DOCUMENT RESUME

ED 099 943 CS 500 938

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TITLE Analyzing Human Communication Networks in Organizations: Applications to Management Problems.
PUB DATE Mar 73
NOTE 24p.; Paper presented at the Annual Meeting of the International Communication Association (Montreal, Quebec, April 1973)

EDRS PRICE MF-$0.75 HC-$1.50 PLUS POSTAGE
DESCRIPTORS Communication (Thought Transfer); *Coordinators; *Information Networks; Information Theory; *Intercommunication; *Management Information Systems; Organizational Change; Organizational Climate; *Organizational Communication; Organizations (Groups)

ABSTRACT

Investigating the networks of communication in organizations leads to an understanding of efficient and inefficient information dissemination as practiced in large systems. Most important in organizational communication is the role of the "liaison person"--the coordinator of intercommunication. When functioning efficiently, coordinators maintain information interchange throughout management communication systems. Research shows that groups formed to be creative and innovative are more successful if they are not highly centralized and dominated. Therefore, by examining the degree of centralization in similar innovative groups and organizations, an assessment of their probable success can be made. Three sources of information are needed to resolve questions on the health or adequacy of a particular communication system: expert opinion, normative data from a large sample of organizations, and accumulated research findings from studies conducted in actual organizational settings. (TS)

Analyzing Human Communication Networks in Organizations:

Applications to Management Problems

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March, 1973

(Paper presented to 1973 International Communication Association--
Organizational Division meetings)

When we talk to managers about some of the communication problems or difficulties they encounter, there are several "themes" that frequently re-occur. The theme that this paper addresses is often described as follows:

> "You know...we've got real problems with our lines of communication. I send out information, but I often don't know where it goes, or who it gets to, or what the people below me do, once they get it."

Or:

> "George, you've been appointed as a liaison between those three work groups for the past six months. Now I find out that you haven't been meeting with them like you should...you haven't been relaying messages to them on a regular basis...and you don't really know what's going on in those groups. You're supposed to coordinate, George, and it sure looks to me like you're falling down on the job."

Or even:

> "We've invested quite a bit of time and money in reorganizing our operations. The new organization chart shows quite clearly how people and groups are supposed to relate to one another. To make sure that everybody follows through on the new organization, I'm sending down the word: no one is to talk to anyone in another area or division about the work if it isn't strictly spelled out by the new organization chart. Everyone understand that?"

From our point of view, these incidents all refer to the general issue of the networks or patterns of communication that exist in organizations. These terms will be described more completely later in this paper, but for the moment think of the human nervous system as an analogy of the information or communication networks in an organization. The nervous system of a human carries information between parts of the body and makes possible the coordination of the parts; in an organization, the networks perform

similar functions. We also want to emphasize that organizational networks are not based solely on communication "hardware," such as telephones, video equipment, or other devices; instead they include both direct, face-to-face contacts as well as those that take place through various hardware devices.

There are three objectives for this paper. The first is to describe the main terms and features of network analysis in large organizations, including a very brief summary of the research and theory that underlies the present level of capability. Second, we will review and summarize the findings about one key communication role in the network--the "liaison," i.e., the person who serves to link or coordinate information flow between two or more groups. And finally, we will turn to the broader question of the kinds of applications that can now be made to organizational communication problems by the new network analysis techniques.

What is a Communication Network?

Organizations may be viewed as a set of roles which are linked or related to each other by channels of communication (both face-to-face and mediated). Through communication--through the exchange of messages over time--the linkages between organizational members are established and maintained. If we observe the communication contacts that occur in an organization, we will find that certain subsets of people engage in communication contacts on a relatively predictable, repetitive basis. These subsets are "cliques" or "clusters" or "groups" of organizational members who communicate more often with one another than with persons elsewhere in the organization.

