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AUTHOR Shapero, Albert; And Others
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ABSTRACT

A study conducted in a non profit research and development organization and the technical development department of a profit corporation was designed to develop and implement interventions that would modify the information-communication behaviors of the technical professionals in these organizations, and to measure and analyze the effects of the interventions undertaken. Special features of the methodology include an STI user view which emphasizes a market-centered approach based upon the wants and predilections of the real-world users, as opposed to the technology centered viewpoint which attempts to push user acceptance and usage of available technologies; a design perspective rather than a science research perspective; and field studies employing interventions which are measured longitudinally in two different organizational contexts. The four interventions studied include the hiring of a "high communicator"--the individual who tends the gates of technical information flow within an organization; the rearrangement of offices and people within a department; the resignation of a "high communicator"; and the progress of individual projects through time. Findings suggest a need for a close look at the "high communicator" concept to account for the professionals' individual differences in function and style, as well as differences encountered over time. The self time study method is suggested as one fruitful means of providing some measurement of process which is necessary to further understand the phenomena. (Author/MBR)

THE EFFECTIVE USE OF SCIENTIFIC AND TECHNICAL INFORMATION IN INDUSTRIAL AND NON-PROFIT SETTINGS: A STUDY OF MANAGERIAL INTERVENTIONS

by

ALBERT SHAPERO, D. MAITLAND HUFFMAN AND ALBERT M. CHAMMAH

DEPARTMENT OF MANAGEMENT

UNIVERSITY OF TEXAS AT AUSTIN

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PREFACE

The study reported here was conducted under Grant Number SIS75-12725 with the User Requirements Program of the Office of Science Information Service of the National Science Foundation.

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CHAPTER I

INTRODUCTION

"Knowledge is of two kinds: we know a subject ourselves, or we know where we can find information upon it."

- Boswell's Life of Dr. Johnson (1924 Edition)

"...slippages.....in the system for distributing information produced damaging inefficiencies.....twenty years after men had learned that it was not sensible to build locks of wood, proprietors of a small canal three hundred miles away were trying with disastrous results to build wooden locks..."

- Morrison (1974)

Every profession is denoted by specialized competencies and a set of norms and values that define the rules of entry into the profession and the behaviors expected of its practitioners. More important, at the heart of every profession is a specialized body of knowledge, usually of high intellectual content, which is applied by its practitioners to the practical concerns of society. Those in a profession engaged in research are at work enlarging the relevant body of knowledge, and those engaged in development or practice draw upon the profession's body of knowledge, transforming it for use in specific applications. Thus, all professionals are concerned with the process of transforming information from one state (e.g. symptoms, design objectives, specifications, instrument observations) to another (e.g. prescriptions for treatment, designs, formulations and reports).

From the information transformation view of professional activity, it can be reasonably concluded that the effectiveness and efficiency of any professional's efforts are importantly affected by the quality, quantity and timeliness of the information available and receptiveness to it. The importance of the role of information and its dissemination in science and technology has long been recognized particularly in the conduct of research and development (R&D), and has resulted in the development of a growing body of knowledge concerned with the production, storage and dissemination of scientific and technical information (STI).

The results from studies in a number of fields provide fairly substantial support for the conclusion that any improvement in the way R&D workers obtain, communicate and use STI can have a direct effect on the efficiency and success of their efforts. There are studies that identify the types of individuals, communication patterns, social-professional practices and spatial relationships associated with productivity in R&D (e.g. Allen, 1977; Gerstenfeld and Gerstenfeld, 1967; Holland, 1970; Pelz and Andrews, 1966). Furthermore, a number of studies of how scientists, engineers and managers obtain information have identified individual and social patterns of information-communication behavior, systematic enough and diverse enough to suggest that it may be possible to intentionally modify work-related information-communication behavior in the direction of behaviors associated with high R&D productiviy (e.g., Allen, 1970; Crane, 1972; Crawford, 1971; Garvey, 1970; Libby and Zaltman, 1967; Menzel, 1970; Paisley and Paisley, 1971).

Despite the apparent importance of information-communication behavior in the conduct of R&D as well as in other technically related activi-

ties and despite the growing body of relevant research little has been done to transform available research results into managerial and design applications. Perhaps no area of R&D management offers so much potential for achieving large improvements in performance with relatively low effort as there is in improving the way technical professionals obtain, use and communicate STI. The importance of improving STI usage has been widely recognized, but emphasis, to date, has been on improving the technology for storing, retrieving and transmitting STI rather than on the human related processes that are the primary preoccupation of R&D managements. With regard to STI usage, the effort to translate research results into management oriented form, with a few notable exceptions (Allen, 1977 and Pelz and Andrews, 1967), have been very limited. Yet, any examination of the results of available studies are rich in potential management applications. Some examples of the possible management implications of research performed to date are offered in Table 1-1.

The study reported here was undertaken with a view to exploring the feasibility of systematically applying available research results on the information-communication behaviors of scientists and engineers with regard to STI to improvement of R&D management. The study aimed at exploring the feasibility of effecting "desired" or improved information-communication behaviors by scientists and engineers engaged in R&D in ongoing organizations by means of interventions based on findings from the literature on STI usage. The intended value of the study resides in its potential for identifying specific managerial means for enhancing STI usage in R&D organizations.

TABLE 1-1

Examples of the Managerial Implications of Selected Research Results Relevant to Information - Communication Behavior in Research & Development

FINDINGS	MANAGEMENT IMPLICATIONS
Scientists and engineers use informal channels of communication more than formal channels to obtain their work related information (Menzel, 1958; Auerbach, 1965; Rosenbloom and Wolek, 1967; Graham and Wagner, 1967)	Deliberate efforts should be made to design situations and mechanism that will permit informal exchange among project members and between project members and others in their field.
Managers depend primarily on personal rather than impersonal sources for their information (Aguilar, 1967)	Project managers should deliberately (and even formally) design for frequent personal, informal reporting from project members and to project monitors
Frequency of contact with colleagues within and outside their groups is associated with higher performance of scientists (Pelz and Andrews, 1966)	Every effort should be made to encourage and to design for frequent interpersonal exchange among project personnel and between project personnel and others in their fields.
The frequency and total percentage of work related conversations with others takes place with those located in their vicinity (Marquis, 1967)	Locating project personnel together in a given building will generate more work related outputs, and should thus be encouraged.
Intergroup communication follows a systematic pattern of channel usage under conditions of uncertainty with telephonic communication increasing followed by an increase in face-to-face communication until the uncertainty passes. There is some indication that frequent face-to-face communication is associated with fewer and shorter periods of uncertainty. Written	Management should encourage and deliberately design for extensive use of telephonic communication and for face-to-face communications between members of different organizations engaged in research and development projects; particularly between monitor and prime contractor, prime contractor and sub-contractors.

TABLE 1-1 (continued)

Examples of the Managerial Implications of Selected Research Results Relevant to Information - Communication Behavior in Research & Development

FINDINGS	MANAGEMENT IMPLICATIONS
Certain individuals are disproportionately responsible for the acquisition and communication of scientific and technical information within organizations (Menzel, 1964; Allen, 1966; Allen, Gerstenfeld & Gerstenfeld, 1968). The individuals with high information-communication capabilities are identifiable in terms of their information acquisition and communication behaviors, in terms of interpersonal behavior characteristics and of their associative abilities as measured by the Remote Associations Tests (Holland, 1970).	Research project managers can consciously attempt to hire individuals who are so-called communication stars, or special communicators, using the information on their behavior and test responses to identify them. Once hired, every effort might be made to put them in a position, locate them and supply them with budgetary support for information acquisition and communication so that they can upgrade the total project information potential.
In interdisciplinary fields technical report usage will be higher than in single discipline fields (Sahanek, 1973).	Special attention should be paid to the provision of access to technical reports by those employed in interdisciplinary projects

Objectives of the Study and the Approach Taken

The objectives of the study were: 1) To design and implement interventions in cooperating R&D organizations with a view to modifying the subsequent information-communication behaviors of the technical professionals in those organizations, and 2) To measure and analyze the effects of the interventions undertaken.

The overall approach taken in this study was characterized by a number of features that determined the style of the study, the methods used, the results reported, and the potential utility of the results obtained. The key features that should be noted included an STI user view of the world which put the emphasis on 'pull' rather than 'push', a design perspective as differentiated from the more familiar science research perspective, and a methodology that consisted of field studies employing interventions and measured longitudinally in two different organizational contexts.

'Pull' Rather Than 'Push' - The study took a market-centered viewpoint that based itself upon the apparent wants and predilections of the users of STI in real world contexts; letting the market 'pull' improvements in STI usage. A Market-centered viewpoint is differentiated from a technology-centered viewpoint that is based upon the logic of the structure of some body of information and from the availability of apparently efficient technologies for storage and retrieval of STI; attempting to 'push' user acceptance and usage of the available technology. Consequently, the study efforts were concerned with interventions that utilized those key figures in STI flows called high communicators,[1] the spatial arrangements of professionals and the inter-

[1]The high communicator/star communicator/technological gatekeeper is a key figure in the STI research literature, who is reported to play a key role in the acquisition and transfer of STI.

personal networks of communication without consideration of the possibility of changing STI usage through changes in the means for storage and retrieval of STI. No doubt the most useful means for designing an organizational STI system would take advantage of both approaches, but, again, for the purposes of this study only 'pull' was considered.

The Design Perspective: Concern With 'How' Rather Than With 'Why' - This study grew out of a concern with improvement of management in the day-to-day world of R&D through the application of the growing body of research results from studies of the employment of STI in the performance of science and technology. Concern with applications means a focus on questions of 'how' to apply relevant research findings to specific R&D management problems rather than on questions of 'why' certain events are generally associated with STI usage in the R&D context. The applications bias puts this study into the frame of reference of design rather than of research.

There are important differences between the design perspective and the science research perspective, and it is important to understand the differences between the two perspectives for a good many failures to obtain successful transfer from research to applications can be attributed to the misapplication of the science research perspective to applications problems. Despite the use of similar instrumentation and analytical techniques in both kinds of endeavors, design and research differ in fundamental ways with regards to central purposes, values and processes.

Design is concerned with utility while research is concerned with explanation. The only measure of a design's success is that it works: it does what is required of it in specific situations within specified

constraints to the satisfaction of the client or user. Thus, the designer's concern is with how to make the design work whether or not he knows why it works. For example, we have a history of approximately 3500 years of using heat to deform metal for specific practical purposes, but are only now beginning to know why metal deforms the way it does with the application of heat. Knowing 'why' whould improve the effectiveness and efficiency of how we apply the process, but it is not necessary to wait for full explanation. Consequently, the designer is content with data of varying quality, and is less concerned with the niceties of proof. The designer interpolates and extrapolates, using existing empirical evidence drawn from various sources and academic disciplines, and filling the gaps with personal judgements.

Where the designer is concentrated on the specific solution, the science oriented researcher is concerned with generalization and explanation, and with establishing,

> "...general laws covering the behaviour of the empirical events or objects with which the science in question is concerned.....and to make reliable predictions of events as yet unknown." (Braithwaite, 1955)

And another philosopher of science puts it,

> "...the distinctive aim of the scientific enterprise is to provide systematic and responsibly supported explanations..." (Nagel, 1961)

Essentially the science explanation is never finished, and is required to be vulnerable to the next replication and the next experiment. The objective of the scientist is to "achieve a consensus of rational opinion over the widest possible field" (Ziman, 1968), and his facts and theories must survive a period of critical study and testing by

other competent, disinterested individuals. Proof is in the critical testing by others and in the laboratory. Methodology is vital to the proof, and questions of statistical significance determine whether or not a particular piece of work is made public at all.

The designer, on the other hand, hangs the fate of his design on engineering test, or as the British express far more aptly, on "trials". Trials have as their purposes the following:

1. To determine if the element, process or unit can be accepted by the 'customer'; that is that it works at an acceptable level which can mean meeting a very tightly specified set of performance criteria in one situation, or in another situation just establishing movement in the right direction. At the conclusion of trials, the decision might be made to 'go into production', or to abandon the particular effort or approach taken.

2. To provide feedback that will enable the designer to adjust the design, provide for unforeseen and undesirable systematic behaviors or to better cater to the customers,wants. Many previous unknowables only become visible in trials.

