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Executive Decision Making in Organizations:
Identifying the Key Men and Managing the Process

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Abstract

A model of executive decision making is developed which examines a series of decisions made over time and emphasizes the interaction of members of an organization in making these decisions. A review of the literature suggests that members of an organization can facilitate the decision making of their colleagues by performing any one of four colleague roles: thinking facilitator, power equalizer, technical link-pin, and organizational link-pin. The concept of role net is advanced to characterize the informal organization involved in decision making. Two studies are described which illustrate the use of the colleague role approach to executive decision making. In one, some characteristics of the key men in executive decision making are identified, and in the other the performance of colleague roles is related to career development. Several suggestions are made for refinement and extension of colleague role theory.

EXECUTIVE DECISION MAKING IN ORGANIZATIONS:
IDENTIFYING THE KEY MEN AND MANAGING THE PROCESS

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Executive decision making in organizations--the making of decisions which have consequences for subsequent organizational activities--is seldom done by individual members of the organization acting alone. People work together in project teams or task forces, coordinate their efforts with broader purposes of the organization, and exchange stimulation and support with their colleagues.

Despite the obvious importance of such interactions between people in organizations in making executive decisions, they have received surprisingly little direct study. Many authors refer to the existence of the "informal organization" and stress its importance, but aside from some interesting case studies, they offer little in the way of systematic statements as to how it works.

Moreover, research and theory on organizational decision making appears to have reached some sort of hiatus. To date it has produced (1) some good models in processes involved in individual decision making (e.g., Edwards, 1961; Miller, 1970) (2) a body of knowledge and some theory about problem-solving groups (Hoffman, 1961; Argyris, 1969; Bales, 1950), and (3) a few interesting case studies of decision making in organizations (Cyert, Simon, and Trcw, 1956; Pounds, 1969). Reviews of much of this work appear in Collins and Guetzkow (1964), Hoffman (1965), Taylor (1965), and Feldman and

Kanter (1965). Much as each body of research and theory has to offer, each has too many limitations to conclude that it alone offers the key to understanding the social psychology of decision making in organizations. In general, (1) the individual process models fail to account explicitly for the social factors involved, (2) the group studies deal with temporary groups in the psychological laboratory setting or formal meetings in the organization, and (3) the case studies generate some interesting hypotheses, but provide a shaky basis for generalization.

In developing a fresh approach to executive decision making, it seems important to consider (1) the fact that executive decisions are made by individuals as members of organizations, but only sometimes as members of groups in the organizations, (2) shifts in types of decision-making activity over time from preliminary phases of idea generation to later emphasis on evaluation and solution, and (3) the social and organizational contexts of the decisions. In order to encompass all these factors, it is proposed to make the unit of analysis not the individual decision maker, group meeting, or case as studied in past research, but rather a series of executive decisions as they occur over time in the organizational context. For example, in a study now underway, we are investigating the process of decision making on development loans granted by Brazilian financial institutions. We are focusing separately on each of several stages in the process and isolating social and organizational factors involved in each. Thus, we are looking separately at the initial presentation of a possible project by an entrepreneur to a regional bank, the analysis of the project

by the technical staff of the regional bank, the approval of the project by the regional bank's officers, and the appraisal and final approval of the project by the national bank. For over 600 such projects, we are relating such outcomes as probability of acceptance and decision-making time to such organizational factors as the influence of each party (entrepreneur, regional bank technical staff and directors, national bank technical staff and directors) at each stage, agreement as to the relative importance of several criteria in making the loan decision, and the image various parties have of the regional bank.

In the present study of executive decision making, we shall utilize a similar approach to analyse the technical decisions made by scientists and engineers in a government research and development laboratory. In such a situation it is possible to begin with a simple model of the stages involved in decision making: (1) a suggestion, (2) a proposal, and (3) a solution. Figure 1 illustrates some social and organizational factors which may affect each stage of decision making.

That an organizational member, such as a scientist, would suggest an idea is likely to be a function of factors including

- (1) his personal characteristics (abilities, motivation, organizational status, etc.)
- (2) information available to him--
 - others' original ideas
 - technical information
 - organizational and administrative information.

To a great extent, such information is available to him through his colleagues.

When a scientist has a "suggestion," he is not apt to keep it to himself for very long, but rather to talk it over with his colleagues. At this point, two characteristics of his colleagues become important:

- (1) their ability to help his thinking by clarifying the nature of the problem, changing the direction of his thinking, etc.
- (2) critically evaluating his ideas.

Finally, the "suggestion" may become a "proposal," but before it can become a "solution" which is implemented in the organization, two other factors become important:

- (1) that the proposal gets a fair hearing
- (2) that administrative help (resources, etc.) be made available to assure its implementation.

Naturally, "feedback loops" occur--after making a proposal, a scientist may suggest something different.

Viewing decision making by members of an organization in this way underscores the importance of interaction with colleagues at every stage of the decision-making process. Thus, an important key to understanding executive decision making may well be the roles which colleagues play in the decision-making process. It is precisely such interaction of organizational

members in making decisions which distinguishes organizational decision making from individual decision making outside the organization or problem-solving by ad hoc groups in the psychologist's laboratory. A fuller understanding of this process requires consideration of both a social psychological (sometimes defined as the study of human interaction) and an organizational psychological (definable as the study of human interaction in structure power relationships) point of view.

This paper represents a beginning in this direction. It proposes that executive decision making can be better understood through a knowledge of the informal organization, and that the informal organization can be conceptualized as networks of relationships among its members, in which members are useful to their colleagues for performing certain activities helpful at various stages of the decision making process. These "role nets" are seen as the basic units of the organization, reflecting ways in which executive decision making actually gets carried out, regardless of the organization chart, policies, or procedures. On the basis of a brief review of previous work related to colleague roles in research and development (R & D) organizations, several roles are proposed in which one member of an R & D organization may be useful to decision making by another. Next, some preliminary research is described to illustrate this approach to executive decision making in organizations. It focuses on 1) identifying the key men involved in performing these roles in the decision-making process, and 2) examining the career development of a scientist in terms of his performance of these colleague roles.

Related Research and Theory

The current approach to decision making in R & D has four clearly identifiable sources of stimulation in past research and theory: a study of supervisory practices and innovation in scientific teams (Andrews and Farris, 1967); Allen's work on technological gatekeepers (e.g., Allen and Cohen, 1969); research and theory on group problem solving, especially that of Hoffman (1961) and Maier (1967); and current attempts to study, conceptualize, and improve inter- and intra-organizational relationships in a national system of financial institutions in a Latin American country (Farris, 1968).

Supervisory practices and innovation. Basing their research design on previous research on leadership in other types of organizations, Andrews and Farris (1967) studied relationships between several aspects of supervisory behavior and subordinate innovation in an R & D laboratory. They found strong, consistent, positive relationships between the supervisor's human relations skills and subordinate innovation; and consistent negative relationships between the supervisor's administrative skills and subordinate innovation. Provision of freedom by the supervisor was positively related to innovation only for supervisors low in the three skill areas; for the more highly skilled supervisors, provision of freedom was unrelated to subordinate innovation. When combinations of skills were examined--for example, when supervisors high in both technical and human relations skills were isolated--little increase in the strength of the relationships to subordinate innovation was found. Technical skills alone accounted for subordinate innovation at least as well as technical skills in combination with other factors.

These findings have two kinds of implications for the study of colleague roles in R & D organizations. First, they show that performance of some members of an R & D laboratory is in fact related to characteristics of a colleague. Second, they indicate that in an R & D organization, one colleague may be useful to another chiefly through his activities in the technical area, and perhaps in the administrative area. Of course, the immediate supervisor is only one of several colleagues of a scientist in an R & D organization, and a special colleague by nature of his supervisory office. Other colleagues may well facilitate technical problem solving performance through similar or somewhat different types of activities.

Technological gatekeepers. Using modified sociometric techniques, Allen and Cohen (1969) studied information flow in R & D laboratories. They found that individuals named most often by their colleagues for frequent discussion of technical matters, the sociometric "stars," tended to make use of individuals outside the organization or read the technical literature more than other members of the laboratory. Thus, they acted as "technological gatekeepers" in a two-step flow of information into and within an R & D laboratory.