In addition to noting groups of members engaged in frequent communication, however, we will also find that certain individuals have contacts

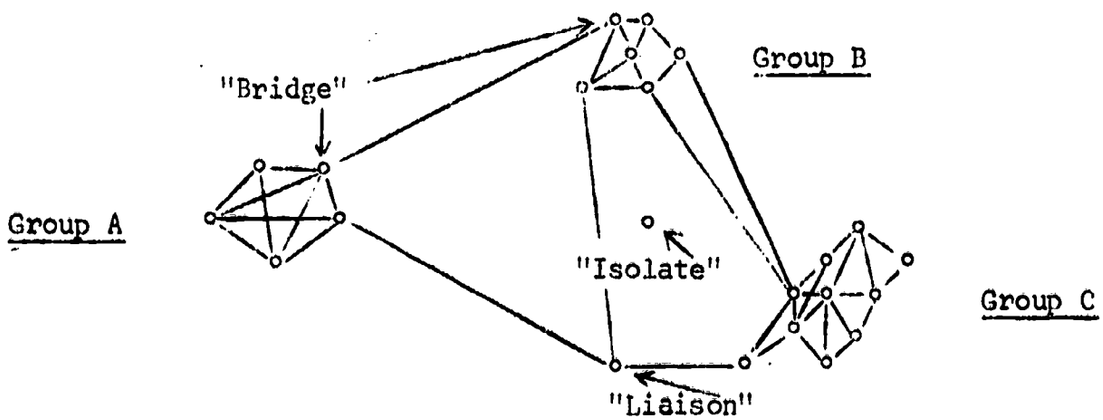
that link or extend between groups. These individuals make possible the movement of information from group to group. Finally, we will probably note certain individuals who are relatively isolated from the groups and from those individuals that link or join groups together.

Therefore, by studying the patterns of contact exhibited by members of an organization, we can identify groups of individuals who communicate frequently with one another, the linkers that allow information to move between groups, and the isolates that do not participate in the network defined by the groups and their linkers.

Thus the primary goal of network analysis is to determine the particular pathways through which information moves in a given organizational setting. One of the major advantages of this technique is its flexibility--networks can be determined on various message content dimensions, at varying levels of frequency of contact, for varying sizes of work units in the overall organization, etc., depending on the purpose of the analysis. In Figure 1, we show an example of a small network.

Figure 1

Example of a Communication Network



The figure above is a visual example of a communication network. The three clusters of dots connected by lines represent groups, and the individuals who are represented by these dots are group members. They share a majority of their communication contacts with each other. Groups may be connected by two basic kinds of linkages--bridges, who are members of a specific group, but who also communicate with a member of another group, and liaisons, who do not have a majority of their contacts with a single group but who serve to link two or more groups.* Since these individuals have a high degree of control over the flow of information in an organization, their role is relatively more crucial to the effective functioning of the organization than the other participants in the network. Non-participants in the network--isolates--are persons who communicate with no one at some specified frequency level.

We should point out here that the communication network is not necessarily the same as the authority network, the status network or other kinds of networks that exist in organizations. The communication network is built from linkages or relations whose primary focus is message exchange or information movement. While network analysis techniques might be used to examine these other kinds of networks, this is not our concern. It is important to expand here on the point made above about the flexibility of communication network techniques.

Communication networks can be determined on a number of different bases. One might plot a communication network at various frequency-of-contact levels. For example, networks might be defined for all those

* These definitions are taken from Jacobson and Seashore (1951), Weiss and Jacobson (1955), and were modified somewhat during the development of the current techniques (see Richards, Farace, and Danowski, 1973).

members of a system who communicate on a weekly basis, a daily basis, or perhaps on the basis of several times a day or more,etc. All of these different networks can be determined for the communication contacts of the same set of people.

One may also define communication networks on the basis of any kind of communication content. A network can be determined for all communication which occurs in an organization without regard to the substance of the communication messages. It is often more useful, however, to generate different kinds of message content categories and study these different networks in the same organization. For example, one might examine the network for communication which is deemed essential to organizational functioning--the "formally proscribed" communication network; or, one might examine the informal communication network--the "grapevine"--of the organization.