3. To uncover lacunae in our knowledge, and, thus, the need for more research.

Trials provide evidence upon which designer and client decide whether they can put the design into practice. Proof is an agreement that it seems likely that the design will work well enough in the intended situation, and that the design can go into production, practice or use without serious problems. The acceptable level of significance is situational. Where life, organizational survival or political safety is at risk the acceptable level of significance may be far

tighter than that acceptable for publication in a scientific journal. Where non-sensitive operations are under consideration, the acceptable level of significance may be quite gross; and movement in the right direction might be considered good enough.

The efforts undertaken in the study being reported here should be considered as a set of trials in which a number of interventions were undertaken in ongoing profit making and nonprofit organizations engaged in R&D with a view to seeing if they 'work'; that is, if they achieve apparent movement or changes in the information-communication behaviors of the technical professionals in those organizations in predescribed, desired directions in the time periods allotted to the study.

On Field Studies and Interventions in Ongoing Organizations - As originally planned, the study was to consist of a number of field experiments in which planned interventions were to be fielded in cooperating organizations, and the effects of those interventions measured over time. As finally carried out, the study consisted of a number of natural experiments in which advantage was taken of relevant natural interventions to measure their effects over time in the cooperating organizations.

A laboratory experiment simplifies life in its design, severely limiting the number of variables entailed in order to obtain some degree of 'control' and in order to be able to draw relatively unambiguous conclusions from the results obtained. The laboratory also radically simplifies life for the investigator since it is much easier to attribute causality in the severely limited situation in the laboratory. However, among the variables that are excluded in

the laboratory situation are those that come under the heading of context, that host of interacting variables vital to the actions and attitudes of humans working in organizations. It is the lack of context that has severely limited the application of the results of much of organization research conducted under laboratory conditions.

> The essential difference between field and laboratory experiments turns on that vague thing called setting. This refers to nothing less than the total environment in which the experiment takes place. This total environment must be seen as a complicated field of stimuli in which each stimulus possesses the potential to influence the dependent variable... Caporaso (1973)

In choosing to carry the study into the field, the decision was consciously made to intrude into contexts that can never be 'controlled' in the laboratory sense of the word. The choice was guided primarily by considerations of context, by the desire to operate in contexts that are actual rather than simulations, and thus to obtain a measure of richness even if it meant foregoing a considerable measure of rigor. The choice, however, was also in keeping with the design viewpoint which demands realistic trials of given interventions in order to fill in the gaps between projections from the laboratory and real situations. As originally conceived, the study was to formulate and introduce specific interventions in the conduct of work in cooperating organizations. For each intervention, the intention was to project desired kinds of changes that should be expected in the information-communication processes of the cooperating organization. Success in such an effort could be measured in terms of whether or not the expected changes did occur in the expected directions and whether or not the amount of change was recognizable and considered useful from a management viewpoint.

As has been already pointed out, the original intentions were necessarily modified. The problems encountered in the course of the research are well described by Rosalie Wax (1971) in her book of doing fieldwork,

> "A fieldworker usually goes into the field with a research proposal composed, in part, of hypotheses, well-planned questionnaires, and ingenious tests. But, in point of fact, he does not know what he is going to do. All he knows is what he hopes to try to do..."

Carrying out a trial intervention in an actual, ongoing, socio-economic environment, at best, is fraught with uncertainty and countervailing efforts. Others are carrying out their own interventions within the same organizational space, confounding the neatness and orderliness that is idealized in experimental research. Management is following its necessary macro-agenda and micro agendas. At the macro level, management is doing those things that have been planned, budgeted, and accepted as the overall direction of the organization. At the microlevel, management struggles to impose orderliness on the chaos of daily events; improvising, responding to unexpected stimuli, putting out fires, holding together the organization in the face of the rush of unknowable events.[1]

The researcher/intervenor is always an intruder in the organization or community being studied. The organization's managers and

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[1] Operating managers are found to be interrupted every 15 to 30 minutes, on the average. They spend 40 to 60% of their days in meetings (most of which they did not plan), very little of their time on events that last longer than 10 minutes, and, according to the many time studies that have been reported, approximately 15% of their time on the telephone. The numbers that are cited come from the growing number of studies that have been made of how managers actually spend their time. The studies have ranged from that of Carlson (1959) who studied top executives in Europe to that of Mintzberg (1973) in the U.S.

workers have their own business to attend to, their own rhythm to march to, and their own anxieties concerning schedules, budgets and technical performance. Consequently, the researcher is always an added variable, an added source of uncertainty in a world of uncertainties. The more stable the endeavor being studied, the more certain its processes and outcomes, the more likely it is to be tolerant of the outside researcher and his demands on the organization. An organization that has been making the same product, in the same way with the same people over years is even likely to welcome the outside researcher as a source of diversity, an entertainment to break up the monotony. Science and technology endeavors fall at the other end of the spectrum where life is conducted under conditions of high uncertainty. The more an organization is engaged in small, short-term contract-project activities, the more it works under the severe pressures of schedules and budgets, the more it is difficult for an outside researcher to intrude within its space.

It is no accident that surveys and questionnaires make up the bulk of measuring instruments used in the study of scientific and engineering organizations and their people. With the questionnaire administered to the organizations that participated in the study being reported here we had to return several times to get the necessary responses.

Many interventions were discussed with the cooperating organization, and tentative agreements were received to proceed with various approaches. However, each intended intervention was delimited by "events" that intervened on their own. People left the organization. New people were hired. Projects changed. Contractual pressures

faced by the organizations being studied changed the tempo of work and the availability of key people. It soon became apparent that intended interventions would not be carried out in a manner that would satisfy the original intentions of the study[1]; to draw upon the available body of literature to fashion interventions that would effect predicted changes in the organization's information communication behavior.

Fortunately, or perhaps as might be expected in any dynamic situation in an American R&D organization, a number of events occurred which made it possible to select and conduct relevant natural experiments. Among the natural experiments that were made possible by autonomous events that occurred in the cooperating organizations were some concerned with that central figure in the literature on STI, the high communicator/technological gatekeeper/star communicator, some concerned with physical moves and some concerned simply with the progress of R&D projects through their natural cycles of performance from inception to completion. By undertaking 'natural' experiments as differentiated from planned 'field' experiments, the richness of context is still maintained. The major difference becomes one of manipulation. French (1965) puts it,

> "...In the field experiment, the manipulation of the independent variable is not left to nature but is contrived, at least in part, by the experimenter; thus, the design is planned beforehand..."

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[1] It should be noted that Dr. Charles Simon of Northwestern had anticipated and warned the research team of this problem, pointing out that any intervention would have to fit in very tightly with the ongoing needs of the management of the organization.

Barnes (1971) also quotes French in defining the 'natural field experiment' and describes it as a situation in which the

> "...researcher 'opportunistically capitalizes upon some ongoing changes'...In the natural field experiment, members of the organizational system initiate and implement changes, while an outside researcher assumes the task of observing, measuring and analyzing the changes..."

Making the argument that the natural field experiment has several advantages over the classical design experiment, Barnes states,

> "...The natural experiment divides research roles by leaving the design and implementation of the experiments with management and the data collection and analysis with outside researchers.....each deliberately avoids influencing the other's work..."

Studies of interventions are perforce longitudinal. Longitudinal research overcomes many of the difficulties and problems encountered when trying to make process inferences from cross-sectional studies. Process is a time bound phenomenon, and it is difficult to make inferences from cross-sectional data concerned with a process. For example, knowing who the high communicators are in an organization at one point in time tells you little about the process how a high communicator becomes a source in the organization. One can only make inferences from cross sectional data as to how the individuals assumed their role or were incorporated into that role. Allen (1977) discusses the problem of establishing causality with regard to high-communicators or technological gatekeepers. He points out that technological gatekeepers are found to be first line supervisors to a far greater extent than their non gatekeeper colleagues. Allen raises the question of causality. Is it the key communicator with his additional information and his pushing of information who gets promoted, or is the first line supervisor's role one that enhances

him as a source of information?

The study by Taylor and Utterback (1974) illustrates the potential value of longitudinal studies in explicating the processes that occur in organizational information-communication behavior following structural and technological changes in organizations; the changes included changes in interaction between groups, variations in the new technical communication patterns that emerged in project groups as differentiated from functional groups.

Some of the advantages that are possible from longitudinal research include the following according to Kimberley (1976):

1. Longitudinal research facilitates attempts to establish causality. "...temporal precedence can be established, at least within the constraints of available data. Although this clearly does not solve the problems of the possible influence of other variables..."

2. It can help minimize the problems of inferring process from cross-sectional data. Most of the questions that are asked by organizational researchers focus on variables that interact and unfold in social time.

3. It permits accounting for contextual constraints in the research design.

Some of the issues that are inherent in longitudinal research include such questions as the following:

1. How long is longitudinal? There is no theory to guide the researcher in selecting appropriate data collection intervals, and we are not sure if we have missed vital short-term effects or stopped

short of the most important longer-term effects. "...In the immediate future.....we will have to be guided primarily by intuition..."

2. How many data collection points are necessary? Where there is no control of exogenous and endogenous variables, there is no great value in considering control groups. There is little in the way of theory to guide us in the choice of number of points of data collection. "...Practically, however, the number will most likely be determined by resource constraints, models of analysis used.....and the urgency of results."

3. And reliability? In the opinion of Kimberley the standard measurement responses are not useful, and the answer has to be based primarily on the nature of the problem being examined. The experience that typically is faced by the longitudinal researcher is nicely understated in the paper by Taylor and Utterback (1974), when they discuss their research method and the apparent opportunity offered them by a chance to compare the communication patterns and choices made in changing groups at two points, 18 months apart.

> "...By arranging for a second round of data collection using the same questions 18 months later.....we would be able to observe the adjustments.....We might even be able to use the initial data as a base for before and after comparisons.....(This has proved to be more difficult than we expected.)"

Research Methodology

The study was carried out as a selected set of natural experiments; each concerned with the effects of a selected intervention on the subsequent information-communication behaviors of the scientists and engineers engaged in R&D in nonprofit and profit-making institutional settings. In each of the natural experiments an intervention

was identified in the form of a deliberate and discrete action by management or key professionals. In each case, the intervention selected was one considered to be part of the natural repertoire of actions taken by managements in organizations, and which, according to the results of research on STI usage, could be expected to have some distinct and measurable influence on the patterns of technical information-communication of scientists and engineers. In each case a suitable intervention was identified, the research literature was reviewed and analyzed with the goal of determining the expected direction of change of the patterns of communications that might result from the intervention over time. The patterns of communication in the cooperating organization were mapped at two points in time to determine if the expected directions of change occurred. The results were analyzed from the viewpoint of whether or not desirable changes occurred in the direction of information-communication flows from the viewpoint of management rather than from the viewpoint of hypothesis testing. The specifics of the research methodology are discussed below in terms of the following:

1. The cooperating organizations and respondents
2. The selected interventions
3. The data collection means
4. First and second mappings
5. And in addition

1. <u>The Cooperating Organizations and Respondents</u> - Two organizations cooperated in the conduct of the study. Organization A was the engineering science division of a nonprofit, contract-project organization that is continuously engaged in proposing and carrying out a

large number and variety of projects. Very little hierarchical control is exercised except in maintaining budgetary control on the operations of the major subdivisions of the organization. A large amount of autonomy and responsibility is exercised down to the level of the project leader and individual professional. There is an awareness of the financial position of the organization at all levels that goes beyong that ordinarily experienced in corporate or governmental institutions. Organization B is a technical development division in a profit making organization that has large commitments with the Department of Defense. It is organized in a corporate mode, is bound by military security, and, on the average, deals with larger and longer term contractual commitments than is experienced in Organization A. Typically, a contract is concerned with the development of electronic gear for installation or incorporation in an aircraft or other type of vehicle. The respondents in Organization A consisted of 41 individual engineers and scientists who cited 44 professionals in the organization as sources of information (three of the professionals did not respond to the questionnaire that was administered). Some of the key demographic characteristics of the respondents are shown in Table 1-2 which follows. The respondents in Organization B consisted of 37 individual engineers and scientists. Some of their key demographic characteristics are shown in Table 1-3.