The implications of this research on technological gatekeepers for the study of colleague roles are also twofold. First, locating technical information may well be an important activity which a scientist can perform for his colleagues. Second, modified sociometric techniques may be fruitful procedures to use to identify colleagues who are especially useful to other scientists. However, in the exchange of information which occurs

during frequent discussion of technical matters, it seems reasonable to expect that useful activities occur in addition to locating technical information. It is important to know not only who talks to whom and how often, but also who talks to whom for what purposes. The literature on group problem solving provides some clues as to what these activities may be.

Group problem solving. In the past 15-20 years, social psychologists have paid increasing attention to phenomena involved when groups of individuals get together to solve problems. Maier (1967) and Hoffman (1961) have recently presented models of human problem solving based on an extensive series of laboratory studies of problem-solving groups and individuals. Hoffman suggests that creative problem solving is apt to occur when a conflict exists between differing, but comparable ideas, all of which have sufficient attraction or "valence" to the problem-solver to be seriously considered, but none of which are attractive enough to be accepted as a solution to the problem. In resolving the conflict among ideas, new solutions are apt to emerge which incorporate advantages of those ideas seriously considered but not accepted.

In a similar vein, Maier suggests that a group is most apt to succeed in its problem-solving efforts when its leader performs an integrative function analagous to that performed by the nerve ring (or, roughly, the "central nervous system") of the starfish. Without an intact nerve ring, the rays of the starfish act as individuals, often controlled by a dominant ray. Similarly, a group of problem-solving individuals may engage in "persuasive activity" (selling opinions already formed) rather than problem-solving activity (jointly seeking unknown solutions). Problem-solving activity

is more apt to occur when the leader does not dominate the discussion and produce the solution, but instead serves as an integrator by receiving information, facilitating communication between individuals, relaying messages, and integrating ideas so that a single unified solution can occur.

The R & D laboratory (and other organizations as well) can be considered to be networks or groups of individuals engaged in technical problem solving. The types of activities performed by individuals most useful to the problem solving of their colleagues would be expected to be similar to those which facilitate problem solving in the laboratory groups studied by Maier and Hoffman. That is, they would increase the valence of less attractive ideas, decrease the valence of more attractive ideas, and integrate positive aspects of ideas suggested by various individuals with others' ideas and organizational realities.

Inter-organizational relations. For the past four years the author and several colleagues have been involved in an action-research program designed in part to study and improve relationships within and between about 20 financial institutions in a Latin American country (Farris, 1968). This program has affected the current study of colleague roles in R & D in two different ways. First, preliminary findings about relationships among the financial institutions suggest certain directions for relationships between the performance of colleague roles and performance of the R & D scientist. Second, the work to date on these organizations in an environment different from the one on which most of current organizational research and theory is based suggests a need for more sophisticated ways of conceptualizing and measuring relationships within and between organizations.

Trends in the research to date (Beals, Farris, and Butterfield, 1970), suggest that the state financial institutions seen as most effective by the federal government financial institution are those which have established a more effective "interaction-influence system" with the federal institution. More effective state institutions tend to report more communication with the federal institution, slightly more influence on the federal institution, and that the federal institution has more influence on them. If the analogy between this system of financial institutions and an organization of scientists holds, then we would expect higher-performing scientists to report greater interaction, especially with higher-levels in the laboratory, and more mutual influence. They would name more colleagues as useful to them (influencing them), and they would be **named** more often as useful to their colleagues (greater influence). These expectations are not radically different from those which would be made on the basis of Likert's (1967) concept of an interaction-influence system, Tannenbaum's (1968) "expanding influence pie," or findings regarding influence and performance of scientists (Pelz and Andrews, 1966; Farris, 1969). However, they differ in stressing the expectation that the higher-performing scientist is more susceptible to influence as well as having more influence.

The action-research on the financial institutions in the Latin American country suggests two types of deficiencies in organizational theory which the current study of colleague roles might help to alleviate. First, we know little more about "effective interaction-influence systems" except that they are important. Perhaps mapping them in terms of "role nets" will help in understanding this aspect of organizational design. Second,

although self-report organizational and attitude surveys have been applied with good results in this research program to measure such things as perceived influence, a clearer picture of the objective situation may be obtainable by coding information about such things as colleague roles.

Colleague Roles

The literature reviewed suggests that one scientist may indeed stimulate the work of another by performing certain roles. The study on leadership suggests that important roles are performed in the technical area; the studies of technological gatekeepers suggest that locating technical information may be a helpful role; the emerging literature on group problem solving suggests that problem-solving activities will be more successful if certain functions are performed; and the studies of financial institutions suggest that higher performance is associated with higher interaction, higher influence, and higher susceptibility to influence. Now, let us use these bits of information as a basis for a more explicit statement about colleague roles in R & D.

It is proposed that scientists can stimulate each others' work by performing at least four types of roles: thinking facilitator, power equalizer, technical "link-pin," and organizational "link-pin." Other roles may be important as well, such as some of the "human relations functions" studied by Andrews and Farris (1967), but the literature reviewed suggests these four types of roles as the best starting point.

The "thinking-facilitator" role consists of activities by which one scientist helps another's thinking about technical problems, through such things as picking out fruitful problems, clarifying the nature of a problem, or changing the direction of his thinking about a problem. He may also be seen as useful for critical evaluation of another's ideas, but only if this evaluation occurs in such a way and at such a time as to stimulate further exploratory behavior rather than to indicate a lack of receptivity to ideas. Similarly, he may be seen as useful for original ideas if these ideas stimulate further exploration rather than inhibit it. These activities in the thinking-facilitator role are of the type which Maier (1967) suggests that a leader should perform to facilitate group problem solving. We are extending his argument here to the more general situation in which one scientist may facilitate another's thinking, treating leader-group relations as only one of several instances of colleague relationships in a scientific laboratory. Whether there is something special about a scientist's relations to his supervisor is an important question which we can investigate empirically.

The "power-equalizer" role consists of activities by which one scientist makes sure another's ideas get a fair hearing or prevents competing ideas from winning out prematurely. Since a scientist's own original ideas may reduce the chances that another's ideas get a fair hearing, depending on the context and manner in which they are presented, it is likely that scientists seen as more useful for original ideas will be seen as less useful for power equalization. Power equalization appears to be what Hoffman (1961)

is referring to as a condition for creative problem solving and Maier (1967) would expect a leader to achieve by supporting minority opinion and not imposing his own opinions on the group.

The "technical link-pin" role consists of activities by which one scientist helps another by locating relevant technical information he did not know about previously. It is based on the internal linkage aspect of Allen and Cohen's (1969) technological gatekeeper. We would expect many of our technical link-pins--scientists seen as useful for locating technical information--to function as technological gatekeepers, that is, to be involved in frequent discussion of technical matters with colleagues within the laboratory and to be well-acquainted with outside sources of technical information through extensive reading of the literature or contact with scientists in other laboratories.

The "organizational link-pin" role consists of activities by which one scientist helps another by providing administrative help in getting needed resources and facilities and providing information about technical and administrative developments happening in the laboratory. This role is hypothesized to be important, since the work of an individual scientist in an organization is dependent on adequate resources and facilities and more useful to the organization if it is integrated with broader organizational goals. Probably supervisory personnel are administrative link-pins much more than other colleagues. Likert (1961) argues that they should be. The study of supervisors by Andrews and Farris (1967), however, which found

a negative relationship between the supervisor's administrative skills and innovation, suggests that other colleagues may be important as organizational link-pins as well.

These four colleague roles--thinking facilitator, power equalizer, technical link-pin, and organizational link-pin--are proposed as ways of conceptualizing the interaction of scientists in the process of making decisions. Probably these same roles would be useful in conceptualizing interaction in decision making in other types of organizations as well, since they are based on a general model of the problem-solving process.

Role Nets and Organization Design

Much of the literature on organization design (e.g., Thompson, 1967; Lawrence and Lorsch, 1967; Lorsch and Lawrence, 1970) emphasizes the role of factors such as technology in determining organizational structure. Others, working in the tradition of the Hawthorne studies (Roethlisberger and Dickson, 1964), consider the "informal organization"--interactions which occur among organizational members regardless of the formal organizational structure. Research on communications in organizations (for a review see Guetzkow, 1965) has identified a number of relatively consistent patterns of such interaction which often occurs among members of organizations or laboratory groups. These include the "wheel," which resembles a formal organizational chart, and the "all-channel," in which each member interacts with each other. (See Leavitt, 1951 for details.)

