is no basis for determining whether a node is source or recipient of a tie. Also consider that "direction" may simply be an artifact of how the tie is defined. A node's centrality "out" in terms of superordination relations equals that same node's centrality "in" when the relation is subordination.

II. MODELS OF NETWORK FORM IN ORGANIZATIONS

A. Formal Structure

The image of formal structure which a table of organization conveys highlights two features: (a) the configuration of horizontally and vertically differentiated positions (offices, departments); and (b) the pattern of links which interrelate these positions in a network. Formal structure in this sense is best a highly idealized image of organizational reality. At worst, it is pure ideology, bearing little direct relation to internal organizational networks (Meyer and Rowan, 1977). Yet organizational researchers have been content to devote considerable time and effort to the study of purely formal structures. Indeed, much of the empirical comparative work on organizations in the last twenty years has been of this nature (Blau and Schoenherr, 1971; Pugh, et al., 1968). But even granting that an investigation of official arrangements is of some scientific utility, one is struck by how little attention has been given to (b) the network dimension of formal structure. Despite a heavy emphasis on network imagery in organization charts, researchers have operationally defined organizational properties almost exclusively in "distributional" terms. By the distributional form of an organization I mean the configuration of positions and the distribution of persons among them. How these positions are tied to one another to form a corporate unit has not seemed worthy of research scrutiny.

Nonetheless, there is a complex interplay between the distributional traits of organizations and their internal network structures. The principles of organization devised by the classical management theorists were apparently grounded in (not always well conceived) considerations of the relational complexities which inhere in large-scale formal systems. Consider three such familiar principles:

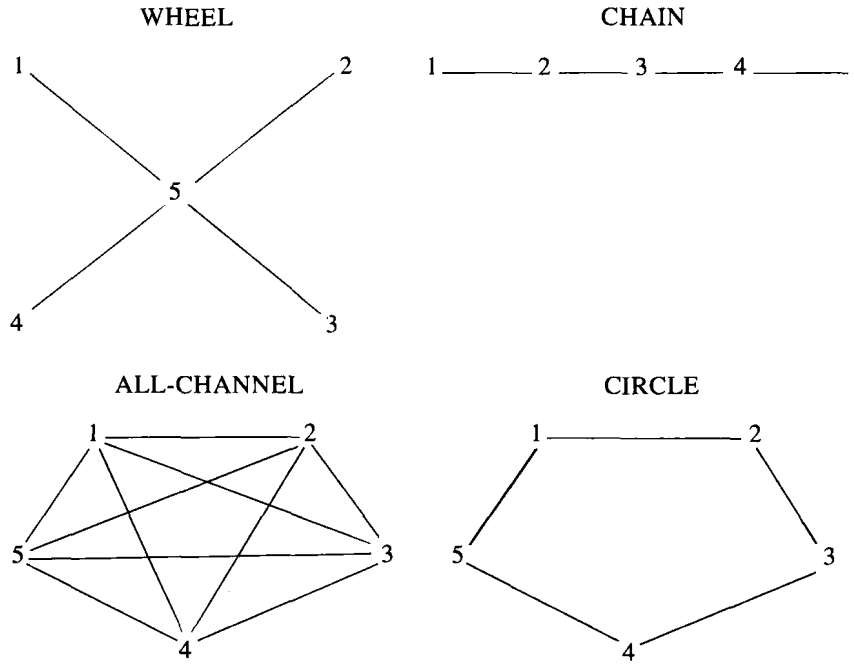
span of control, unity of command, and the "scalar" principle (Massie, 1965). The classical prescription that spans of control should not exceed five or six subordinates was largely inspired by Graicunas's (1937) observation that the number of intersubordinate links is, with the exception of very small groups, considerably greater than the number of subordinates. It was Graicunas's view that supervisors manage not merely their subordinates' individual actions but the relations among them as well.

Similarly, the unity of command principle—that each subordinate should be directly responsible to no more than one superior—rested on a motivation to control the form and direction of ties in organizations. If two superiors shared the same control relation to a particular subordinate, contradictory demands might be conveyed and coordination problems compounded. Finally, the scalar principle—that authority should flow in an unbroken line from the top executive to the lowest subordinate—suggests an awareness of the importance of connectivity in instrumental networks. Gaps or "holes" in the network reduce managers' ability to mobilize it for organizational purposes.

Other "principles" set down by the early management theorists had less to do with network phenomena than with dividing work up in organizationally efficient ways. But the invocation of the three principles discussed above is sufficient to produce a model of formal structure which has won broad acceptance. This is the familiar inverted "tree" structure, where authority relationships are portrayed as branching downward symmetrically in unbroken sequences of ties to encompass an increasing number of members at each supervisory level (Boorman, 1977; Meyer, 1971). Other models of internal network structure have been proposed on the basis of somewhat different principles. In a particularly noteworthy attempt, Friedell (1967) suggested that a semilattice structure, rather than the conventional tree, may be the preferred mathematical analogue. The key difference in assumptions between the two is that the semilattice violates the unity of command principle. It permits subordinates to be tied simultaneously to multiple superiors. This, however, is a problematic assumption only if control relations are taken to be the critical connecting ties that form the network. Friedell argued that if coordinative, rather than directive, vertical role relations are assumed, links from two or more superiors to a single subordinate do not necessarily create communications conflict in the organization.

Another approach to modeling network structure in organizations has attracted considerable attention and has stimulated a certain amount of research besides (Bavelas, 1951; Guetzkow and Simon, 1955; Rogers and Agarwala-Rogers, 1976:120). Figure 2 illustrates four communication nets which might characterize social groups: the all-channel network, the circle, the wheel and the chain. In the all-channel net, all nodes are linked directly to all others. This arrangement maximizes network density and communications complexity. The circle and the chain are considerably simpler networks: each node is directly tied to no more than two others, although the number of links (for the same number of nodes) is

Figure 2. Types of Communication Networks



greater in the case of the circle. In the wheel, however, relational simplicity and communications efficiency are at a maximum relative to other forms. With five nodes, only four ties are present, as in the chain. But the wheel is much more closely joined than the chain. Each node can reach every other in two steps or less, while in the chain nodes 1 and 5 are joined by a path of four steps.

Many writers have seen in these patterns a persuasive rationale for hierarchy in organizations (Caplow, 1964; Williamson, 1970). By creating a central coordinator position and forcing subordinate links through it, the organization achieves a considerable reduction in the complexity of its communications network, while concentrating control in the hands of administrative elites. Moreover, a series of experimental studies have concluded that centralized networks such as the wheel are, in fact, more efficient in performing certain kinds of group tasks than other network models which tolerate greater relational density (see Katz and Kahn, 1978, for a recent review). Yet Katz and Kahn (1978:438) note that such efficiency gains may not be realized when the network is embedded in a real organization. They cite research by Cohen, et al. (1969) which indicated that members of work groups who were constrained from free communication with their peers tended to direct their attention outside the group, forging lateral ties to other organizational members.