2. The Selected Interventions - The term 'intervention', as used here, refers to a human-caused, intentional perturbation in the natural flow of events in an organization that causes changes in that flow that would not otherwise have occurred. The class of 'interventions' that were the concern of this study are, of course, only one

TABLE 1-2

Variable	CHARACTERISTICS OF RESPONDENTS IN ORGANIZATION A					
	Range	Mean	Median		Distribution	
				Years	n	%
Age	23-57 years	35.8 years	36 years	23-25	6	15
				26-30	4	10
				31-35	7	17
				36-40	12	29
				41-45	6	15
				46-57	6	15
					41	101
Years of Technical Experience	1-33 years	11.7 years	10.5 years	0-5	10	24
				6-10	9	22
				11-15	12	29
				16-33	10	24
					41	99
Years with Organization	0-25 years	8.5 years	7.0 years	0-1	10	24
				2-5	5	12
				6-10	11	27
				11-15	8	20
				16-25	7	17
					41	100
Number of different Career organizations	1-4	2.4	2	No.	n	%
				1	11	27
				2	12	29
				3	9	22
				4	9	22
					41	100

TABLE 1-2 (continued)

		n	%
University Education	Highest degree		
	Some College	2	5
	Bachelors	12	29
	Masters	14	34
	Doctorates	13	32
		41	100
Type of university education			
	Material Science, Metallurgy, Metallurgical Engineering	5	12
	Ceramic Engineering, Geology, Chemistry	4	10
	Aero/Astrospace Engineering	8	20
	Applied Mechanics, Engineering, Mechanics, Mechanical Engineering	14	34
	Civil Engineering, Electrical Engineering, Engineering	3	7
	Physics, Math/Physics	6	15
	English	1	2
		41	100

TABLE 1-3

CHARACTERISTICS OF RESPONDENTS IN ORGANIZATION B

Variable	Range	Mean	Median	Distribution Years	n	%
Age	26-57 years	36.9 years	38 years	26-30	8	22
				31-35	7	19
				36-40	8	22
				41-45	7	19
				46-57	7	19
					37	101
Years of technical experience	1-28	12.4	11	0-5	8	22
				6-10	10	27
				11-15	8	22
				16-28	11	30
					37	101
Years with Organization	0-16	5.0	3	0-5	24	65
				6-10	5	14
				11-15	7	19
				16-	1	3
					37	101
Number of different career organizations	1-11	3.3	3	No.	n	%
				1	4	11
				2	13	35
				3	8	22
				4	5	14
				5	3	8
				7	2	5
				8	1	3
				11	1	3
					37	101

TABLE 1-3 (continued)

Variable		n	%
University education	Highest Degree		
	No College	5	13
	Some College	5	13
	Bachelors	15	39
	Masters	12	31
	Doctorates	2	5
		39	101
Type of University Education			
	Airo/Aerospace Engineering	6	21
	Mechanical Engineering, Engineering Mechanics	10	35
	Electrical Engineering	7	24
	Chemistry, Ceramics	2	7
	Physics	2	7
	Industrial Technology	1	4
	Management	1	4
		29	102

category or class of interventions selected from among the multitude of categories and levels that exist at any point in time in any given matrix of human events. An organization is one type of intervention in itself; a human created ensemble of individuals, rules, processes and equipments dedicated to generating outputs that might not otherwise have ever occurred. The simplest transformation of information or materials within an organization is an intervention. Management actions, the types of interventions with which this study was concerned, comprise another category of interventions that differs from the organization and the simple transformation in terms of the time and space encompassed. The management actions discussed here are concerned with affecting units of organizations over time periods stretching into a 'visible' future of six months to perhaps three years. By comparison, a total organization's time frame must be considered to be indefinite, while the time frame of a simple transformation of information or materials may be measured in seconds or minutes.

The management actions included in this study as interventions were selected on the basis of their pervasiveness in managerial practice, their apparent relevance to information-communication behaviors (as indicated by the research literature on STI usage), and by their amenability to unequivocal identification and measurement. The management actions that occurred during the early period of the study and that were deemed to best meet the criteria for inclusion were the following:

a. The hiring of a high communicator

b. The resignation of a high communicator who had been with the organization for a long period of time.

c. The rearrangement of offices and people within a department.

d. The progress of projects through time.

To manage is to intervene, and some of the interventions that managers make are more influential on subsequent flows of technical communications among the technical professionals in an organization than others. Key among the subjects that recur in the literature on STI usage by scientists and engineers are those that are concerned with that key figure, the high communicator/technological gatekeeper/star communicator. Thus, the addition of a high communicator to an organization and his subtraction through transfer or termination are among the key interventions available to a manager of R&D. Hiring, firing and transfer of personnel are among the most ubiquitous acts of management in any organization, and they are particularly important in the conduct of R&D.

R&D is a non-routine process that is man-dependent and man-centered. The R&D process is concerned with the production of one-of-a-kind outputs under conditions of great uncertainty, and it cannot be specified or controlled in detail. Furthermore, where attempts are made to control R&D tightly and in detail there is evidence that strongly suggests that the results are counterproductive (Pelz & Andrews, 1976; Gerloff, 1971). In effect, the competent professional sets the standards for his own work, and the manager of R&D has the choice of letting the professional do the job or doing the job for him. Consequently, the case can be made that the most important means available for the control of R&D by management is the hiring of competent, highly motivated, technical professionals (Shapero, 1977). Similarly, the case can be made that the exit from an R&D organization of a highly competent person must have a marked effect

on the subsequent efforts in the organization, at least in the short run.

Physical proximity and accessibility affect the pattern and frequency of technical communications between the technical professionals in an organization according to a number of studies that have been made of STI usage (Allen, 1977 summarizes much of the data to date). Furthermore, since the rearrangement of offices and workers is a frequent event in organizations, the decision to rearrange offices within a department can be considered a primary managerial intervention that affects the subsequent information-communication behaviors in an organization.

The very performance of an R&D project and its progress from one state to another is an intervention that must affect information-communication patterns. Projects, particularly large ones, have changing information needs at different stages of their progress, and a high likelihood of changing the patterns of information-communication in an organization. Though there have been few longitudinal studies of the changing patterns of communication during the life of a project, the differences noted between different fields of science and between science and technology suggest that different patterns might result from the very intervention of time.

3. The Data Collection Means - A variety of means were used to collect the data used in the study including both obtrusive and non-obtrusive means. The data collected included demographic information on the respondents in the cooperating organizations, data on the information-communication habits and preferences of the respondents,

maps of the locations of the various organizations and respondents, data on preferences for coworkers, travel, library usage and telephone usage, and on time with the organizations studied.

A questionnaire employing elements of questionnaires that have been used in previous studies (Holland, 1970) was used for some of the demographic data and for indication of choices of coworkers for various kinds of information and for "like to work with" (See Appendix A). Building on Holland's approach, the respondents were asked to indicate preferences (first and second choices) for sources of project/task information, state-of-the-art information and for research/laboratory information. The kinds of information were differentiated in order to determine differences, if any, in kinds of high communicators that might be identified in an R&D environment; particularly, since Holland had found, for example, that project/task information tended to be the domain of the first line supervisor rather than technical information.

Again, from Holland, the respondent was asked, "Please name the two members of your organization you would most like to work with." This question of liking was raised in order to determine whether and to what extent cited sources were preferred coworkers, or, put another way, how 'liking' relates to patterns of information flow within an organization.

Other data were obtained from existing documentation in the responding organizations such as library records of books, journals and reports checked out, telephone records, travel records, and maps of respondent locations in the buildings.

4. First and Second Mappings - After obtaining the cooperation of the nonprofit research organization identified as Organization A, entree was arranged, and a first distribution of the questionnaire was made in September 1975 to all members of the cooperating engineering division who were not on leave. Of the 44 members of the organization at that time, eventually, responses of some kind were obtained from 41 or 93%. The bulk of the other data used were obtained from the organization's library records and from the records of the central administration (including accounting data, telephone and travel records). A second distribution of the questionnaires was made 16 months after the first mapping.

5. And in Addition - As was pointed out, the study effort was considered to be in the nature of engineering trials, and, as with engineering trials, lacunae in the research literature were made evident, and additional efforts had to be undertaken to overcome some of the identified gaps if the study was to proceed. In attempting to determine the effects on subsequent information-communication behaviors of hiring a high communicator into the organization, it was found that there are no ready means for identifying a high communicator at the point of hiring.

Though many studies are available that discuss the high communicator's characteristics in general terms, no listing or instrument exists to differentiate or scale high communicators from others a priori. Though there are data concerning the information habits of high communicators, most of the data identify that individual on the basis of sociometric studies (e.g. who do you

go to for information?); which requires membership in the organization for some period of time. Consequently, it was necessary to devise means for predicting who would most likely show up as a high communicator once hired.

To overcome this gap so that the study could proceed, a means for identifying who was most likely to be a high communicator among the new hires (those with the organization for less than two years) was developed.

After the first mapping of the information source preferences of the respondents, there appeared to be obvious differences in the individuals identified as high communicators depending on the kind of information sought. The 'disaggregation' of the high communicators by kind of information sought, intrigued the study team, and an effort was made to obtain some data on the differences in information-communication patterns that might be associated with their identity with different kinds of information.

Using special self-time-study equipment provided by the Tensor Corporation, time study data were collected on ten of the scientists and engineers in Organization A. The ten individuals used in the study included individuals who had been ranked very highly as sources of information in the first round of data collection. The time study was exploratory in nature and was conducted to see if it was possible to determine patterns in the way variously ranked professionals (as sources of information) distribute their communications and information gathering efforts. It was reasoned that time usage as well as source and channel usage by high communicators might be one means

for usefully differentiating key sources from others, and, it was further reasoned, that a better understanding of the behavior of key people might provide information to help develop a basis for intervention in terms of training.

The data were collected at random intervals in terms of the activity being performed, who was contacted (if anyone) and the function being performed. In terms of the limited exploratory study, distinct differences between the very high selected sources of information and the average for the sampled group. The very high sources for all kinds of information were differentiated in the following ways:

CHAPTER 2

ENTRY: A HIGH COMMUNICATOR IS HIRED

> An American will build a house in which to pass his old age and sell it before the roof is on; he will plant a garden and rent it just as the trees are coming into bearing; he will clear a field and leave others to reap the harvest; he will take up a profession and leave it, settle in one place and soon go off elsewhere with his changing desires
>
> - Alexis de Toqueville (1835, 1966 edition)

The mobility of workers between organizations in the United States is so pervasive and has been such a typical feature of American life for so long that most Americans accept mobility as typical of industrial practice. It would be a matter of surprise to most Americans to learn that our mobility may be the characteristic that most denotes American Industry from that of other countries in the world. As young de Toqueville was amazed by the restlessness of Americans in the early 1800's, so visitors from Europe, Japan, and Latin America are amazed today at the ease with which American workers move between companies and regions.[1] A good case can be

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[1] Mobility is the hallmark of United States industry as compared to that in any other country. In studies that included data on the mobility of 35,000 scientists and engineers in the industries providing R&D to the Department of Defense and NASA, Shapero and his colleagues (Shapero et al., 1964, 1965; Draheim, et al., 1966) found that the average number of companies per scientist and engineer was 2.6. In a later, unpublished study of executive mobility that was undertaken as an expert witness in the case of Motorola vs. Fairchild, Shapero found that the average number of companies per executive for 20,000 executives was also 2.6.

made that the United States may be the only country in the world where professionals can change jobs without penalty.[2]

The positive effects of American mobility on the flow of technical information throughout our industry has not been measured in terms of its impact on the transfer of technology, the dissipation of attempts at company secrecy, and on a national willingness to try new things. Overall, and in the long run, the mobility of Americans appears to provide a kind of macroefficiency to our economy. Ideas move with people, and thus, are widespread in our very large economy. Some notion of the effects of mobility can be obtained from the data found in Table 2-1. Sales and profits of companies in selected industries were correlated to the average number of companies its executives had worked for. As can be seen from the data, in the long run, profitability was correlated with executive mobility for more than half of the industries studied. Furthermore, as can be seen in Table 2-1, after fifteen years more of the variation between companies in all of the industries studied could be explained by executive mobility.

Though the data in Table 2-1 support the notion that an overall efficiency is obtained from mobility by industry in the long run,

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[1] An analysis of hypothetical lifetime earnings of scientists and engineers with the bachelor's degree related to number of jobs held which was based on actual salary data of several thousand professionals showed little significant difference between those w stayed in one company ($489,000) or had worked in three ($482,000) or six ($467,000) (Shapero, et al., 1965).