In three previous studies, the authors have employed such category systems for communication content as: production communication--the exchange of message relating to "getting the job done in the organization", maintenance communication--the exchange of messages which are "people-oriented", involving the handling of personnel problems, maintaining the self-identities and self-esteem of organizational members, maintaining the group identities or group cohesiveness of work group member, etc., and innovation communication--messages involving new alternatives for production and maintenance activities, the generation of new ideas from within the organization, the search for new ideas in the organizational environment,

and the diffusion of new ideas or innovations through the organizational system.

We have also used other content categories that subdivided these larger ones. For example, in a study now underway, the categories deal chiefly with work related matters--(a) daily work flow, (b) daily work flow problems, (c) errors and deadlines, and (d) error trends and missed deadlines. For each topic, the expectation is that a somewhat different network will be activated.

The power of this ability to define communication networks on whatever content category managers and the researchers find desirable is that the organization can be provided with extensive knowledge about the nature of information flow throughout the entire system for any particular kind of communication content. These categories can be tailor-made to the particular relevant circumstances in the organizational setting.

A third way in which networks can be studied (in addition to varying frequency or content dimensions) is mode of communication. Many organizations have "distribution lists" for memos (often differing by the content of the memo), policies for using telephonic equipment, formal and informal rules for calling meetings, etc. Thus under this type of network study the purpose is to define networks in terms of various communication modes available to the organizational members.

The belief that knowledge of communication networks in large organizations has important implications for management is not new; in fact, it has been prevalent for many years. Practical attempts to analyze networks date

back over 20 years, to the pioneering work of Jacobson and Seashore (1951). They analyzed the communication network in a federal agency, and gave particular attention to the liaison role.

A genuinely robust ability to deal with large-scale human communication networks--from both practical and theoretic perspectives--has not existed until very recently, however. Two major problem areas account for this. First, significant analytic problems limited the size and complexity of networks that could be studied. And while this problem could be solved only through use of the computer, it was not a matter of programming complex mathematical equations (which is relatively easy to do), but rather one of programming very complex logical sequences (which is significantly more difficult to do).

The second major problem area was conceptual, rather than analytic. The best single source of measures for describing communication networks is the studies done in laboratory settings. However, measuring the same kinds of properties in the field, when actual ongoing organizations are being examined, is no simple task. So new ways of measuring the same properties had to be developed. In addition, other network properties for which there were no existing measures had to be devised. And finally, sufficient data had to be gathered to test the validity and usefulness of the new techniques and measures in actual organizational settings, before reporting them to others.

A longer and more complete review of the research traditions and major findings underlying the current level of development of network analysis

is found in Farace and Monge (1973). Briefly, that review describes the laboratory social psychological research on communication networks, and the field research done by sociologists as well. Three previous techniques to analyze large scale networks are summarized--the use of graph theoretic concepts and sociograms, matrix manipulation and multiplication, and multi-dimensional scaling. The major strengths and weaknesses of each of these techniques is presented, as well as a discussion of the analytic and conceptual problems remaining to be overcome.

In recent years, however, significant advances have been made in resolving these problems, so that now, large-scale human communication networks can be analyzed. Capabilities presently exist to determine networks on a wide variety of bases (e.g., by varying frequency, content, modality and other characteristics) for organizations of up to 5,000 individuals and up to 50,000 links (see Richards, 1971; Richards, Farace and Danowski, 1973). Techniques for data gathering, results of studies to validate the network analytic procedures, and applications of the network measures to other organizational phenomena are also discussed in Farace and Monge (1973).