In a similar manner, it is possible to describe an organization design in terms of "role nets," which consider not only who interacts, but also the usefulness of this interaction to a focal person for a particular function. Thus, in an all-channel communications network, a role net for

the colleague role "organizational link-pin" may be in the shape of a¹⁵ wheel. One key man in the communications network may be the only one who is useful to his colleagues for providing administrative help and information.

More specifically, a role net is a description of organizational structure which describes all the patterns of interaction in which one member is useful to another for performing a particular role. Like Merton's (1957) role set, a role net considers a focal person and others with whom he interacts. However, role set theory (see Rommetveit, 1954; Kahn, et al., 1964; Katz and Kahn, 1966) emphasizes expectations which are communicated by members of the role set to the focal person--the "sent role." Role net theory, on the other hand, considers whether members of the role set are useful to the focal person for performing a certain role. To oversimplify, the focal person in a role set receives expectations as to how he himself should perform; the focal person in a role net receives help in his decision making when members of his role set perform a particular role for him.

Decision making in an organization may be described in terms of role nets for each of the four colleague roles. Each role net may be analyzed by the methods typically applied to sociometric descriptions, for example, graph theory (Harary, 1959). Analyses may be made of such phenomena as reciprocal choices, stars, and isolates. These descriptions of the role nets may be in turn related to "input" variables such as personal characteristics of the members of the organization or perceptions of the organizational

reward system, and to "output" variables, such as speed of decision making, quality of decisions, or scientific innovation.

The remainder of this paper describes two such studies.

Study I. Predicting Role Performance

Under what conditions is a scientist apt to perform a role which is useful for a colleague's decision making? When colleagues do perform these roles, do the focal persons perform better? If a scientist is useful to his colleagues for performing one role, is he apt to be useful in the performance of other roles as well?

In this first study a preliminary attempt is made to answer these questions. The general theoretical model is shown in Figure 2. It considers five sets of factors which may predict the performance of colleague roles and six sets of factors which may be correlated with the performance of colleague roles. The five predictors are the scientist's personal characteristics; his perception of the organization's reward system; his past performance; his past interaction with colleagues, influence on work goals, and involvement in his work; and the performance of colleague roles by his own colleagues. The correlates are the performance of colleagues who name him as being useful, his current communications patterns, his current working environment, the rewards he receives, his job mobility, and his own current performance. In the

present report, we shall consider only three sets of the predictor variables and one set of correlates. The appendix to this paper shows preliminary results for the other predictors and correlates, and a current Master's thesis (Swain, 1971) examines these other factors in detail. In the present report we shall test five hypotheses:

1. The more a scientist is named as useful in one role, the more he is named as useful for others. That is, some scientists are more "catalytic" than others. However, a particular scientist is apt to be more useful in some roles than in others.
2. The performance of colleague roles is positively related to the scientific performance of the focal persons. That is, higher-performing scientists name more colleagues as useful to them in their technical decision making than do lower performing scientists.
3. The higher a scientist's past performance, the more he will be named as useful in performing colleague roles.

4. The higher a scientist's past involvement in work, influence on work goals, and communication with colleagues, the more he will be named as useful in performing colleague roles.
5. The more a scientist names his colleagues as useful to him for performing colleague roles, the more he himself will be named by his colleagues as useful in performing colleague roles for them.

Method

The study was conducted in a NASA research center. The scientists in our study were engaged in a wide variety of R & D activities related to aerospace, including basic research on chemical and physical processes and the conduct of atmospheric and deep space experiments utilizing rockets and satellites. / One hundred and seventeen / Seventy-seven professionals participated in the study. / of these also had participated in a similar study five years before. In each study the scientists completed a questionnaire in which they described aspects of their motivation and working environment, and a panel of other professionals rated the performance of the individuals who participated in the study.

Colleague roles. The participants in the study were asked to name individuals they saw as being useful to them for various colleague roles:

Considering the technical activities you have been involved in over the past few years, which people have been most useful to you for the following: (The same person may be named as many times as seems appropriate)

- A. Locating relevant technical information you did not know about previously. (Spaces for up to 8 names were provided in each part).

- B. Helping your thinking about technical problems - e.g., picking out fruitful problems, clarifying the nature of a problem, changing the direction of your thinking about a problem.
- C. Critical evaluation of your ideas.
- D. His own original ideas.
- E. Making sure your ideas get a fair hearing or preventing competing ideas from winning out prematurely.
- F. Providing administrative help in getting you needed resources and facilities.
- G. People from whom you learn about technical administrative developments happening in (name of division).

For each colleague role, two scores were determined: the number of times an individual was mentioned, and the number of people the respondent named. The number of times a scientist was mentioned by the participants in this study was utilized as an approximation of the degree to which he performed a colleague role. The distributions of the colleague role scores were found to be highly skewed, with a few scientists being mentioned very frequently for each role. Because these scores were going to be used in Pearson product-moment correlations, they were adjusted by means of a lognormal transformation to reduce their skewness.

Scientific performance. Four measures of scientific performance were used:

Innovation--the extent the scientist's work had "increased knowledge in his field through lines of research or development which were useful and new."

Productiveness--the extent the scientist's work had "increased knowledge in his field along established lines of research or development or as extensions or refinements of previous lines."

Usefulness--the extent the scientist's work had been "useful or valuable in helping his R & D organization carry out its responsibilities."

Reports--the number of technical reports the scientist had written over the past five years.

The first three qualities were independently assessed by an average of 7.6 judges, each of whom claimed to be familiar with the scientist's work.

Since the judges showed reasonably good agreement (Spearman-Brown estimate for reliability of a multiple item scale = .87), their evaluations were combined into a single percentile score on each measure for each scientist.

All four scores were then adjusted to remove effects attributable to two background factors: time at R & D center, and degree (BS, MS, or Ph.D.).

Intercorrelations among the three ratings ranged from .71 to .79, and the ratings correlated with the measure of reports at about .20. Details

on these types of procedures for collecting, combining, and adjusting the performance measures are more fully described in Pelz and Andrews (1966).

Similar procedures were used and similar reliability estimates obtained with the measures of past performance; Andrews and Farris (1967) present details.

Involvement, Influence, Communication. These three characteristics of the scientist's working environment were measured by single questionnaire items having Likert-type scales. The scientists reported the extent of their involvement in their work, their influence in determining their work goals, and their contact with colleagues.

Results

Hypothesis 1. Interrelationships among colleague roles.

In the first hypothesis it was argued that some scientists are generally more useful to more of their colleagues, but that differences would occur among the colleague roles. Table 1 shows the intercorrelations among the number of times scientists were mentioned for each colleague role. They range from a low of .40 between being

Insert Table 1 about here

useful for original ideas and providing information about developments in the division to a high of .87 between helping to think about a problem and providing critical evaluation. The median correlation is .66. Thus, scientists named often as useful for one role are also named often for other roles, but the same scientists are not named most often for all roles.

Inspection of Table 1 shows some preliminary support for the four colleague roles discussed in an earlier section of this paper. Note how administrative items (E,F,G) tend to be highly intercorrelated and technical items (A,B,C) tend to correlate highly among themselves. Factor analyses of the correlations in Table 1 have been performed which generally support the four factors proposed in this paper. For details see Swain (1971).

Hypothesis 2. Colleague roles and performance. It was hypothesized that higher performing scientists would name more colleagues as useful to them for the various colleague roles. Like the better-performing Brazilian banks studied by Beals (1970), they would be more susceptible to influence. Underlying this hypothesis was the assumption that "The more help, the better," rather than "Too many cooks spoil the broth." Certainly, however, it is possible for a scientist to receive important help in his decision making from only a small number of useful colleagues.

Insert Table 2 about here

Table 2 shows correlations between the number of colleagues a scientist named as useful to him for the various colleague roles and his own performance. The correlations are low and positive. Relationships are strongest when usefulness to the organization is used as the measure of performance. For all colleague roles, scientists who name more colleagues as useful to them are judged to be more useful to their organization.