TABLE 2-1

CORRELATIONS OF MOBILITY WITH SALES AND PROFITS BY INDUSTRY[1]

Industry	Correlations[2] Compound Growth Rates Sales 15 Years	Sales 5 Years	Profits 15 Years	Profits 5 Years
Broad Woven Fabrics	.54	.33	.09	-.15
Footwear	.63	.20	.59	-.35
Crude Oil and Natural Gas	.69	.36	.68	-.01
Department Stores	-.08	.03	-.17	-.13
Drugs	.00	.33	-.04	-.01
Communication Equipment	.72	.39	.73	-.02
Aircraft and Parts	.04	.50	.25	.36
Electronic Components	.03	.29	-.31	-.05
Radio/TV Broadcasting	.52	.37	.28	.15

[1]The data were collected in connection with expert witness testimony in a trial between two major corporations over alleged conspiracy to take away key executives and professionals from one of the companies in the case. Within each industry presented in Table 2-1 an analysis was made of the differences in the compound growth rate of sales and profits for each company in that industry. The analysis was oriented towards determining how much of the intra-industry differences in growth might be explained by differences in mobility among the various companies in each industry.

[2]This number may range between -1.00 and 1.00, where 1.00 implies complete correlation of sales/profits of an industry with mobility, .0 implies no correlation, and -1.00 implies complete negative correlation of sales/profits of the particular with mobility.

they also highlight the short term effects of mobility on companies. At the five year level there was a negative correlationship between profits and mobility for the sample of companies in most of the industries studied. High mobility acts to keep companies on what may be a never ending learning curve, constantly requiring the orientation and digestion of every new person and constantly requiring recovery from the loss of a key person.

The very pervasiveness of mobility in U.S. organizational life makes hiring, firing, transferring and quitting among the most used interventions by managers and workers. Furthermore, from what has been reported in the literature about the crucial role played by the high communicator in the flow of technical information in organizations it becomes evident that hiring, losing or transferring a high communicator may be one of the most available and effective interventions available to a manager of R&D. Consequently, managerial actions or reactions to the entry, exit and location of high communicators in the organizations studied were central to the study reported here.

Two natural interventions that occurred and were studied were concerned with that central figure in the STI user study literature--the high communicator. In one of the interventions, a high communicator was hired. In the second a high communicator of long standing in the organization resigned--made his exit from the organization. Given the importance of the high communicator in the information-communication patterns in an organization it seemed obvious that the

entry or exit of such a person from an organization must have some measurable effects on the information communication patterns that subsequently develop in the organization.

The literature would suggest that hiring a high communicator is one of the most efficacious actions a manager of technical professional activities can take with regard to improving the quantity, flow and use of technical information in his organization. Once that statement has been made, however, a number of questions arise relating to the practical implementation of such an action. What should we expect from hiring a high communicator? How long would it take a potential high communicator to take on that function within an organization that is new to him? How can we identify a person who would most likely be a high communicator for purposes of hiring? Are there necessary conditions that must be in place before a high communicator can act as such?

Who is the High Communicator?

Allen's pioneering study (1966) established the centrality in the information-communication process of that individual referred to in this report as the high communicator. Allen referred to that central figure as the technological gatekeeper, an individual who tends the gates of technical information flow within an organization. Others, in many contexts, have identified the same and similar functions and individuals; the great man who receives and transmits outside information (Glock and Menzel, 1958), the scientific troubador who is the carrier of select, know-how information (Menzel, 1964),

the information specialist who distributes relevant information to the group (Bernal, 1959; Rubenstein, 1961; Hodge and Nelsón, 1965), the internal consultant (Allen, 1966), the special communicator (Holland, 1972), the opinion leader who affects the adoption of innovations (Lazarsfeld, Berelson and Gaudet, 1958; Katz and Lazarsfeld, 1955; Katz, 1960; Coleman, Katz and Menzel, 1966), the internal linker (Hodge and Nelson, 1965). Other terms that have been used have included the following: key communicator, communication star.

The literature provides us with a number of findings concerning the information gathering characteristics, demographic characteristics, and characteristics as a worker of the high communicator. Some of the findings relevant to the study reported here are listed below:[1]

High communicators

- Read more than their colleagues
- Read more sophisticated (refereed) technical journals than their colleagues
- Participate more frequently in professional meetings and conferences than their colleagues
- Have and use more personal contacts outside the organization than their colleagues
- Have more intraorganizational contacts than colleagues
- Use more technical specialists within an organization than their colleagues

[1] Allen (1977) provides a good review of the literature to date drawing on his own work and that of others.

- Maintain close communication with other high communicators in their organizations
- Are high technical performers
- Present significantly more papers at professional conferences than their colleagues
- Do not differ from colleagues in age
- Are more likely to hold a doctorate or medical degree than their colleagues
- Are highly represented in first line management
- Are seldom with the organization less than five years and never less than two
- Tend to be used less as sources of information as they progress organizationally beyond first line supervisory level

Typically, studies of information-communication patterns in organizations identify the high communicator by means of a sociometric instrument by which professionals in an organization identify their choices of others as sources of information or as sources of important information. The most cited sources are identified as the high communicators, and are further examined in terms of their information gathering habits, demographic characteristics, and practices. All of the studies are a posteriori, and tell us who has come to play the role of high communicator and what his characteristics are now that he is there. Except for the longitudinal study of Taylor and Utterback, we know of no study which explicitly provides a means to predict, even retrospectively, who will become a high communicator.

Allen (1977) states,

> "....Seldom are gatekeepers found with fewer than five years in an organization and never with fewer than two...."

and, in another place, states,

> "....gatekeepers are most frequently found at the first level of technical supervision.."

Both of Allen's statements imply that to become a functioning high communicator in an organization requires a social process that takes years to accomplish. Allen's statements raise the question of whether or not it is feasible for managers to even try to identify and hire high communicators, particularly considering the high mobility rate among technical professionals. Allen makes a point that managements should do something to cut down on the time period required to bring an individual's high communication characteristics on-stream if, as he puts it, they are fortunate enough to have hired someone with the potential to become a high communicator.

Studying the Entry of a High Communicator into an Organization

Despite the unpromising outlook that seemed to face any attempt to study the entry of a high communicator into an organization the decision was made to proceed with such an effort. The decision to proceed seemed well justified considering the potential value to management of R&D if it was possible to systematically identify the potential high-communicator with any certainty, and to, subsequently, facilitate his ability to play the role.

To study the entry (and exit) of high communicators into an organization and his subsequent development into the role the following was done:

- The information-communication patterns in an organization identified as Organization A were mapped at one point in time to establish base lines for measurement of subsequent changes in pattern that might be attributed to given interventions.

- Means were developed for systematically identifying and ordering the high communicator potentialities of newcomers to the organization.

- The information-communication patterns in Organization A were mapped sixteen months after the first mapping to determine what changes had occurred if any.

- An analysis of the changes in information communication patterns was made to determine whether the newcomer(s) with an indicated potential for becoming a high communicator did move up in ranking as a cited source of information for any or all of the kinds of information identified in the study.

First mapping of the information-communication patterns in Organization A (See Table 2-2). Of the 44 professionals in Organization A (41 respondents to the questionnaire) 11 were cited (given as first or second rank as a source of information) at least once in all of the three categories of information (i.e., project/task, state-of-the-art and research/laboratory technique information) with the number of citations per individual ranging from

TABLE 2-2

DISTRIBUTION OF SELECTIONS OF PREFERRED SOURCES OF INFORMATION WITHIN ORGANIZATION A BY TYPE OF INFORMATION--FIRST MAPPING

Type of Information	Number of Selections Per Individual Source (n)	Number of Sources Cumulative (n)	%	Number of Selections Cumulative (n)	%
Project/Task Information	8	2	4.6	16	30.8
	6	1	6.9	6	42.3
	5	2	11.4	10	61.5
	4	1	13.6	4	69.2
	3	1	15.9	3	75.0
	2	3	22.7	6	86.5
	1	7	38.6	7	100.0
	0	27	100.0		
Total		44		52*	

*There were an additional 15 selections of sources within the institute but outside Organization A.

State-of-the-Art Information	12	1	2.3	12	18.8
	7	2	6.8	14	40.7
	4	1	9.1	4	46.9
	3	4	18.2	12	65.7
	2	9	38.6	18	93.8
	1	4	47.7	4	100.0
	0	23	100.0		
Total		44		64*	

*There were an additional seven selections of sources within the institute but outside Organization A.

TABLE 2-2 (continued)

Type of Information	Number of Selections Per Individual Source (n)	Number of Sources Cumulative (n)	Number of Sources Cumulative %	Number of Selections Cumulative (n)	Number of Selections Cumulative %
Research/Laboratory Information	10	1	2.3	10	17.2
	5	1	4.6	5	25.9
	4	2	9.1	8	39.7
	3	5	20.5	15	65.5
	2	5	31.8	10	79.3
	1	10	54.6	10	100.0
	0	20	99.9		
		44		58*	

*There were an additional 11 selections of sources within the institute but outside Organization A.

five (three individuals) to fourteen (one individual). Nine were cited at least once in two of the information categories with citations ranging from three (three individuals) to 17 (one individual cited only in the two technical categories of state-of-the-art and research/laboratory information). Eleven individuals were cited in only one category with three of those cited receiving between three and eight citations. Thirteen of the professionals received no citations at all.

There were 67 citations of individuals as preferred sources of project/task information (see Table 2-2), 15 of which were to individuals outside the organization being studied but within the overall parent organization. Of the 52 citations of individuals within the organization, 36, or 69% of the citations, were made to six individuals or 14% of the professionals in the laboratory. The citation of individuals within the parent institute but not within the organization studied is to be expected in a large project-contract research organization with a large number of small as well as large projects in process at any given point in time. The citation of 'outsiders' as sources for project/task information would not be as typical in a large-project, hardware-oriented organization. Twelve of the 15 citations of someone outside Organization A as a source of project/task information were to one individual who functioned in a clearly administrative role in the overall institution. Three of the members of Organization A were cited only for project/task information and not for either of the two technical information categories.

There were 71 citations of individuals as preferred sources of state-of-the-art information (see Table 2-2), seven of which were to individuals within the institute as a whole but not in the department being studied. Of the 64 citations made to professional within Organization A, 42 citations, or 66% were made to eight or 18% of the professionals in the laboratory. One person accounted for 12, or 19%, of all of the citations for state-of-the-art information.

There were 69 citations of individuals as preferred sources of research/laboratory information (see Table 2-2), 11 of which were to individuals within the institute as a whole but not within the department being studied. Of the 58 citations of professionals within Organization A, 38, or 66% were made to nine, or 21% of the professionals within the organization. One person (the same individual who accounted for 19% of the state-of-the-art citations) was cited 10 times, 17% of all of the citations for research/laboratory information.

Disaggregating the information source preferences according to type of information sought (i.e., project/task, state-of-the-art and research/laboratory) supported what, post facto, appears to be the obvious point that there is more than one kind of high communicator. The results of our fieldwork suggest that the high communicator role may be a collectivity of roles that have been lumped together under the omnibus envelope title of high communicator/

technological gatekeeper. Some of the individuals in Organization A did appear to function as omnibus high communicators, being cited as a preferred source for all three categories of information, but, if we separate the project/task information source data from the more clearly technical information source data we find some interesting differences between the results obtained in this study and the research results reported in the literature.

Perhaps the most interesting finding that came out of the disaggregation of information sources by type of information was concerned with the roles of supervision and high communication. Of the seven individuals who received three or more citations as a preferred source for project/task information, six were supervisors, both first and higher level supervisors (citation of higher level supervisors is to be more readily found in a contract-project, many small project research laboratory than in a more hierarchical hardware oriented R&D firm). Though supervisors were represented among those cited as preferred sources for technical information they were not highly represented among those cited most frequently. Of the seven individuals cited three or more times as preferred sources of state-of-the-art information only one had a supervisory title. Of the ten individuals cited three or more times as preferred sources of research/laboratory information, three had supervisory titles.

Another difference from the expected had to do with some of the information-communication behaviors of those cited as preferred

sources of technical information. The individual most cited as a preferred source in the technical information categories displayed none of the characteristics widely associated with the high communicator. He read little, did almost no traveling, used the telephone little, read no journals, wrote little. On closer investigation we found that particular individual highly prized for his talents in the structuring of laboratory projects and instrumentation.