Basically, the results of a network analysis provide a "map" of information flow in an organization. The map shows the groups (and their specific membership), the links between groups, and the isolates (those who do not participate in the network). Various properties of the groups, the linkers, portions of the network, or the entire network, can be determined. For the person interested in theory-building, these results are an intermediate step, since typically the theorist is interested in (a) relationships among the network properties, (b) relationships between the properties and

other variables outside the network, or in (c) network changes over time. The practitioner will be primarily interested in the descriptive use of the information from the network (which is discussed in detail in Part III of this paper). However, it should be clear to both theorists and practitioners that important advances in the power and utility of the conclusions which can be drawn from the theoretic analyses are also highly relevant to the practitioner. To paraphrase Kurt Lewin, "the better the theory, the more practical its use."

In the following section, we turn to one of the more important network roles, the "liaison."

The Liaison Communication Role.

Managers of organizations have realized, for quite a long period of time, the importance of a component which serves to coordinate the activities of some larger set of components in the system. Some of the earliest formal organizations in history--military and religious organizations--have employed liaisons in their formal structure to coordinate the operation of various units.

The term liaison denotes a connector, a linker, a coordinator. Within the social sciences there have been a number of terms which have some degree of overlap with the concept of the liaison communication role. Some examples are: Likert's "linking pin" notion, which specifies that organizational groups ought to have overlapping membership; Walton's notion of "magnetic centers" in organizations, who draw people to them for information and

advice; Katz and Lazarsfeld's notion of "opinion leaders," who serve as interfaces between the mass media and groups of people, and provide interpretation and advice concerning mass media information; and Merton's "cosmopolite," designating someone who links the local village to the more advanced urban/ technological world on the outside. Common to all these concepts is an underlying notion of a role in some type of social structure which is important in relating in various ways the components or members of the social system.

As we noted earlier, in communication network analysis the concept of liaison refers to the component or role position in the network which does not share a majority of communication contacts with the members of a single group, but which links two or more groups together. The concept was developed in this context by Jacobson and Seashore (1951) when they found in their investigation of the communication patterns in the Office of Naval Research that:

> ...some individuals appear to function as "liaison" persons between groups, and characteristically have many, frequent, reciprocated, and important contacts which cut across the contact group structure.

This early work was instrumental in explicating the liaison communication role with respect to the nature of the communication contacts of organizational members. The way was now open for the examination of whether these individuals are distinguishable from other organizational members on a variety of dimensions. What relationships exist between the nature of their communication contacts and other variables? Are these individuals different from non-liaisons with respect to other communication variables...their

control of information flow...their influence in the organization...their personal characteristics? How do liaisons perceive themselves on these kinds of dimensions? How do non-liaisons perceive them?

These questions went unanswered until the late 1960's. Nearly two decades passed after Jacobson and Seashore's work before further exploration of the liaison communication role was made. Schwartz (1968) sought additional answers to these questions. He conducted a network analysis in a university College containing 142 members. The communication content upon which the network was defined not was differentiated into sub-categories--all communication messages were treated the same. Then, MacDonald (1970) defined three different networks in the headquarters of a large federal bureaucracy located in the Pentagon with 185 members. He utilized content categories of production, maintenance, and innovation, which we discussed earlier. Finally, Amend (1971) analyzed the communication network in a research dissemination organization composed of 50 members based on communication about technical matters, which in this particular organization served a production function.

In discussing the results of these studies, we have selected findings which appear to be generalizable across specific organizational settings. It should be cautioned that these findings should not be taken as widely-supported knowledge claims, but are tentative generalizations because of a limited empirical base.

We will discuss the characteristcs of liaisons in terms of (a) their actual, objective differences from non-liaisons, (b) differences in how they perceive themselves and the organization, and (c) how non-liaisons perceive

liaisons.

Actual.

1) Liaisons have higher agreement (between themselves and others they talk with) about who their contacts are with than do non-liaisons.

2) Liaisons are more likely than others in the organization to serve as first sources of information.

3) Liaisons have higher formal status in the organization than do non-liaisons.