If we assume for the moment that colleague roles are causally related to performance, the findings appear to indicate that having more helpful colleagues aids a scientist's usefulness to his organization more than his innovation, productiveness, or report writing. Why should this be so? Perhaps a scientist can produce an innovative or productive piece of work or a good report without a lot of colleagues helping him out. In order for his work to be useful to the organization, however, it must be integrated with organizational goals and efforts. Perhaps such integration is

achieved in part through the scientist's interaction with colleagues. The more who help his work, the better integrated and more useful to the organization his work becomes.

Hypothesis 3. Colleague roles and past performance. The hypothesis argues that scientists who perform well subsequently will be named more often by their colleagues as helpful to them in their technical decision making. Performance feedback loops--associations between the performance of members of organizations and their subsequent working environments -- have been described previously by Farris and his colleagues (Farris, 1969; Farris and Lim, 1969; Farris and Butterfield, 1971). The association between a scientist's past performance and his involvement in helping his colleagues' technical decision making is seen as one of these.

Correlations between the number of times a scientist was mentioned for each of the colleague roles and four indicators of his past performance are shown in Table 3. For the three judgments

Insert Table 3 about here

of performance the correlations are positive. Correlations are generally in the .30's, with colleague roles in the administrative area the least related to past performance. For output of reports, the correlations are not different from zero.

Hypothesis 4. Colleague roles and past involvement, influence, and communications. It was hypothesized that scientists who had been more involved in their work, more influential in determining their work goals, or in greater contact with their colleagues would

subsequently be named more often as helpful to their colleagues. Those more involved in their work would make the effort to be helpful; those with greater influence would become especially helpful in the administrative and power equalization roles; and those in contact with more colleagues would become useful to more of them.

Results are shown in Table 3. For involvement and influence the correlations are positive; for contacts, the correlations are close to .00. There is a tendency, as expected, for past influence to be associated more strongly with usefulness in the administrative areas.

Perhaps the relatively long time period between measurements -- five years -- accounts for these findings. Involvement and influence may be relatively persistent characteristics, involvement because it is associated with enduring personal characteristics of the scientists, and influence because scientists tend to maintain a relatively high level of influence once it is attained. Contacts, on the other hand, may be more associated with the particular task on which a scientist is working, and thus change as his tasks change over time. For engineers in three industrial laboratories, Farris (1969) found that involvement and influence were more stable characteristics over a five-year period.

Hypothesis 5. Colleague roles and helpfulness of colleagues.

It was hypothesized that scientists named more often as helpful by their colleagues would, in turn, name more colleagues as helpful to them in their own technical decision making. There are two bases

for this prediction. First, some scientists may thrive on a working style involving greater interaction with their colleagues, while others may work well with less interaction. As in the case of the Brazilian banks (Beals, 1970), mutual influence may be important. Second, the process of interaction in decision making may involve a degree of reciprocation. When a scientist helps a colleague, the colleague is apt to reciprocate by helping in return.

Differences would be expected to occur for the different colleague roles. For example, those scientists named most often as helpful in administrative areas probably would be more apt to name more colleagues as helpful in the technical areas. A scientist named often as useful for his original ideas would probably be less apt to name many colleagues as helpful to him for their original ideas, but more apt to find more colleagues useful for making sure his ideas get a fair hearing and a critical evaluation.

The correlations shown in Table 3 indicate positive correlations between the number of times a scientist is named as useful and the number of colleagues he names as useful to him for the various colleague roles. As expected, there is some tendency for scientists named most often as useful for administrative help to name more colleagues in the technical areas than in the administrative areas. Moreover, the scientists named most often as useful for their original ideas tended to name more colleagues as helpful to them not for original ideas, but rather for providing technical information,

critical evaluation, and a fair hearing.

From this preliminary study of colleague roles a picture of the key men who perform them is beginning to emerge. If a scientist is named often as useful for performing one role, he also tends to be named often for other roles. However, his usefulness tends to center in separable technical and administrative areas. Scientists named most often as useful to their colleagues have higher past performance, involvement in their work, and influence on their work goals. They name more colleagues as helpful to them in their own work. Finally, scientists who name more colleagues as helpful to them are judged to be higher performers in terms of their usefulness to their organization.

A related area of importance is the performance of colleague roles as a scientist's professional career develops. Study II deals with this question.

Study II. Colleague Roles and Career Development

As a person spends more time with a particular organization, certain changes are apt to occur. In the case of scientists, Berlew and Hall (1965) reported on the importance of early experiences in the organization for subsequent performance; Gerstberger (1971) investigated the integration of new hires into their organization; Andrews and Farris (unpublished report) discovered a "sophomore slump" in one organization, where those who had been with their organization from three to nine years were lower than colleagues with greater or less seniority in several aspects of motivation, communication, and involvement; and Capitanio (1969), investigating these same factors in several other R & D organizations, found generally linear and positive relationships between them and seniority.

Recently Schein (1971) proposed a conceptual scheme for describing an individual's career development in an organization. An important aspect of his scheme is the passage of the individual through three types of boundaries -- hierarchical, functional, and inclusion. He states that the inclusion boundaries are the most difficult to identify and measure because "to a considerable extent their very existence usually remains implicit."

Perhaps colleague roles in decision making could be used to help identify and measure inclusion boundaries and a person's centrality in his organization. In this study we shall examine the extent to which scientists are named by their colleagues as useful for performing the various colleague roles as a function of the time they have been with their organization. If the performance of colleague roles is a useful measure of inclusion, we would not only expect it to make conceptual sense, but we would also expect that 1) the performance of colleague roles varies with seniority, and 2) the relationships between degree of inclusion and seniority are different for the different colleague roles.

To investigate the relationships between seniority and the performance of colleague roles, the scientists in this study were divided into four groups. The first group consisted of 12 people who had been employed there 0-4 years; the next, 47 people with 5-9 years employment; the third, 31 people with 10-14 years employment; the fourth, 28 people with 15 or more years employment. Figures 3 and 4 show the percentage of scientists at each level of seniority who were named at least once by their colleagues as useful for performing each of the colleague roles.

The data show that the performance of all colleague roles, except being useful for original ideas, varies with seniority. Scientists with greater seniority are apt to be named more often.

The relationships between degree of inclusion and seniority were different for different colleague roles. The roles in the administrative areas (Figure 4) are more strongly related to seniority than are the roles in the technical areas (Figure 3). Conceptually, the former appear to be closer to Schein's (1971) definitions of "inclusion" and "centrality" which emphasize knowledge of company secrets and the individual's power. Moreover, the scientists with the least seniority were just as apt to be named as useful for their original ideas as the scientists with the greatest seniority.

Similar findings occurred when the criterion of inclusion was changed so that the percentage of scientists mentioned several times was examined as a function of seniority.

Another question asked with whom the scientists most frequently discussed technical matters. For this general question on communications, the percentage of people named at least once was greater for those with lower seniority. The percentages were 100%, 96%, 81%, and 93% for the four groups. Similar percentages held for those mentioned by three or more colleagues: 67%, 60%, 52%, 61%. Apparently, inclusion in a communications network is not the same as inclusion in a role net. These findings underscore Schein's (1971) treatment of inclusion as a complex phenomenon.

It is possible, then, to conceptualize inclusion in a multi-dimensional manner. Just as it is relevant to ask "communication for what purpose," it is relevant to ask "inclusion in what activity."

Examining the performance of colleague roles as a function of seniority appears to be a useful way of identifying and measuring different dimensions of inclusion. The findings of this study indicate that scientists are included more rapidly in technical areas of organizational decision making than they are in administrative areas. And, one of the chief values of the new hires is the original ideas they bring to the organization. With added measurements and observations, it would be possible to utilize inclusion in the organization, as evidenced in the performance of colleague roles, to test systematically some of Schein's (1971) hypotheses about socialization and innovation in the career.

Summary and Conclusions

In the first part of this paper, a model of executive decision making was developed which examines a series of decisions made over time and emphasizes the interaction of members of an organization in making these decisions. A review of the literature suggested that members of an organization could facilitate the decision making of their colleagues by performing any one of four colleague roles: thinking facilitator, power equalizer, technical link-pin, and organizational link-pin. The concept of role net was then developed. It is a description of organizational structure which depicts all the patterns of interaction in which one member is

useful to another for performing a particular role. Role nets in a sense are the inverse of role sets in that they concentrate on the help the focal persons receive from their role senders rather than the expectations for how they themselves should perform. Role nets were seen as a way of characterizing an organization design or structure which describes the informal organization or "real" (as opposed to stated or formal) decision making process.