Which newcomers are most likely to become high communicators? At the time the study was undertaken, no instrument or systematic technique was available to identify a priori which newcomers in an organization were most likely to become high communicators in that organization. To overcome the lack of instrument it was necessary to develop some means for differentiating among the newcomers to Organization A with regard to their potential for becoming high communicators within that organization using only the kinds of information available to an employer considering someone for employment. For the purposes of the study it was important that we take the viewpoint of a manager trying to hire a potential high communicator using the findings available from the research on high communicators.

Seven of the responding technical professionals in Organization A were judged to be 'newcomers'. The definition of a newcomer for the purposes of the study were all those who had been with the organization for less than two years. The two year cutoff was based

on Allen's statement, given above, that no high communicator develops into that role in less than two years. To differentiate among the newcomers as potential high communicators two analyses were made. One analysis made a comparison of the seven newcomers and ranked them as potential high communicators in terms of individual characteristics deemed relevant (on the basis of past research) and a second analysis used the technique of discriminant analysis to develop three discriminant functions to discriminate between those [redacted] those not cited as sources of each of the three kinds of information identified for the study (i.e., project/task, state-of-the-art, and research/laboratory).

In the first analysis the seven newcomers were compared with regard to their questionnaire responses to thirteen items that could be found in an employment application blank or employment interview at the time of hiring. The items used in the comparison included the following:

University training (degree level)

Years technical experience in field

Number of different career organizations

Patent applications past five years

Papers published past five years

Professional program participations past year

Unpublished papers written past year

Number of professional directory listings

Number of honors and awards past three years

Professional meetings attended past year

Professional journals read per month

Unpublished reports read per month

Communications with outside acquaintances per month

The data on the seven newcomers are shown in Table 2-3, and, as can be readily seen, one individual (#11) stands out as a potential high communicator with regard to most of the characteristics that have been found associated with high communicators in past studies. Despite the ease with which one can make an 'eyeball' selection of newcomer #11 based on the data shown in Table 2-3 questions arose to disturb the study team. Which of the variables really do discriminate the potential high communicator from others? How strong must an individual be with regard to any or all of the variables to be considered as a high communicator candidate? What is the relative weight of each of the variables with regard to discriminating the potential high communicator from others?

Development of the Discriminant Function. A discriminant analysis was employed to systematically evaluate the newcomers with regard to their information-communication potential for Organization A, and to answer questions concerning the relative weights of the variables used in identifying high communicators. Multiple discriminant analysis was used to distinguish between those cited as preferred sources and those not cited at all for each type of information (i.e., project/task, state-of-the-art and research/laboratory technique).

TABLE 2-3

CHARACTERISTICS OF NEWCOMERS IN ORGANIZATION "A" RELEVANT TO THEIR INFORMATION-COMMUNICATION POTENTIALITY

Variable	Individual 6	11	17	22	23	27	30
University training (degree)	MS	Ph.D	MS	M	B	B	MS
Technical experience in field (yrs.)	1	15	2	1	1	2	1
Career organizations (number)	2	4	1	1	1	4	1
Patent applications past five years	0	4	0	0	0	0	0
Papers published past five years	1	10	1	0	0	1	1
Professional program participant last year (number)	1	2	0	0	0	0	2
Unpublished papers written past year	1	24	0	0	4	0	4
Professional directory listings (number)	0	0	0	0	0	0	0
Honors/awards past three years (number)	0	7	0	0	0	0	0
Professional meetings attended last year (number)	2	2	1	0	1	8	10
Professional journals read per month	2	0	5	4	7	1	2
Unpublished reports read per month	10	16	2	0	6	2	5
Number of communications with outside acquaintances past month	1	20	3	0	10	2	2

A discriminant function was developed for each type of information source. For the development of each of the discriminant functions, 26 variables were used (see Table 2-4 for a listing of the variables and their means and standard deviations). A computer was used to carry out a stepwise refinement of each discriminant function, adding or subtracting one variable at a time until it was judged that continuing iterations would provide minimal gains (after 30-40 iterations).

The statistical measures used to indicate the degree of separation of the cited and noncited groups in each information category were canonical correlation and Wilk's lambda. The canonical correlation denotes the relative ability of the discriminant function to separate the groups. The higher the value of canonical correlation the better the separation. Canonical correlation squared can be interpreted as the proposition of variance in the discriminant functions explained by the groups. Wilk's lambda determines the probability that the difference between the two groups in each case occurred by chance. The smaller the lambda the more the discriminating power present in the function.

For each category of information source a discriminant function was derived, and the values for the coefficients of each of the included variables was computed. To overcome the differences in scale of the included variables, the variables were normalized to produce standardized discriminant function coefficients. Individual scores were computed for each of the

TABLE 2-4

MEANS AND STANDARD DEVIATIONS FOR VARIABLES SUBJECTED TO STEPWISE DISCRIMINANT ANALYSIS OF CITED FROM NONCITED SOURCES OF INFORMATION IN ORGANIZATION A

Variable	Mean	Standard Deviation
Age	36.75610	8.74008
University training	17.90240	1.80007
Years with organization	8.48780	6.77909
Years technical experience in field	11.68293	8.35595
Number of different career organizations	2.39024	1.11530
Number of people supervised	4.80488	14.84961
Number of people reported to	2.19512	2.36875
Patent applications past 5 years	1.02439	2.60277
Papers published past 5 years	6.68293	7.66955
Professional program participant past year	1.07317	1.31130
Unpublished papers written past year	5.19512	6.74989
Number professional directory listings	1.29268	3.57941
Number honors/awards past 3 years	1.02439	2.95371
Professional meetings attended past year	2.97561	3.15031
Professional journals read per month	4.87085	3.10810
Unpublished reports read per month	8.17073	13.70019
Percent unpublished reports from outside organizations	42.90244	37.17715
Communications with outside acquaintances	10.09756	10.46854
Number of outside communications for technical information	8.65854	9.84279
Number of outside communications in same technical field	7.02439	9.19643
Other fields in outside communications	1.60976	1.61056
Number of regular contacts internally with colleagues for project/task info	1.12195	7.60327
for state-of-art info	4.68293	4.49688
for research/lab info	4.12195	5.76713
Number of internal contacts in same technical field	6.24390	6.47217
Number different fields contacted in organization	4.21951	3.25202

individuals in the organization. The individual scores for each discriminant function were computed by multiplying each individual's raw score for each variable by the unstandardized coefficient for that variable, and then summing the products (variable scores by coefficients) and adding the constant for each of the equations. The scores of the newcomers were examined in terms of how they compared with regard to scores that represented membership in the group of those cited as sources. (Of course, it should be noted that the newcomers were included in the development of the discriminant functions, thus biasing the scores somewhat.)

The Project/Task Discriminant Function---The stepwise computer analysis for the project/task information discriminant function was terminated when 16 variables had been included.[1] The 16 variables and their standardized discriminant function coefficients were as follows:

Age	-.45299
Years technical experience in field	-.41128
Number different career organizations	-.02591
Patent applications past 5 years	.86351
Unpublished papers written past year	-.31739
Professional directory listings	1.09835
Honors/awards past 3 years	-.78870
Professional meetings past year	-.47377
Professional journals read per month	.33897
Unpublished reports read per month	-1.16759
Communications with outsiders	-1.68951

[1] Canonical correlation = 0.77989; Wilk's lambda = 0.39178; Chi-Square = 29.98610; D.F. = 16; Significance = 0.18; Prediction results -- 95.1% of cases correctly classified.

Number of above for technical information	2.25909
Number of above same technical field	-.25772
University training	-1.04840
Percent reports read from outside	-.14568
Professional program participations	.24174

The absolute magnitudes of the standardized discriminant function coefficients indicate the relative importance of the variables in the discriminant function. Thus, a variable with a coefficient of +2.00 contributes twice as much as coefficients of +1.00 or -1.00. The signs of the coefficients, negative or positive, indicate the position of the variable on an axis along which all members of the organization are arrayed according to their position in the two groups (i.e., the cited and the non cited). In the project/task information discriminant function the negative sign is in the direction that locates the group of those cited as perferred sources (The direction varies with each function.). Thus, the variable 'communications with outside acquaintances' with the largest negative coefficient, -1.690, contributes most to locating an individual in the group of those cited as preferred sources of project/task information.

The standardized discriminant function coefficients for the sixteen variables ranged from -1.68951 to +2.25909. In the case of this discriminant function the negative sign is in the direction of inclusion in the group of those cited as sources. The following variables had the most weight in locating an individual among those cited as preferred sources of project/task information:

Communications with outside acquaintances	-1.690
Unpublished reports read per month	-1.168
University training	-1.048
Honors/awards past three years	- .789
Professional meetings attended last year	- .474
Age	- .453
Years of technical experience in field	- .411
Unpublished papers written past year	- .317

The within group correlationships of the variables used in developing the discriminant functions provide some useful insights into the nature of the variables. The variable "unpublished reports read per month" was highly correlated with "number of people supervised" (.78328) and negatively correlated with "number of people reported to" (-.08153), suggesting that the unpublished reports read were internal reports and that reading them was a function of supervision. It further suggests that perhaps the latter variable should not have been included.

Examining the project/task discriminant function scores of the entire population of respondents, we find that they ranged from -3.899 to +2.864, and that the scores of the seven newcomers were as follows:

Individual	Score
#6	.342
11	-3.899
17	1.511
22	1.396
23	2.057
27	.631
30	- .164

The State-of-the-Art Discriminant Function---The stepwise analysis for the state-of-the-art discriminant function was

terminated at 16 variables.[1] The 16 variables and their standardized discriminant function coefficients were as follows:

Age	-1.12643
Years technical experience in field	.54743
Number different career organizations	- .12311
Patent applications past 5 years	.09261
Papers published past 5 years	- .08764
Unpublished papers written past year	- .62374
Number professional directory listings	.83070
Professional meetings past year	- .17023
Professional journals read per month	- .27477
Unpublished reports read per month	- .18426
Communications with outsiders	- .54064
Number of above for technical information	1.81616
Number of above in same technical field	-1.30941
University training	- .54706
Percent reports read from outside	- .31456
Professional program participations	.27405

The standardized discriminant function coefficients for the 16 variables ranged from -1.30941 to +1.81616, with the negative sign being in the direction of inclusion in the group cited as preferred sources. The following variables had the most weight in locating an individual among those cited as preferred sources of state-of-the-art information:

Age	-1.126
Unpublished papers written past year	- .624
University training	- .547
Communication with outside acquaintances	- .541
Professional journals read per month	- .275
Professional meetings attended past year	- .170

The within group correlationships of the variables showed that "number of communications with outside acquaintances in the same technical field" had a .96403 correlationship with "communication with outside acquaintances," an obvious relationship that suggests that

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[1] Canon[illegible] correlation = 0.69216; Wilks lambda = 0.52901; Chi-square - 20.[illegible]9; D.F. = 16; Significance = 0.184; Prediction results -- 82.9% of known cases correctly classified.

the two variables are practically equivalent. Another obvious correlationship is between "age" and "years of technical experience in the field," 0.93002.

The state-of-the-art discriminant function scores of the entire population of respondents varied from -3.099 to +2.525. The scores of the seven newcomers were as follows:

Individual #	Score
6	1.112
11	-3.099
17	1.642
22	.741
23	.510
27	.463
30	1.117

The Research/Laboratory Technique Discriminant Function---

The stepwise analysis for the research/laboratory technique discriminant function ended with sixteen variables.[1] The sixteen variables and their standardized discriminant function coefficients were as follows:

Age	.57839
Years technical experience in field	- .45817
Number different career organizations	.90489
Patent applications past 5 years	.45295
Papers published past 5 years	.57000
Professional directory listings	1.13286
Honors/awards past 3 years	-1.07217
Professional meetings past year	- .72102
Professional journals read per month	- .14702
Unpublished reports read per month	- .96937

[1] Canonical correlation = 0.69242; Wilks lambda = 0.52055; Chi-square = 20.89155; D.F. = 16; Significance = 0.183; Prediction results -- 80.5% cases correctly classified.