4) Liaisons have been organizational members for longer periods of time than have non-liaisons.

5) The levels of formal education, and ages of liaisons are similar to those of non-liaisons.

Liaison perception of themselves.

1) Liaisons perceive themselves to have greater numbers of communication contacts in the organization.

2) Liaisons perceive themselves to have greater amounts of information with respect to the content dimensions upon which their role is defined.

3) Liaisons perceive the communication system as more "open"-- information is seen as more timely, more believable, more useful, etc.

4) Liaisons perceive themselves to have greater influence in the organization.

Other's perceptions of liaisons.

1) Liaisons are perceived by others to have greater numbers of communication contacts in the organization.

2) Liaisons' communication contacts are seen as having a wider range throughout the organizational structure.

3) Liaisons are perceived as having more information on the content dimensions on which the network is defined.

4) Liaisons are perceived as having more control over the flow of information in the organization.

5) Liaisons are perceived to have more influence over the "power structure" of the organization.

6) Liaisons are perceived to be more competent at their organizational activities.

In conclusion, there appear to be major differences between liaisons and non-liaisons on a number of dimensions--both in terms of their actual communication behaviors, how they perceive themselves and the organization, and how others perceive them. The liaison communication role appears to be valid and useful. As a concluding note, using the four studies as our data base, it appears that 10-20% of the members of organizations like these are liaisons.

The Utility of Network Analysis For Organizations.

The remainder of this paper will be devoted to a discussion of some feasible and important applications of network analysis to potential management problems. Probably the most basic advantage of network analysis for organizations is its ability to describe the ongoing, day-to-day communication patterns among all organizational members. These patterns correspond to the paths along which information flows, given the introduction of messages into the system. This "nervous system" of the organization can be "mapped-out" and summary descriptions of a variety of characteristics of the network can be calculated. Furthermore, these results can be evaluated in several different ways; our concluding remarks will address this issue.

The description of actual communication patterns enables a comparison

of ongoing patterns with the formal "blueprint" or organizational chart--or to what management feels is necessary or desirable with respect to who talks to whom about what.

Management is often aware of when communication patterns deviate too greatly from what they expect to occur, but often management is unable to determine precisely how large this deviation is, or to pinpoint exactly where the deviations are taking place. Network analysis can provide this information quite readily.

Aside from the questions of the extent to which actual communication patterns depart from expected communication patterns, network analysis also enables the assessment of the "health" of the ongoing communication system. Given that a particular kind of pattern is occurring--regardless of its degree of overlap with the proscribed formal chart--the strong points or weak points of the network can be detected. Both actual and potential problem areas can be discerned.

Quite a wide range of aspects of the communication network can be examined. One set deals with characteristics of the groups in the network. Are certain groups too large...or perhaps too small? Are the internal communication patterns of the group too restricted for optimum task accomplishments or member morale? Is the group too dominated by one or two individuals? Or, is the internal communication pattern too loose and unrestricted for the accomplishment of particular task objectives? Is there enough centralization of the group structure? Are the shortest paths of communication between any two group members sufficient,

or are they excessive in length?

Another set of questions concerning the extent to which groups are linked to each other can be effectively answered through network analysis. Are particular groups completely isolated from the larger system at some specific frequency level--and experiencing information underload? Are certain groups too highly connected to other groups in the organization--perhaps raising problems of information overload and communication breakdown? Are there too many links through which information must pass to reach certain groups--increasing the likelihood of information being seriously distorted?

Network analysis can focus on the communication behaviors of individuals in the organization. How many individuals are isolated from the communication network at a specified frequency level? Who are these individuals? For example, are certain organization members not communicating about work-related matters on a daily basis? Or, are certain individuals communicating too often with too many people about non-work-related matters?