Two studies were then reported which illustrate the use of the colleague role approach to executive decision making. In the first study it was found that some members of a scientific laboratory were named more often by their colleagues as useful in helping their technical decision making, and that conceptually meaningful differences among the colleague roles occurred. Relationships were found between the number of times a scientist was named as helpful and his past performance, past involvement in work, and previous influence on work goals, but not his previous contact with colleagues. Scientists who were named most often as helpful also named more colleagues as helpful to them for certain colleague roles. Finally, scientists whose work was judged to be more useful to their organization named more colleagues as helpful to them in their technical work.

In the second study the performance of colleague roles was examined as a function of the length of time a scientist had been with his laboratory. This research was stimulated by past work on the career development of scientists and Schein's (1971) conceptual

approach to career development which emphasizes the importance of inclusion in the organization as well as difficulties in measuring inclusion. Considering the performance of colleague roles to be indicators of a scientist's inclusion in his organization, it was found that more senior scientists were more included. Scientists with greater seniority were named more often for all colleague roles but one. Greater differences were found for administrative roles than technical roles, indicating that less senior scientists are included in the technical aspects of organizational problem solving more rapidly than the administrative. New hires were named as often as the most senior scientists as being useful for original ideas.

These preliminary studies indicate that colleague roles and role nets are useful tools for studying executive decision making in organizations. Let us close this paper with some suggestions for refinement and extension of these concepts.

Refinement. Seven colleague roles were examined separately in the preliminary studies. It is important to know whether these roles have more basic factors underlying them. Results of a factor analytic study (Swain, 1971) indicate that they do, and that the underlying factors are very similar to the four colleague roles hypothesized on the basis of the decision making literature.

Absent from this initial research was any consideration of human relations or support roles which one person may perform for a colleague. These, too, may turn out to be important for executive decision making in some situations.

The measurement of colleague roles in this initial research was simply in terms of the number of times a scientist was mentioned by his colleagues for a particular role. Other types of measurement should be explored also. Two of the most promising are reciprocal choices and role net profiles. The former would examine instances in which two scientists name one another for the same role or for different roles. It may be hypothesized, for example, that certain colleague roles are complementary -- that very few reciprocal choices occur for original ideas, but that a productive situation occurs when one scientist names a colleague for original ideas and the colleague names the first scientist for critical evaluation.

A role net profile might consider a group of scientists who work together -- for example, a project team or section -- and examine whether or not members of these units mention one another for the various colleague roles. The effectiveness of such a unit may then be examined in terms of characteristics of its role nets, for example whether each role is performed at least once by one member for another (low profile), members are named for several roles (high profile), one member is named for all roles (steep profile), or each member performs an equal number of roles (flat profile).

Extension in this R & D Laboratory. Four extensions of the research on colleague roles are planned for the laboratory used in this study. The first examines more extensively the charac-

teristics of key men or "catalytic colleagues" who are named most often as helpful in performing the colleague roles. (See Figure 3, Appendix A, and Swain, 1971 for some current results.)

The second studies teams of scientists to determine whether colleague roles are performed by team members, the supervisor, or outsiders, and how these role set profiles are related to team innovation.

The other two studies are still in the planning stages. The first of these would examine the relationship of information flow and communications in the laboratory to the performance of colleague roles. Preliminary examination of the data indicate that some scientists are named often by their colleagues for "frequent discussion of technical matters," but are seldom mentioned as helpful for any of the colleague roles. What characterizes scientists with such a low "signal-to-noise ratio?" How do they contrast to scientists with higher signal-to-noise ratios?

The second study would examine the performance of colleague roles as a function of the interaction of personal characteristics of the scientist and aspects of his environment. For example, under what conditions does a scientist of high creative ability get mentioned by his colleagues as useful to them for his original ideas? (The correlation between creative ability and the number of times a scientist is mentioned as useful for his original ideas is $-.01$ -- see Appendix A!)

Extensions to other situations. Examination of colleague roles should be helpful in understanding any situation in which people interact in making decisions. Moreover, role nets provide bases for comparing different organizations in the ways they make decisions. Let us consider some examples.

1. Comparative studies of organizations. Would similar role nets be found in an academic department or research institute as in this NASA laboratory? What kinds of role nets characterize decision making in a functional, project, or matrix organization? Would similar role nets characterize banks in Brazil and in the United States or Japan?
2. Inter-organizational relations. Jaques, Farris, and Sirota (1971) found that some international organizations handled their communications with subsidiaries more effectively than others. What colleague roles were performed by whom to allow some firms to overcome the effects of geographical distance? Interactions with certain congressional committees are of critical importance for the State Department. What roles are related to the effectiveness of these inter-organizational relations? Who performs them?
3. Non goal-congruent situations. The theoretical model developed in this study was based on a situation in which

the various persons involved had relatively similar or congruent goals. In many situations, however, goals are either ambiguous or in conflict. Does the relative importance of the four colleague roles described in this paper change? Do additional roles become important? In the process of technical assistance, for example, goals are not always clear, and often conflicts of goals exist between the "donor" and the "recipient." In such situations, the technical link-pin role may be much less important than it appears on the surface; power equalization and organizational linking may well be more important.

4. Small group studies. Just as Bales (1950) has coded aspects of the process of group discussions and Hoffman (1961) has coded the valence of cognitions in problem-solving groups, it would be possible for outside observers to code the performance of colleague roles in a controlled experimental situation. Do more innovative groups have more or fewer members who are useful for their original ideas? Is non-evaluative feedback or critical evaluation more helpful, and under what conditions?

These are but a few ideas for extending this preliminary work on colleague roles and role nets. If they are successfully applied, they should increase our understanding of social psychological factors in decision making in organizations and provide insights to aid in managing the process.

Footnotes

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References

- Allen, T. J., & Cohen, S. I. Information flow in research and development laboratories. Administrative Science Quarterly, 1969, 14, 12-19.
- Andrews, F. M., & Farris, G. F. Supervisory practices and innovation in scientific teams. Personnel Psychology, 1967, 20, 497-515.
- Argyris, C. The incompleteness of social-psychological theory: Examples from small group, cognitive consistency, and attribution research. American Psychologist, 1969, 24, 893-908.
- Bales, R. F., Interaction process analysis: a method for the study of small groups. Reading, Mass.: Addison-Wesley, 1950.
- Beals, A. Relationships between control and effectiveness in Brazilian development banks. Unpublished M. S. thesis, M. I. T., 1970.
- Beals, A. L., Farris, G. F., & Butterfield, D. A. Communication in the Brazilian development banking system -- a preliminary report. Sloan School of Management, M. I. T., Development Banking Project Working Paper No. 27, 1970.
- Berlew, D. E., & Hall, D. T. The socialization of managers: the effects of expectations on performance. M. I. T. Sloan School Working Paper No. 125-65, 1965.
- Capitanio, F. An examination of the relationship between years of tenure and the attitudes and performance of scientists and engineers. Unpublished M. S. thesis, Sloan School of Management, M. I. T., 1969.
- Collins, B. E., & Guetzkow, H. A social psychology of group processes for decision-making. New York: Wiley, 1964.
- Cyert, R. M., Simon, H. A., & Trow, D. B. Observation of a business decision. Journal of Business, 1956, 29, 237-248.
- Edwards, W. Behavioral decision theory. In P. R. Farnsworth et al. (Eds.), Annual Review of Psychology, 1961. Vol. 12. Palo Alto: Annual Reviews, 1961. Pp. 473-498.
- Farris, G. F. Applied psychology, development banking, and economic development in Latin America: status report on an attempt to build a national system of development banks. Proceedings of the XVth International Congress of Applied Psychology. Amsterdam: Swets and Zeitlinger, 1969.