Communications with outsiders	- .10092
Number of above for technical information	- .36981
Number of above in same technical field	.59602
University training	- .22660
Percent reports read from outside	- .34751
Professional program participations	.68843

The standardized discriminant function coefficients for the sixteen variables ranged from -1.07217 to +1.13286, with the positive sign in direction of location among preferred sources. The following variables had the most weight in locating an individual among those cited as preferred sources for research/laboratory technique information:

Number of professional directory listings	1.133
Number of different career organizations	.905
Professional program participant past year	.688
Number of communications with outside acquaintances in same field	.596
Age	.578
Papers published past five years	.570
Patent applications past five years	.453

As with the state-of-the-art discriminant function, there was a high within-group correlationship between the variables "number of communications with outside acquaintances in the same field" and "communications with outside acquaintances."

The research/laboratory technique discriminant function scores of the entire population of respondents varied from +2.086 to -2.581, and, in this case, it should be reiterated that the positive sign is in the direction of location in the group of those cited as preferred sources. The scores of the seven newcomers were as follows:

Individual #	Score
6	-1.415
11	- .079
17	-1.444
22	- .608
23	-2.156
27	- .756
30	-2.581

Which Newcomer Should Be Considered the High-Communicator?

Examining the three sets of discriminant scores for the seven 'newcomers' one individual stands out clearly as the only one most likely to fill the role of an entering high communicator. The individual, identified as #11, ranks highest among all 44 members of the laboratory in terms of individual discriminant scores for inclusion in the cited groups for project/task information and for state-of-the-art information. In terms of the discriminant scores for inclusion in the cited group for research/laboratory technique information, #11 is by far the highest of the newcomers, but ranks 22nd among all individuals in the laboratory. None of the other newcomer scores placed them above 18th in rank for project/task, 27th for state-of-the-art and 25th for research/laboratory technique.

On the basis of the scores obtained through the discriminant analysis it could be reasonably assumed, given all of the methodological caveats, that individual #11 is a high communicator and that there should be a pronounced increase in the number of citations of him as a preferred source for information at the time of the second mapping of the information communication patterns of the organization.

Changes in the number of citations of individuals as sources of information from the first mapping to the second mapping. The results of the first and second mappings and the changes in numbers of citations of individuals as sources of information are shown in Table 2-5.

In the time between the two mappings some individuals were no longer in the organization studied, and new people had been hired. Five of those who had been included in the first mapping were no longer in the organization; one of them having been the most frequently cited source for research/laboratory-technique information and one of the most cited sources for state-of-the-art information. Those who left and who had been cited as first or second choices as sources of information, in effect, vacated citation spots to others who remained. Consequently, there had to be growth in the number of citations for those who remained in the organization by virtue of the very way the data were collected (requesting names of two most preferred sources for each category). In all, those who left vacated three citation spots for project-task infroamtion, eight for state-of-the-art information and 13 for research/laboratory-technique information.

As can be seen in Table 2-5, ten individuals gained 16 citations and five lost six citations; the difference in totals between the two data collections being accounted for by the fact that new people received some citations and not all respondents cited two selections of sources for each category of information during the two data collection efforts. As sources for state-of-the-art information, 13 people received an increase of a total of 18 citations while seven lost 11. As sources for research/laboratory technique information,

TABLE 2-5

CITATIONS OF INDIVIDUALS IN ORGANIZATION A AS SOURCES OF INFORMATION: NUMBERS OF CITATIONS FOR EACH OF THREE TYPES OF INFORMATION FOR EACH OF TWO TIME PERIODS

Individual	PROJECT/TASK CITATIONS			STATE-OF-THE-ART CITATIONS			RESEARCH/LAB TECH. CITATIONS		
	Time 1	Time 2	Change	Time 1	Time 2	Change	Time 1	Time 2	Change
1	1	1	0	3	2	-1	2	1	-1
2	6	6	0	7	10	+3	3	4	+1
3	8	9	+1	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0
5	1	2	+1	12	8	-4	1	0	-1
6**	0	0	0	0	0	0	0	0	0
7	8	11	+3	2	4	+2	3	4	+1
8	0	1	+1	2	2	0	3	4	+1
9	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0
11**	1	5	+4	2	5	+3	0	4	+4
12	0	0	0	2	1	-1	0	3	+1
13	0	0	0	1	1	0	2	4	+4
14	0	0	0	3	4	+1	0	1	0
15	2	3		2	3	+1	1	0	-1
16	0	0		0	0	0	1	3	+2
17**	0	1	+1	0	1	+1	0	0	0
18	2	1	-1	2	1	-1	3	2	-1
19	0	*	0	7	*	0	10	*	0
20	0	0	0	2	2	0	5	8	+3
21	3	5	+2	0	0	0	0	0	0
22**	0	0	0	0	0	0	0	0	0

*Individuals who had left by the time of the second round of data collection.

**"Newcomers"--those with Organization less than two years at time of first data collection.

TABLE 2-5 (continued)

Individual	PROJECT/TASK CITATIONS			STATE-OF-THE-ART CITATIONS			RESEARCH/LAB TECH. CITATIONS		
	Time 1	Time 2	Change	Time 1	Time 2	Change	Time 1	Time 2	Change
23**	1	0	-1	0	0	0	0	2	+2
24	5	6	+1	2	3	+1	4	4	0
25	0	1	+1	0	1	+1	0	0	0
26	0	0	0	0	1	+1	4	4	0
27**	0	0	0	0	0	0	0	0	0
28	4	3	-1	3	1	-2	1	0	-1
29	1	0	-1	4	3	-1	3	5	+2
30*	0	*	0	0	*	0	0	*	0
31	0	0	0	0	1	+1	1	2	+1
32	0	0	0	0	1	+1	1	0	-1
33	1	1	0	3	3	0	1	2	+1
34	0	0	0	1	0	-1	2	6	+4
35	0	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0	1	+1
37	0	0	0	0	0	0	0	0	0
38[1]	0	0	0	0	1	+1	0	1	+1
39[1]	0	0	0	1	0	0	0	0	0
40[1]	1	0	0	0	0	0	0	0	0
41[1]	2	*	0	1	*	0	2	*	0
42[1]	0	*	0	0	*	0	1	*	0
43[1]	0	0	0	2	3	+1	1	2	+1
44[1]	5	3	-2	0	0	0	2	1	-1

[1]Individuals #38-#44 did not respond to questionnaire though cited by others.

16 people received an increase a total of 30 citations while seven individuals lost a total of seven citations.

And What Did Happen with the Entering High Communicator?

The individual, #11, had been identified as an entering high communicator on the basis of the discriminant analysis scores that had been applied to all of the newcomers in the first mapping. In the second mapping, #11, showed the greatest number of gains in the organization in citations as a source of information for all three categories of information; receiving or tying for the highest number of additional citations in each category increases of four for project-task information, three for state-of-the-art information, and four for research/laboratory-technique information.

Examining the other newcomers and their relative changes in status as sources of information over time we can see from the data in the Table that one, #17, received one citation, each, for two of the three categories of information, where he had received none in the first round of data collection. A second, #23, showed changes both upward and downward in two of the categories, while three of the newcomers received no citations in either data collection. One newcomer was gone by the second mapping, #30.

Reexamining the discriminant scores of the two newcomers who showed changes in numbers of citations, we find that for individual #17, the discriminant function score received for project/task information placed him among the very low sources (31st in a field of 41), yet he received one citation in the second mapping, none the first. The same individual also received an added citation as a source

for state-of-the-art information in the second round, none the first time. In the state-of-the-art, too, #17 had a discriminant score that would give no indication of his being picked as a source; 37th among 41. The second newcomer, #23, who had received a citation as a source of project/task information in the first round, received none in the second round. His discriminant function score for the project/task category placed him 39th in a field of 41. In the latter case, the change in status was in consonance with the discriminant score received. The same individual, #23, also received two citations as a source for research/laboratory-technique information in the second round while not having received any citations in the first round. In the latter case the discriminant score was very much in consonance with the direction of change, being the third highest in the organization in the first round of data collection (3rd out of a field of 41).

It should be pointed out that a change of one in citation totals may not have much meaning since the data collection instrument asked for two names, and, thus, every deletion of one added another name perforce; easily meaning a rise or fall of one citation in an individual's count.

Are the Discriminant Functions Generalizable to Other Organizations?

Access to a second organization provided us with an opportunity to examine the generalizability of the discrimimant functions developed with Organization A data, to see if the same combination of variables and weightings assigned them would derive from Organization B data.

Discriminant functions, similar to those developed for Organization A, were developed with data from Organization B. This was done with a view to seeing if the differences in the character of the two organizations in terms of technology, orientation and history would be reflected in differences in the two sets of discriminant functions in terms of variables included by the stepwise analysis and the weighting given to the variable.

The Discriminant Functions for Organization B. Discriminant functions, similar to those for Organization A, were developed using the data on citations in the first mapping of Organization B (see Chapter 4 for fuller discussion of study of intervention in Organization B).

The Project/Task Discriminant Function---The stepwise computer analysis was terminated when 17 variables had been included.[1] The 17 variables and their standardized discriminant function coefficients were as follows:

Age	.74024
Years technical experience in field	-.74071
Number different career organizations	-.81878
Patent applications past 5 years	.31252
Papers published past 5 years	-.43049
Unpublished papers written past year	.60251
Number professional directory listings	.64619
Honors/awards past 3 years	-.05860
Professional meetings past year	.71052
Professional journals read per month	.40127
Unpublished reports read per month	.34514
Communications with outsiders	1.74885

[1] Canonical Correlation = 0.79360; Wilks lambda = 0.37020; Chi-Square = 27.32705; D.F. = 16; Significance = 0.053; Prediction results — 83.8% of known cases correctly classified.

Number of above for technical information	-.48195
Number of above in same technical field	-.74617
University training	.26622
Percent reports read from outside	-.44823
Professional program participations/year	-.07342

The standardized discriminant function coefficients for the 17 variables ranged from +1.74885 to -.81878 with the positive sign being in the direction of inclusion in the group of those cited as preferred sources. The variables that had the most weight in determining whether an individual was included in the group of the cited were the following:

Communications with outsiders	1.749
Age	.740
Professional meeting participations/year	.711
Number professional directory listings	.646
Unpublished papers written last year	.603
Professional journals read per month	.401
Unpublished reports read per month	.345
Patent applications past five years	.313

The State-of-the-Art Discriminant Function---The stepwise computer analysis was terminated when 17 variables had been included.[1] The 17 variables and their standardized discriminant function coefficients were as follows:

Age	- .44312
Years technical experience in field	.28842
Number different career organizations	- .31760
Patent applications past 5 years	- .03929
Papers published past 5 years	- .34885
Unpublished papers written past year	- .14146
Professional directory listings	.28810
Honors/awards past 3 years	- .25906
Professional meetings past year	- .16964
Professional journals read per month	- .89292

[1] Canonical Correlation = 0.77562; Wilks lambda = 0.39842; Chi-Square = 25.30680; D.F. = 17; Significance = 0.88; Prediction results -- 89.2% of all cases correctly classified.

Unpublished reports read per month	1.31494
Communications with outsiders	.93976
Number of above for technical information	-2.13249
Number of above same technical field	1.54168
University training	- .52714
Percent reports read from outside	-1.17678
Professional program participations	.04098

The standardized discriminant function coefficients for the 17 variables ranged from +1.54168 to -2.13249 with the negative sign being in the direction of inclusion in the group of those cited. The variables that had the most weight in determining whether an individual was included in the group of the cited were the following:

Professional journals read per month	- .893
University training	- .527
Age	- .443
Papers published past five years	- .349
Number of different career organizations	- .318
Honors/awards past three years	- .259
Professional meetings attended past year	- .170
Unpublished papers written past year	- .142

(The greatest weight was given to the variable, "Number of communications with outsider for technical information," but it was not listed above with the most weighted variables because it is a variable that has a within group correlation with the variable, "communications with outsiders" of .934. The variable, "communications with outsiders," was heavily weighted in the direction of non inclusion in the cited group. It was reasonable to judge the "communications with outsiders" variable as taking precedence, and that the percentage of the communications used for any purpose would mislead rather than add to our understanding.)