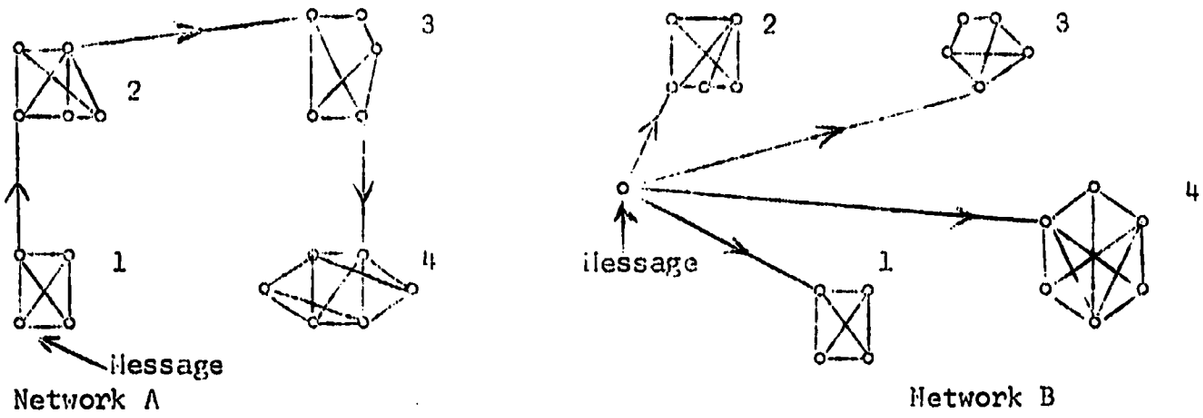
Persons who fill linking roles can be examined. Are the persons performing these roles those which management desires? Are there an adequate number of liaisons compared to the number of bridges in the organization to allow for the effective coordination of work group activity...or for the minimization of distortion potentials? This possibility warrants additional comment.

When examining the organization as a whole, there is a greater likelihood that information will be distorted when the linkages for a set of

groups are provided largely by bridges, rather than liaisons. (See Figure 2)

Figure 2

Comparison of Probable Distortion Levels in Two Networks



In Network A, a message introduced into the system must pass <u>through</u> each group and then travel to the next group. There are many more links in the "chain" through which the information must pass, thus increasing the likelihood of distortion of the information. There is a greater chance that details of messages will be dropped out, added, and modified.

In Network B, all the groups are more likely to receive the same information than the groups in Network A, since the message which reaches the groups originates from the same source once it is introduced into the system--the liaison. For example, if the nature of the same message introduced into each network were compared for Group 1 and 4, in Network A and Network B, there is a greater likelihood that there will be a <u>closer</u>

correspondence between the information received by Groups 1 and 4 in Network B than in Network A.

Once communication network analysis provides the basis for answers to the kinds of questions we have noted above, the effective restructuring of the communication system is feasible. Restructuring can be undertaken which hits on target, since problem areas have been precisely designated. Energy expenditures on restructuring efforts can return higher pay-offs. For effective change, not only is the delineation of management objectives necessary, but management must have a clear picture of what it is attempting to change.

Since the relative "health" of specific components can be determined and the components ranked on dimensions which management views as important, plans for change can be developed which deal with communication network problems directly in terms of organizational priorities. Problem areas can be rank ordered and dealt with systematically. More serious problems can be given more rapid and more intense treatment.

Once restructuring efforts have been undertaken, the communication network can be plotted again, to gauge the effectiveness of the restructuring attempts. Direct feedback can be provided to management and further corrective measures can be taken if necessary.

Network analysis might be employed to regularly monitor the communication system in the organization. Organizations would no doubt benefit from something analogous to the "yearly check-up." Attention might then be shifted more from problem-solving to prevention--potential problems could

be predicted before they occur, and necessary steps could be taken to guard against their happening.