- Farris, G. F. Some antecedents and consequences of scientific performance. IEEE Transactions on Engineering Management, 1969, EM-16, 9-16. (a)
- Farris, G. F. Organizational factors and individual performance: a longitudinal study. Journal of Applied Psychology, 1969, 53, 87-92. (b)
- Farris, G. F. & Lim, F. G., Jr. Effects of performance on leadership, cohesiveness, influence, satisfaction, and subsequent performance. Journal of Applied Psychology, 1969, 53, 490-497.
- Farris, G. F. & Butterfield, D. A. Are current theories of leadership culture-bound? an empirical test in Brazil. M. I. T. Sloan School Working Paper No. 529-71.
- Feldman, J., & Kanter, H. E. Organizational decision making. In J. G. March (Ed.) Handbook of Organizations. Chicago: Rand McNally, 1965, Pp. 614-649.
- Gertberger, P. G. The preservation and transfer of technology in research and development organizations. Unpublished Ph. D. dissertation, M. I. T., 1971.
- Guetzkow, H. Communications in organizations. In J. G. March (Ed.), Handbook of organizations, Chicago: Rand McNally, 1965, 534-573.
- Harary, F. Graph theoretic methods in the management sciences. Management Science, 1959, 5, 387-403.
- Hoffman, L. R. Conditions for creative problem solving. Journal of Psychology, 1961, 52, 429-444.
- Hoffman, L. R. Group problem solving. In L. Berkowitz (Ed.), Advances in experimental social psychology. Vol. 2. New York: Academic Press, 1965. Pp. 99-132.
- Jaques, F. M., Farris, G. F., & Sirota, D. Improving communications in the international firm. Unpublished manuscript, Sloan School of Management, M. I. T., 1971.
- Kahn, R. L., Wolfe, D., Quinn, R., Snoek, J. D., & Rosenthal, R. A. Organizational stress. New York: Wiley, 1964.
- Katz, D., & Kahn, R. L. The social psychology of organizations. New York: Wiley, 1966.
- Lawrence, P., & Lorsch, J. Organization and environment. Boston: Harvard Business School, 1967.
- Leavitt, H. Some effects of certain communication patterns on group performance. Journal of abnormal and social psychology, 1951, 46, 38-50.

- Likert, R. New patterns of management. New York: McGraw-Hill, 1961.
- Likert, R. The human organization: its management and value. New York: McGraw-Hill, 1967.
- Lorsch, J., & Lawrence, P. R. (Eds.) Studies in organization design. Homewood, Ill.: Irwin, 1970.
- Maier, N. R. F. Assets and liabilities in group problem solving: the need for an integrative function. Psychological Review, 1967, 74, 239-249.
- Merton, R. K. Social theory and social structure. (Rev. ed.) New York: Free Press, 1957.
- Miller, J. R. Professional decision-making. New York: Praeger, 1970.
- Pelz, D. C., & Andrews, F. M. Scientists in organizations: productive climates for research and development. New York: Wiley, 1966.
- Pounds, W. F. The process of problem finding. Industrial Management Review, 1969, 11, 1-19.
- Roethlisberger, F. J., & Dickson, W. J. Management and the Worker. Cambridge, Mass.: Harvard University Press, 1964.
- Rommetveit, R. Social norms and roles. Minneapolis: University of Minnesota Press, 1955.
- Schein, E. H. The individual, the organization and the career: a conceptual scheme. Journal of Applied Behavioral Science, 1971, in press.
- Swain, R. L. Catalytic colleagues in a government R & D organization. Unpublished M. S. thesis, M. I. T., 1971.
- Tannenbaum, A. S. Control in organizations. New York: McGraw-Hill, 1968.
- Taylor, D. W. Decision making and problem solving. In J. G. March (Ed.), Handbook of Organizations. Chicago: Rand McNally, 1965, 48-86.
- Thompson, J. Organizations in action. New York: McGraw-Hill, 1967.

Table 1. Intercorrelations among "number of times mentioned" for all colleague roles.

	B	C	D	E	F	G
A. Locating technical information.....	75	70	64	65	58	58
B. Help thinking.....		87	73	74	56	57
C. Evaluation.....			68	83	66	63
D. Original ideas.....				56	43	40
E. Fair hearing.....					82	72
F. Administrative help.....						81
G. Division developments						

Note: All correlations are statistically significant at $p < .001$ level. In all tables, correlations are based on log-normal transformations of colleague role measurements, and decimal points are omitted.

Table 2. Correlations between number of colleagues named and performance.

<u>Colleague role</u>	<u>Performance</u>			
	<u>Innovation</u>	<u>Usefulness</u>	<u>Productiveness</u>	<u>Reports</u>
Locating technical information	18*	27***	10	11
Help thinking	08	25***	13	13
Evaluation	21**	33***	05	-00
Original ideas	10	26***	09	13
Fair hearing	11	22**	15	14
Administrative help	13	26***	15	13
Division developments	05	24***	05	00

* $p < .05$ (one-tailed test)

** $p < .01$ (one-tailed test)

*** $p < .001$ (one-tailed test)

Table 3. Correlations between number of times mentioned for colleague roles and past performance, past working environment, and number of people focal person mentions for colleague roles.

	<u>Colleague Role</u>						
	Tech Info	Help Think	Eval	Ideas	Fair Hearing	Adm Help	Div Devel
Past performance							
Innovation	36***	30***	36***	37***	32***	29**	20*
Productiveness	43***	34***	34***	31***	37***	25*	14
Usefulness	44***	37***	47***	36***	45***	37***	30***
Reports	15	06	06	13	-00	-00	-15
Past environment							
Involvement	22*	26**	15	25*	29**	32***	22*
Influence	23*	24*	24*	21*	24*	30***	33***
Communications	13	08	10	08	10	07	08
People focal person mentions for colleague roles							
Technical info	25***	23**	22**	25***	23**	26***	15*
Help thinking	20**	20**	20*	06	25***	39***	32***
Evaluation	26***	32***	36***	23**	34***	41***	36***
Ideas	17*	17*	24***	08	31***	33***	27***
Fair hearing	25***	22**	30***	26***	30***	34***	36***
Admin help	25***	17*	21**	16*	25***	28***	32***
Division devel	20**	16*	19*	21*	24**	27***	35***

* $p < .05$ (one-tailed test)

** $p < .01$ (one-tailed test)

*** $p < .001$ (one-tailed test)

APPENDIX A: PREDICTORS AND CORRELATES OF THE PERFORMANCE
OF COLLEAGUE ROLES: SOME PRELIMINARY FINDINGS

Table A-1. Correlations between number of times mentioned for colleague roles and personal characteristics.

Characteristic	Colleague Role						
	Tech Info	Help Think	Eval.	Ideas	Fair Hearing	Adm. Help	Div. Devel.
Abilities							
Creative	06	02	02	-01	02	08	07
Confidence in.....	32***	31***	28***	21**	26***	17*	28**
Motivation							
Involvement.....	28***	25***	24***	21**	23**	16*	17*
Importance attached to:							
Colleague character-							
istics							
Competence.....	10	15*	14	11	13	-00	-08
Congeniality.....	-22**	-20*	-17*	-21**	-20*	-20*	-16*
Respect.....	02	-05	07	02	08	05	00
Using skills.....	-05	-11	-05	-04	-08	-10	-14
Salary.....	-09	-13	-11	-11	-01	-05	-05
Advancement.....	-08	-13	-12	-10	-03	-00	08
Fair evaluation.....	-04	-04	-03	-00	-06	-09	-05
Feeling of accom-							
plishment from:							
Developing personnel...	19*	23**	23**	05	14	10	13
Innovation.....	20**	22**	27***	32***	22**	10	09
Productiveness.....	-07	-07	-03	01	-07	-08	-04
Usefulness.....	-08	-10	-11	-07	-00	-01	01
Meeting expected							
standards.....	-24***	-18*	-21**	-24**	-16*	-12	-08
Exceeding expected							
standards.....	-27***	-17*	-07	-09	-05	-04	-03
Working styles							
Map broad features.....	29***	37***	33***	25***	29***	36***	35***
Lone wolf.....	-24***	-26***	-33***	-13	-35***	-42***	-48***
Right-hand man.....	-10	-14	-15	-23**	-09	-04	01
Reading habits.....	23***	13	02	17*	03	04	07
Other							
Seniority.....	26***	21**	23**	03	27***	34***	38***
Education.....	34***	30***	33***	23**	23**	13	14

* $p < .05$ (one-tailed test)

** $p < .01$ (one-tailed test)

*** $p < .001$ (one-tailed test)

Table A-2. Correlations between number of times mentioned for colleague roles and perception of reward system.