The Research/Laboratory Technique Discriminant Function--

The stepwise computer analysis was terminated with 15 variables had been included.[1] The 15 variables and their standardized discriminant function coefficients were as follows:

Age	-.07830
Years technical experience in field	- .45835
Number different career organizations	.37512
Patent applications past five years	- .84267
Unpublished papers written past year	.39156
Professional directory listings	- .13754
Honors/awards past three years	- .10689
Professional meetings past year	- .28265
Professional journals read per month	- .28426
Unpublished reports read per month	2.29126
Communications with outsiders	1.37270
Number of above for technical information	-2.27557
Number of above in same technical field	.93577
University training	-1.07810
Percent outside reports read	-2.31299

The standardized discriminant function coefficients for the 15 variables varied from +2.29129 to -2.31299 with the negative sign being in the direction of inclusion in the group of those cited. The variables that had the most weight in determining whether an individual was included in the group of the cited were the following:

Age	-1.078
Patent applications past five years	- .843
Years technical experience in field	- .458
Professional journals read per month	- .284
Professional meetings attended past years	- .283
Professional directory listing	- .138
Honors/awards past three years	- .107

[1] Canonical Correlation = 0.79707; Wilks Lambda = 0.36467; Chi-Square = 28.74961; D.F. = 15; Significance = 0.017; Prediction results -- 89.2% of all cases correctly classified.

Comparisons of the Discriminant Functions of Organization A with Those of Organization B. Comparisons of the standardized discriminant function coefficients of the two organizations for each of the categories of information make it clear that, using the variables that were used in this study, there is very little probability that a generalized discriminant function can be developed applicable to a broad spectrum of organizations. Though there was considerable overlap between the two organizations in terms of variables that made up their discriminant functions, they were not identical, and the weightings of the varaibles differed considerably between the two organizations.

The differences in the variables and their weightings in the discriminant functions of the two organizations provide an opportunity to gain some important insights into those information-communication characteristics that may be general to the general high communicator function and those characteristics that may be organization/technology specific.

Project/Task Information Comparison---Comparing the variables that made up the discriminant functions for project/task information for both Organizations A and B it is seen that the Organization B (the hardware development organization) function included one more variable than that of Organization A, "Papers published in the past five years." The latter variable was heavily weighted toward exclusion from the group of those cited. Variables common to the discriminant functions of both organizations and their standardized coefficients are discussed below. The following variables were weighted in the direction

of inclusion in the group of cited sources in both Organization A and Organization B:

Age: In direction of inclusion in both organizations, but weighted far more heavily in Organization B.

Unpublished Papers Written Past Year: In direction of inclusion in both organizations, about equally weighted by both, and not weighted too heavily.

The following variables were weighted in the direction of inclusion in the group of cited sources in Organization A, but in the direction of exclusion in Organization B:

Honors/Awards Past Three Years

Years of Technical Experience in Field: Greatest difference in weights and direction between both organizations.

Number of Different Career Organizations

The following variables were weighted in the direction of inclusion in the group of cited sources in Organization B, but in the direction of exclusion in Organization A:

Number of Professional Directory Listings: Large difference between both organizations.

Patent Applications Past Five Years: Large difference between both organizations.

Professional Journals Read Per Month

State-of-the-Art Information Comparison---Comparing the variables that made up the discriminant functions for state-of-the-art information for both Organizations A and B, it is seen that Organization B included one more variable than Organization A in the discriminant function, "Honors/Awards past three years." Variables common to the discriminant functions of both organizations and their relative weights as expressed by their standardized coefficients are discussed below:

The following variables were weighted in the direction of inclusion in the groups of cited sources in both organizations:

University Training

Age: Weighted more heavily in Organization A

Unpublished Papers Written Past Year: Weighted far more heavily in Organization A.

Professional Meetings Attended Past Year

Number of Different Career Organizations: Weighted more heavily in Organization B.

Papers Published Past Five Years: Weighted more heavily in Organization A.

The following variables were weighted in the direction of inclusion in the group of cited sources in Organization A and in the direction of exclusion in Organization B:

Communications with Outsiders: Extreme difference in direction and weighting between the two organizations.

Unpublished Reports Read Per Month: Extreme difference between the two organizations suggesting that those selected for state-of-the-art information did not also serve as project/task sources in Organization B.

The following variable was weighted in the direction of inclusion in the group of cited sources in Organization B and in the direction of exclusion in Organization A:

Patent Applications Past Five Years

Variables that were weighted in the direction of exclusion from the groups of cited sources in both organizations included the following:

Years of Technical Experience in the Field

Number of Professional Directory Listings

Professional Program Participations Past Year

Research/Laboratory Technique Information--Comparing the variables that make up the discriminant functions for research/laboratory technique information for both Organizations A and B, it is seen that Organization A included one more variable than Organization B in the discriminant function, but there are a total difference of three variables between the discriminant functions of both organizations. Organization A includes two variables not included in the Organization B discriminant function, "Papers published past five years" and "Professional program participation." Organization B included, "Unpublished papers written past year" which was not included in the discriminant function of Organization A. Variables common to the discriminant functions of both organizations and their relative weights as expressed by their standardized coefficients are discussed below:

Variables weighted in the direction of inclusion in the groups of cited sources in both organizations are the following:

Age: Weighted far more heavily in Organization B

Patent Applications Past Five Years: Weighted far more heavily in Organization B.

Professional Directory Listings: Weighted more heavily in Organization A.

A variable that was weighted in the direction of inclusion in the group of cited sources in Organization A but in the direction of exclusion in Organization B was the following:

Number of Different Career Organizations: Very large difference in direction and weighting between the two organizations.

Variables that were weighted in the direction of inclusion in the group of cited sources in Organization B but the direction of exclusion in Organization A were the following:

Years of Technical Experience in the Field

Honors/Awards Past Three Years

Professional Meetings Attended Past Year

Professional Journals Read Per Month

University Training

Variables that were weighted in the direction of exclusion from the groups of cited sources in both organizations included the following:

Unpublished Reports Read Per Month: Heavily weighted in both organizations, again suggesting that laboratory technique oriented sources tended not to be supervisors.

Communications with Outsiders

The similarities and differences between the two discriminant functions provide us with some insights into which variables are more likely to be generally associated with the high communicator for each of the kinds of information identified. They also provide us with some insights into how the differences between two organizations and the technologies with which they are concerned affect the nature of who is identified as a high communicator. The source for project-task information was clearly an individual who is in touch with the outside world; he is a boundary spanner. He communicates with more outsiders, attends more professional meetings. He reads a lot of unpublished reports, which in the organizations studied, is highly correlated with being a supervisor.

Differences between the two organizations reflect the hardware orientation and the involvement in a fast moving defense electronics field of one as compared to the other; patents and professional journals are more highly valued in Organization B, the hardware organization. In Organization A more weight accrued to experience and education; years of experience, number of career organizations, honors

and awards, age, and university training, as might be anticipated with an organization oriented more towards research than development.

Choice as a source for state-of-the-art information was differentiated from the pattern of choices for other kinds of information by the variable---Papers published past five years and Unpublished papers written past year. In both organizations, age and experience were associated with choice for state-of-the-art information with age, university training, and number of different career organizations being weighted positively in both organizations. What emerges is a picture of an experienced technical worker who is denoted by production of published and unpublished papers-- the stuff of state-of-the-art.

Those chosen as sources for research/laboratory technique information in both organizations were clearly more hardware oriented than those chosen for project-task information or for state-of-the-art information as is indicated by the weight given to patents and by the negative weighting given to reading reports. In both organizations those chosen were older and were listed in more professional directories. In the hardware-oriented, corporate organization more weight was given to years of technical experience in the field, university training, and professional journals read which could reflect the specialized technology in which the company was engaged (electronics countermeasures).

Summary

Is it possible to identify and hire a potential high communicator using the data available to management at the time of hiring (i.e., employment application blank data and interview information)? How much time would it take for a potential high communicator to come 'on stream' in the role of high communicator when no steps are taken to consciously facilitate the process? The foregoing were the critical questions that were raised at the beginning of this chapter, and the concern of the parts of the study discussed in this chapter.

The data collected on the information-communications behaviors of the organization studied strongly support a positive answer to the first question stated above. It is possible and feasible to systematically identify a potential high communicator for an organization using the data typically available to managements at the time of hiring. The data collected also lend support to a finding of Allen (1977) that it appears to take a minimum of two years for the potential high communicator to go 'on stream' as such without any particular facilitation on the part of management.

To answer the questions that were raised in the first paragraph, above, the following steps were undertaken: 1) the information-communication behaviors in the cooperating department of a nonprofit, contract-research organization were mapped at the beginning of the study, 2) two methods of identifying potential high

communicators among the newcomers to the organization were developed and applied, identifying a potential high communicator, 3) a second mapping of the infomration-communications behaviors in the cooperating organization was carried out, 4) the change in number of citations to the newcomers were measured.

Two means were used for classifying the newcomers with regards to their potential as high communicators. In the first method, data concerning several dimensions associated with high communicators were collected and the seven individuals who were newcomers were ranked according to their scores on the dimensions. Since the foregoing means was felt to be unsatisfactory in that it did not place any differential weights on the variables nor assigned any significance to them, a more systematic means for examining the newcomers was developed; a set of discriminant functions, one for each category of information. The discriminant functions did provide a far more satisfactory means for comparing the newcomers in the organization with regard to their potentiality as high communicators in the organization. The discriminant functions provided means for scoring each of the newcomers thus permitting a scaled comparison of all of the newcomers with regard to each of three kinds of information being considered. Furthermore, the discriminant functions weighted each of the 26 variables considered, excluding some, weighting those included in each of the functions, and showing their relationship to inclusion or exclusion from among the group of those cited as preferred sources of information.

The data collected on the information-communication behaviors in the organization being studied 16 months after the first data collection effort strongly underlined the ability of the discriminant functions to identify the potential high communicator. The individual newcomer identified as a potential high communicator received the highest increase in number of citations as a preferred source of information in the entire population of the organization being studied.

The discriminant functions provided valuable insights into the differences that might be associated with being cited as a preferred source of information when the information has to do with administrative or project/task matters and when the information is concerned with such technical matters as state-of-the-art or research/laboratory technique. The most important insight has to do with the disaggregation of the high communicator concept. The data raise serious questions as to the existence of the all-purpose source of information implied in most descriptions of the high communicator. The data from this study showed marked differences between the sources sought for different kinds of information. Though previous studies indicate that first line supervisors are highly represented among high communicators, our data indicate that first line supervisors rank high as preferred sources for project/task information but not for technical information. The profiles of the preferred sources varied in significant and

often obvious ways by type of information (e.g., the preferred sources for state-of-the-art information are denoted by production of published and unpublished papers).

Were the discriminant functions developed for the nonprofit, project-contract organization generalizable to other kinds of organizations; again, a test of the generality of any given high communicator type? To answer the question of generality of the discriminant functions from one organization to another, a set of discriminant functions were developed with data from a corporate, hardware oriented, development organization and compared with the set from the nonprofit organization. The two sets of discriminant functions differed in several important ways; variables included, relative weighting given to the individual variables and the whether the variable indicated inclusion in the group of these cited as preferred sources for a particular kind of information or exclusion from the group. In conclusion, though there were similarities between the functions for the two organizations the fundamental conclusion was one of nongeneralizability. The process for developing a set of discriminant functions as an aid in hiring high communicators is generalizable and useful, but the specifics of the functions vary as a result of differences in technology, institutional purpose, organizational structure and organizational history.

CHAPTER 3

EXIT: A HIGH COMMUNICATOR OF LONG STANDING LEAVES

Drink and dance and laugh and lie,
Love the reeling midnight through,
For tomorrow we shall die!
(But, alas, we never do.)

Parker (1939)

Exit is an organizational event that is almost as frequent in our mobile American society as entry. Except for those entering the workforce out of school and those exiting into retirement or into hopefully temporary unemployment, every exit in the workplace is associated with a subsequent entry somewhere else. Entry generates a process of assimiliation for the entering individual who must accomodate to an established social and cultural system with its rules, norms and values. For the management an entry means finding and hiring the right individual for the job; well established, conscious managerial actions. For managements with a broader and more perceptive view of their responsibilities, entry poses questions of how to facilitate assimiliation of the new individual so as to obtain his productive contribution for the benefit of the organization. Exit, however, poses different questions for both exiting individual and management of the organization from which the exit is made.

Entry is far more within the obvious control of management than is exit. No one is hired without the manager's explicit or implicit agreement. Management can solicit individuals to join the organization, offer incentives, set criteria, require references, test, query, and negotiate conditions of work. Management's control of exit from the organization is far more limited than is its control over entry. Though management can terminate or transfer an individual from the organization, it cannot prevent an individual's autonomous decision to leave the organization.