Restructuring of organizational communication systems in conjunction with network analysis might entail much more than specific problem-solving or problem-predicting. A Number of organizations have undergone entire transformations of the physical/spatial relationships among organization members--what has been called "office landscaping." First, a communication network analysis is conducted in the organization to determine what the groups in the system are, who the specific members are, and how the groups are linked together. Next, the internal walls of the physical plant are removed, or a new building without interior walls is constructed. People are then arranged into clusters of work spaces according to the communication network "map". This can yield a much more efficient movement of information through the system.

Aside from organizational restructuring use, network analysis can be employed as a measurement tool to gauge the effects of organizational development or change programs (O.D.) on the nature of the interaction patterns in the organization. For example, to what extent do training programs directed toward improving the group discussion skills of supervisors, or their ability to facilitate a participative decision-making climate, result in less restrictive internal group communication patterns? To what extent does sensitivity training contribute to measurable and quantifiable changes in the number and nature of maintenance communication groups, etc?

Another effective use of network analysis as a measurement tool in

organizations involves the gauging of the effects of the implementation or alteration of various management information systems on the nature of the human communication system. How does the human network change as a function of increased capabilities for efficient information transmission? Are these changes desirable from a management point of view? Once these effects can be determined, appropriate merging of the physical and human communication systems can be more readily accomplished.

Looking to the future, in order to provide management with more effective answers to questions in the long run, continuous concerted efforts at basic theory building about communication networks and their effects should be undertaken. While basic research involving communication networks might have somewhat limited immediate pay-off to the organization, it is through this means that more powerful assistance can be provided over time.

Conclusion and Summary.

By now, many of you will have thought of one of the over-riding questions in this whole area: a question that pervades organizational research in general, let alone organizational communication research or communication network research as a subset of that. The question is: "How do you know what the state of 'health' is, or 'efficiency,' or 'adequacy,' in the network?"

There is no easy answer to this question, but there are at least three avenues worth pursuing where answers can be obtained. The first is what might be called "expert opinion." Many managers, regardless of their

formal training in communication, are keenly aware of, and able to verbalize, their communication problems. They often know where information needs to be sent, or who should perform which liaison function. They have their own supply of "horror story" anecdotes about situations where communication problems have plagued them. So the first source of a comparison base for evaluating health is the manager himself. (As an aside, it could also be the non-manager just as easily.)

The second source of information from which to make evaluative comments is normative data. By that we mean data that are gathered in a wide sample of organizations, and which are systematically collected on the same overall set of variables, to provide an understanding of the range and variation in communication that occurs in existing organizations. Many of you have seen a parallel to this idea in reports on job satisfaction levels, where a given organization is compared with norms established in a large set of organizations. Clearly there are problems in this type of evaluation (as there are in all the others) because one is often tempted to argue that "my organization" is so different from all others that "comparison is meaningless." The answer to that possibility lies in examining the existing normative data vis-a-vis the particular organization under study. (It should be apparent here that the proposed "Communication Audit" by this division can produce exactly these kinds of data--data that, to our knowledge, do not now exist.)

The third source of evaluation comes from various other research findings about organizational communication--deriving both from laboratory and field settings. For example, from the laboratory

studies we know that groups formed to be creative and innovative are more successful if they are relatively leaderless--are not highly centralized and dominated. Thus when we look at similar innovative groups in organizations and examine their degree of centralization, we can make an assessment of their probable success.

We would therefore argue for three sources of information as possibilities in helping resolve questions on the health or adequacy of a particular communication system--expert opinion, normative data from a large sample of organizations, and accumulated research findings (especially those conducted in actual organizational settings). It should also be clear that none of these sources is unflawed, and that we will simply have to make do until we improve our basis for making knowledge claims.

In summary, this paper has addressed three topics. First, we outlined the basic terms and features of communication network analysis in formal organizations. Then we condensed the information from a variety of sources--all of which dealt with one aspect or another of the liaison or coordinating role in a network--and presented the condensation. Finally, we outlined some of the managerially important questions that can now be addressed by existing network analysis techniques.

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