Colleague Role

	Tech Info	Help Think	Eval.	Ideas	Fair Hearing	Adm. Help	Div. Devel.
Perception of reward System for:							
Developing personnel...	-07	01	-01	02	10	14	07
Innovation.....	-02	-05	07	-08	02	05	-02
Productiveness.....	-14	-13	-06	-08	-16*	-20*	-21**
Usefulness.....	09	09	11	20*	06	06	02
Meeting expected standards.....	-14	-10	-15*	-08	-11	-12	-15*
Exceeding expected standards.....	-03	-01	-01	-06	-02	-00	-10

* $p < .05$ (one-tailed test)

** $p < .01$ (one-tailed test)

*** $p < .001$ (one-tailed test)

Table A-3. Correlations between number of times mentioned for colleague roles and communications patterns.

Colleague Roles

Tech Info	Help Think	Eval.	Ideas	Fair Hearing	Adm. Help	Div. Devel.
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Contacts

In division

Number named by focal person.....	38***	38***	38***	28***	40***	38***	39***
Times named by others....	60***	63***	62***	58***	55***	48***	54***
Number of people talked to.....	43***	44***	47***	31***	46***	48***	48***
Number of people talked to in center.....	19**	25***	23**	08	24**	27***	28***
Number of people talked to in organization.....	34***	32***	34***	17*	40***	46***	41***
Number of people talked to outside organization...	31***	34***	34***	22**	39***	42***	38***
Ease in communicating ideas.....	18*	12	17*	17*	19*	15*	11
Familiar with work							
Number named by focal person.....	15*	04	16*	06	10	11	08
Times named by others....	64***	70***	76***	55***	81***	77***	68***

* $p < .05$ (one-tailed test)

** $p < .01$ (one-tailed test)

*** $p < .001$ (one-tailed test)

Table A-4. Correlation between number of times mentioned for colleague roles and working environment.

<u>Colleague Roles</u>							
	Tech Info	Help Think	Eval	Ideas	Fair Hearing	Adm. Help	Div. Devel.
Influence	04	18*	15*	19*	17*	06	02
Supervisor's skills							
Technical							
Critical evaluation.....	-07	-07	-03	-08	-11	-12	-07
Understanding of work.....	-04	-01	-05	-06	-09	-18*	-12
Human relations							
Encouragement.....	-00	-00	05	-11	11	02	01
Work together.....	-14	-14	-11	-11	-10	-16	-07
Recognition	02	-02	06	-00	11	08	08
Administrative							
Inter-group relations...	-10	-13	-07	-04	-07	-07	04

* $p < .05$ (one-tailed test)

** $p < .01$ (one-tailed test)

*** $p < .001$ (one-tailed test)

Table A-5. Correlations between number of times mentioned for colleague roles and rewards, mobility, and performance.

	Colleague Roles						
	Tech Info	Help Think	Eval.	Ideas	Fair Hearing	Adm. Help	Div. Devel.
Rewards							
Provision for:							
Colleague characteristics							
Competence.....	09	05	07	-04	09	08	12
Congeniality.....	-05	-03	-01	05	01	-02	05
Respect.....	18*	15*	13	05	12	03	-02
Using skills.....	10	05	07	09	05	-02	-01
Salary	20*	29***	26***	17*	24***	20**	16*
Advancement	18*	24***	28***	13	32***	36***	29***
Fair evaluation.....	10	06	16*	-01	17*	11	09
GS level	09	10	02	00	08	08	-02
Mobility							
Ease of new job.....	06	-01	09	-02	11	10	11
Propensity to leave.....	06	03	-03	04	-11	-10	-08
Performance							
Innovation.....	45***	44***	39***	50***	30***	27***	18*
Productiveness.....	46***	41***	32***	45***	33***	31***	24**
Usefulness	51***	47***	46***	42***	49***	51***	45***
Reports	02	11	08	10	06	13	11

* $p < .05$ (one-tailed test)

** $p < .01$ (one-tailed test)

*** $p < .001$ (one-tailed test)

Figure Captions

Figure 1

Some Factors in the Process of Executive
Decision Making

Figure 2

General Theoretical Model
for
Identifying Key Men

Figure 3

Percent of Scientists with Different Seniority
Who are Mentioned for "Technical" Colleague Roles

Figure 4

Percent of Scientists with Different Seniority
Who are Mentioned for "Administrative" Colleague Roles

Fig. 1. Some Factors in the Process of Executive Decision Making

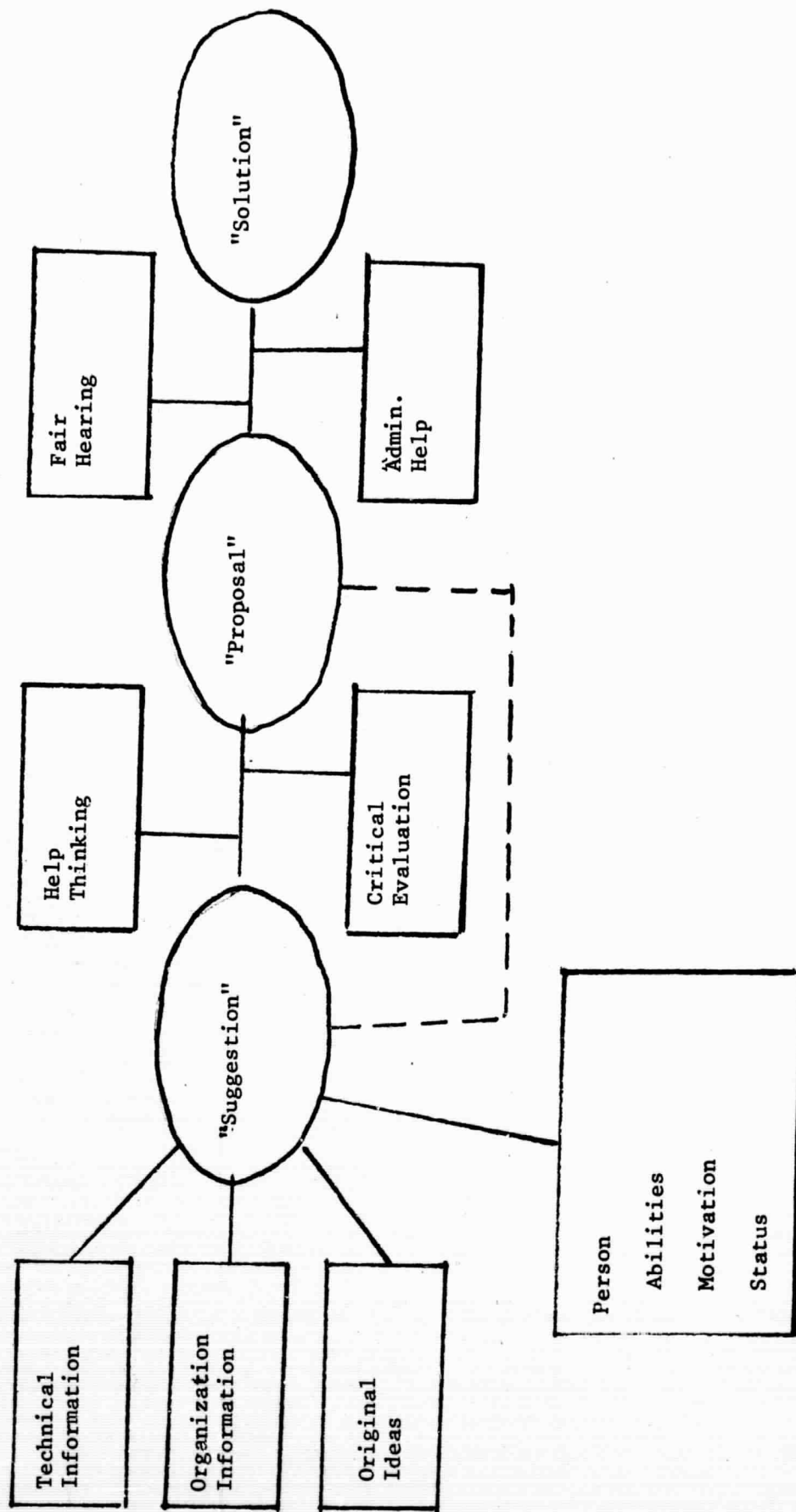


Fig. 2. General Theoretical Model for Identifying Key Men

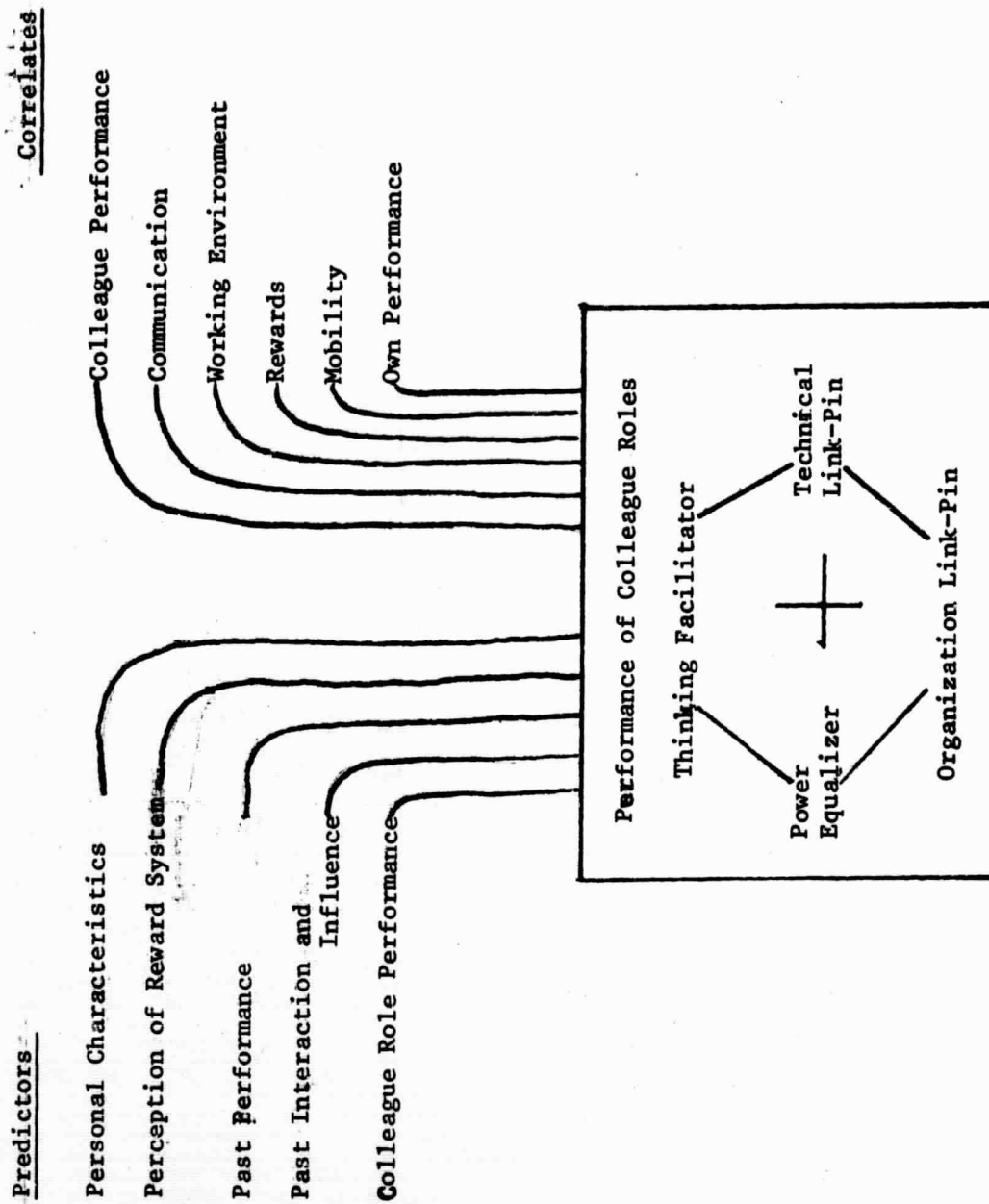


Figure 3. Per cent of scientists with different seniority who are mentioned for "technical" colleague roles.

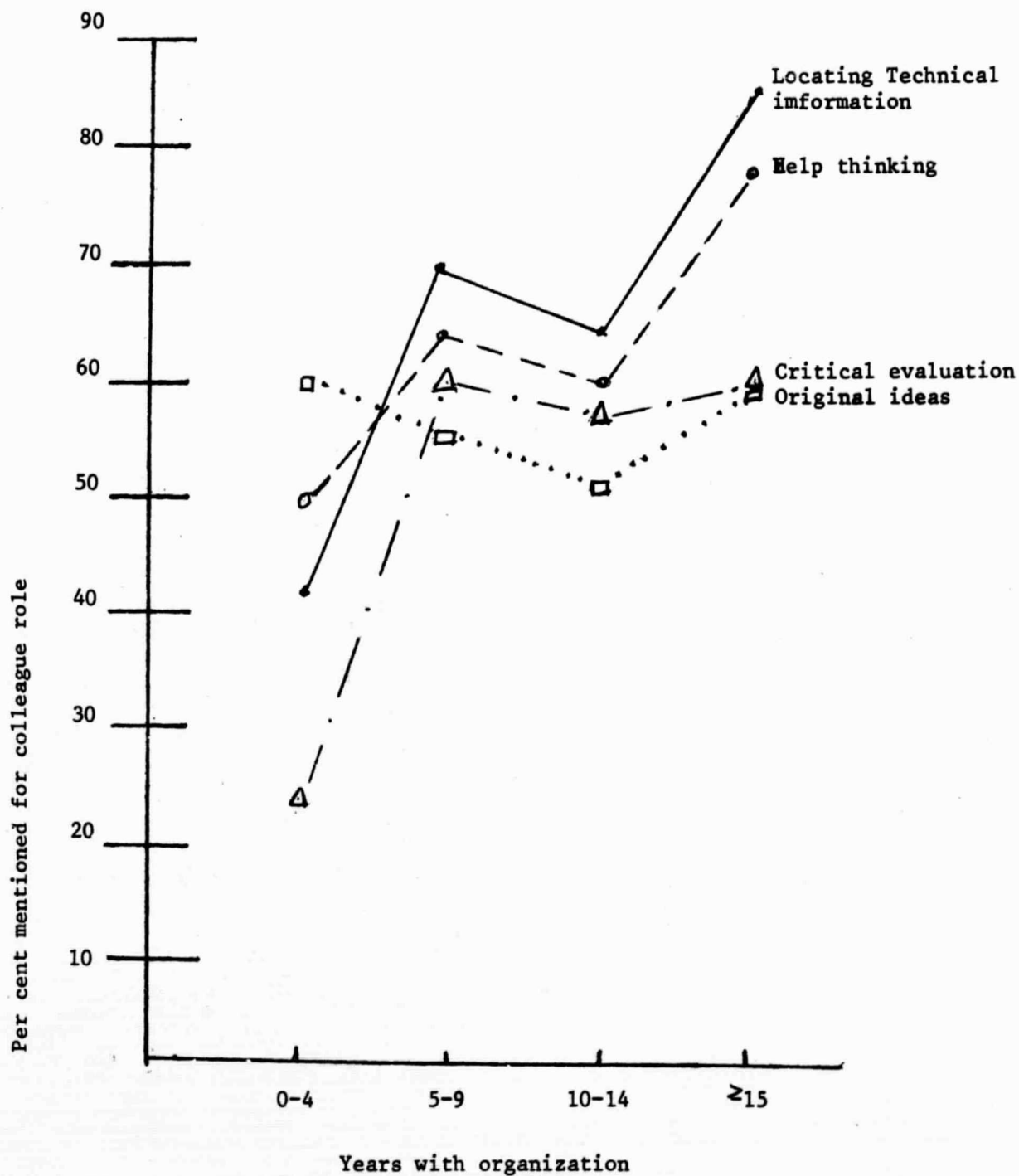


Figure 4 . Per cent of scientists with different seniority who are mentioned for "administrative" colleague roles.