In a free society with a very high degree of mobility, autonomous decisions of individuals to leave organizations are not only possible but are highly probable. The reasons motivating a competent employee to leave an organization are numerous, extremely varied, and are prompted by both positive and negative stimuli. An individual may leave an employer to take advantage of perceived opportunities elsewhere; return to school (an almost uniquely American phenomenon), serve in government, leave a severe climate or just to respond to de Toqueville's 'American restlessness'. Perhaps more frequently, negative reasons lead to a competent employee's exit; perceptions of inequitable or bad treatment by management, an undesired transfer to another region, frustration at the management's rejection of a proposed project (a frequent percursor to the formation of a new company by the frustrated individual). Not least among the reasons for exit are the

layoffs that result from a downturn in an industry or company or the completion of a contracted project by an employer.

Theoretically, since many management actions can create the situations that cause a desired, competent individual to opt for exit, a greater awareness of the needs, problems and feelings of the employee on the part of management could generate actions that might prevent the exit. Operationally, however, the situation is far more difficult. Organizational practice in the great majority of establishments is not congenial to discussion of potential exit on the part of the individual, carrying with it connotations of threat and disloyalty. Preoccupied and/or unperceptive managements usually learn of the impending exit of a desired employee only when negotiations with the next employer have been completed, and there is no room to negotiate. An employee seriously considering exit is often far less prone to risk retaliation or insult by mounting a protest against some situation perceived as intolerable than to vote with his feet by negotiating for a job elsewhere.

Whether a competent employee exits autonomously or because of some deliberate management action such as firing or promotion or transfer to another part of the overall organization, the manager of the affected group is faced with the consequences of the exit. Exit of a competent employee of long standing means a direct loss of the individual's technical capabilities, and accumulated knowhow,

and, in a continuing organization, it means investment in a required replacement with all the attendant learning curve costs. There is also a loss of something less direct and far more difficult to calculate; that is the loss of the contribution of the individual to the overall functioning of the organization with regard to its style, its way of doing things, its interpersonal infrastructure. Thus, the manager is not only faced with the replacement of lost technical capabilities or the obvious sort, but is also faced with questions concerning the ability of the organization to function well as a systematic entity.

Perhaps the most important of the interpersonal infrastructures that affect the performance of an R&D organization is that concerned with the flow of work related technical information. The literature on STI usage would suggest that the information-communication flows in an organization are essentially social.[1] The flows are primarily interpersonal and dependent on the way the individuals in an organization perceive and interact with each other. The loss to the organization of any

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[1] The term social is used in the sense that is found in the first entry under that term in Gould and Kolb, (eds.) 1964, "...the term, as applied to human beings, refers to any behavior or attitude that is influenced by past or present experience of the behavior of other people.....or that is oriented.....toward other people...."

person who plays a key role in an organization's information flows would apparently have serious effects on the ability of the organization to function effectively. Thus, the exit of a high communicator, ranked highly as a preferred source for work-related information, should raise a number of serious questions from the viewpoint of management.

What happens to the patterns of flow in technical information within the organization with the exit of the high communicator? To whom do the former information 'clients' of the high communicator turn for their information now? To other high communicators? To those to whom the high communicator turned for information? Do others rise to fulfill the role of the exited high communicator or is there a measurable decrement in the information flows in the organization? Is there something a manager can or should do to maintain the information-communication flows upon the exit of a high communicator? Should management take into consideration the role played by an individual as a high communicator in his group when contemplating his transfer to another group or when considering major reorganizations?

What Could Have Been Anticipated about the Loss of a High Communicator

There is little available in the literature that is directly useful for predicting the effects of the loss of a high communicator on subsequent technical communication patterns in an organization. For one thing, the great majority of research on how scientists get and use information is cross-sectional and provides little, if any, insight into the processes by which an

individual develops into the role of high communicator or how communication channels are reconstituted once a high communicator has left. In the absence of directly appropriate research results, clues were sought from studies of networks in the international science community, the so-called, 'invisible colleges.' Some of the literature on social networks, their constitution and dynamics and some of the literature on social exchange and interpersonal attraction were reviewed. The latter literatures were reviewed on the reasonable assumptions that the high communicator functions through the social professional network of which he is a part and that the choice of a source of information may be a function of social exchange and/or interpersonal attraction.

The literatures reviewed were social network and social exchange oriented, and reflected an approach typified by Lin (1973), discussing the delivery system for information-communication,

> "At least three types of networks constitute the delivery system..One...involves the individual's social contacts, his kinships, friendships, professional ties..... These relationships establish and maintain a network of limited membership---called the social network--around him. Another type....is the result of physical and spatial contiguity.....(the) spatial network...third type.... links persons with the mass media....."

The individual technical professional depends on his social network as his primary source of technical information. Whether as a member of an international social professional circle linked together by 'membership' in a group studying phenomena in a limited

sub-field or as a member of a social technical group linked by membership in a given company department and by close spatial relatedness. Allen (1977) carefully avoids the question of causality, but points out the very high overlap between social and technical discussions in two laboratories that were studied. Lin (1973) reviews a number of studies which suggest that informal contacts are more effective than formal ones, and goes on to make the obvious point that once a social network is formed encounters between its members will be much higher than encounters between nonmembers.

Several writers about invisible colleges in the science community (Price, 1963; Crane, 1972) found that members of an invisible college know about new findings one to two years before they are published, receive feedback and recognition before the formal process of publication has occurred. Compton (1973) reviewing scientific communication research, wrote,

> "...Informal communication appears to be particularly effective in conveying procedural information, supplying reinforcement and feedback, providing leads to archival sources, and facilitating the application of scientific knowledge...."

The informal social professional networks are vital to the technical professional's working process, and is depended on to perform a number of functions relevant both to the work at hand and to personal development and satisfaction.

Within the social professional networks the high communicator functions as linker between his 'clients' and other networks in the organization, and as linker and pusher between

his clients and the literature. There is every reason to conclude that the high communicator goes beyond the communications function to also serve as opinion leader, helping to set the norms and style for fellow network members. Consequently, the implication is that upon exit of the high communicator from the work place, social professional circle there should be a net decrement in information flows and a reorientation of work style at least in the short run. Taylor and Utterback (1974) found a reduction in technical communications in an organization that had undergone changes in organizational structure and technical assignments. It would be reasonable to suggest that, in part, the drop in communications was due to the serious disruption of social networks and the dislodgement of the high communicators.

The links between individuals in a work situation are generated for some purpose or because of some consciously recognized interest on the part of one or both of the people interacting (Mitchell, 1969). The links are characterized by formal and informal exchanges that include job assistance, social conversation and personal service intermingled day to day. Lin(1973) categorizes the benefits obtained from the exchanges into intrinsic and extrinsic benefits. Among the intrinsic benefits he cites are information relay and verification, friendship and play. The extrinsic benefits cited by Lin include recognition and influence. In the working situation the intrinsic and extrinsic are intertwined. Joking is easily combined with recognition. Information relay an

verification is easily combined with influence.

Informality and lack of hierarchy characterize the organizational relationships in R&D organizations. The technical professionals and their supervisory personnel are professional peers. The nature of the work makes it difficult to maintain any kind of munti-tiered hierarchy or highly formalized set of procedures. Typically, the interpersonal exchange relationships among the members of an R&D organization are a combination of the formal and informal to a far greater extent than is found in other more routine kinds of work-related activities. Consequently, it might be expected that a preferred source of work-related information would not only have to be technically competent, but would also have to be 'liked' or, certainly, not 'disliked'. Some support for the foregoing expectation is obtained from Holland (1970) in which using a semantic differential he measured the perceptions of the citors as to the characteristics of their cited sources of information. Under 'trustworthiness', Holland listed a number of dimensions such as kind-cruel, agreeable-disagreeable and warm-cool that essentially differentiate liked from disliked persons. Of the 67 sources of information rated 59 were very strongly rated as trustworthy. It would be reasonable to anticipate, therefore, that after the exit of a high communicator, subsequent choices as sources of information will be part of the same social circle as the high communicator and ranked high as 'liked.'

The literature on interpersonal attraction (Berscheid and Walster, 1969) suggests a number of factors that would operate to influence liking in the work situation, including reciprocity, propinquity, similarity, and cooperation. The social exchange literature with regard to liking (Chadwick-Jones, 1976) makes reference to the same factors but relates them to reduction in costs (e.g., proximity reduces costs) and increase in rewards (e.g., peership and similarity increase rewards). Examining the literautre with a view to anticipating who the technical professionals in an R&D organization would go to after the exit of a high communicator, it is suggested that subsequent preferred choices as sources of information would reflect the following:

Propinquity--The closer two individuals are located to each other the more likely they will be attracted to each other and the more likely they will select each other as information sources (Berschied and Walster, 1969; Allen, 1977). After exit of a high communicator there should be a turn to those located nearby. Propinquity is not only measured in physical terms. There is also social propinquity. When Newcomb (1956) wrote,

> "...the shorter the distance between two individuals the more probable it will be that the two will interact and, therefore, the more likely that they will be attracted to one another..."

there was also the implication that social distance between two individuals has more effect on the movement of information,

values, and prestige through a system than physical distance. The foregoing suggests that after the exit of a high communicator his former clients might turn to those located nearby in the social sense; friends of the exited high communicator, friends of the clients.

Reciprocity--We like those who cooperate with us in attaining rewards for ourselves, those who like us, those who give us something (Berschied and Walster, 1969; Homans, 1961). It works both ways, too, and we will be asked for information by those to whom we gave information and better liked by them (Aronson, 1977). A benefactor is liked better when the recipient has a chance to reciprocate and disliked when there is no chance to reciprocate (Gross and Latane, 1974). Further, there is a tendency to find a confederate of the benefactor more attractive when the benefactor has acted on a voluntary basis (Gross and Latane, 1974). After exit of a high communicator the former clients should turn to others who they cited as sources for other kinds of information, should turn to those they have acted as sources for, and should turn to the associates of their former source.

Similarity--Similarity is associated with liking (Berschied and Walster, 1969; Homans, 1961). After exit of a high communicator his former clients should turn to others like themselves, namely, those in their social circles who might be identified as those to whom they went for other kinds of information and who came to them for information (same as for 'reciprocity').

Studying the Exit of a High Communicator from the Organization

To study the exit of a high communicator from the organization and the subsequent adjustment of information-communication patterns the following steps were undertaken:

- The information-communication patterns in Organization A were mapped at the beginning of the study to establish base lines for measurement of subsequent changes in pattern that might be considered to have resulted from the exit of a high communicator (same mapping used for study of entry of high communicator and described in previous chapter).

- The information-communication patterns in Organization A were mapped sixteen months after the first mapping to determine new citations for preferred sources of information (same mapping as used for study of entry and described in previous chapter).

- An analysis was made of the changes in citation of preferred sources for all those who had previous cited the exited high communicator to determine what were the apparent systematic or patterned shifts in citation and to compare them with those anticipated on the basis of the literature that was reviewed.

- An analysis was made of those cited as "like to work with," and the relationship of citation of "like to work with" and citation as preferred source of information.

First and second mappings of the information-communication patterns in Organization A---The citations of individuals as preferred sources for project/task, state-of-the-art and research/laboratory information in Organization A at two different periods of time 16 months apart are shown in Table 2-5 in Chapter II. As can be seen in Table 2-5, theindividual identified as #19 was the most highly cited person in Organization A in the first mapping, receiving seven citings as preferred source for state-of-the-art information and ten citings for research/laboratory information. At the time of the second mapping, 16 months later, #19 had left the organization after having been with the organization for more than 12 years.[1]

Figure 3-1/3-2 depict the network of citations to and from the high communicator, #19. The network of citations includes those who cited #19 as a preferred source for information, and those whom #19 cited as his preferred sources of information. The network also includes the others cited by those who cited #19 and those who cited those who cited #19 (a good level at which to stop).

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[1]The exited high communicator was 41 years old at the time of the first mapping, had a bachelors degree in physics, had worked in two different career organizations, had made two patent applications in the past five years, published four papers in thepast five years, participated in no professional programs, written three unpublished papers, gone to no professional meetings in the past year, received no honors or awards, was listed in no professional directories, read five journals monthly, had no communications with outsiders.

FIGURE 3-1

FIRST ROUND CITATIONS TO AND FROM THE EXITED HIGH COMMUNICATOR IN ORGANIZATION A

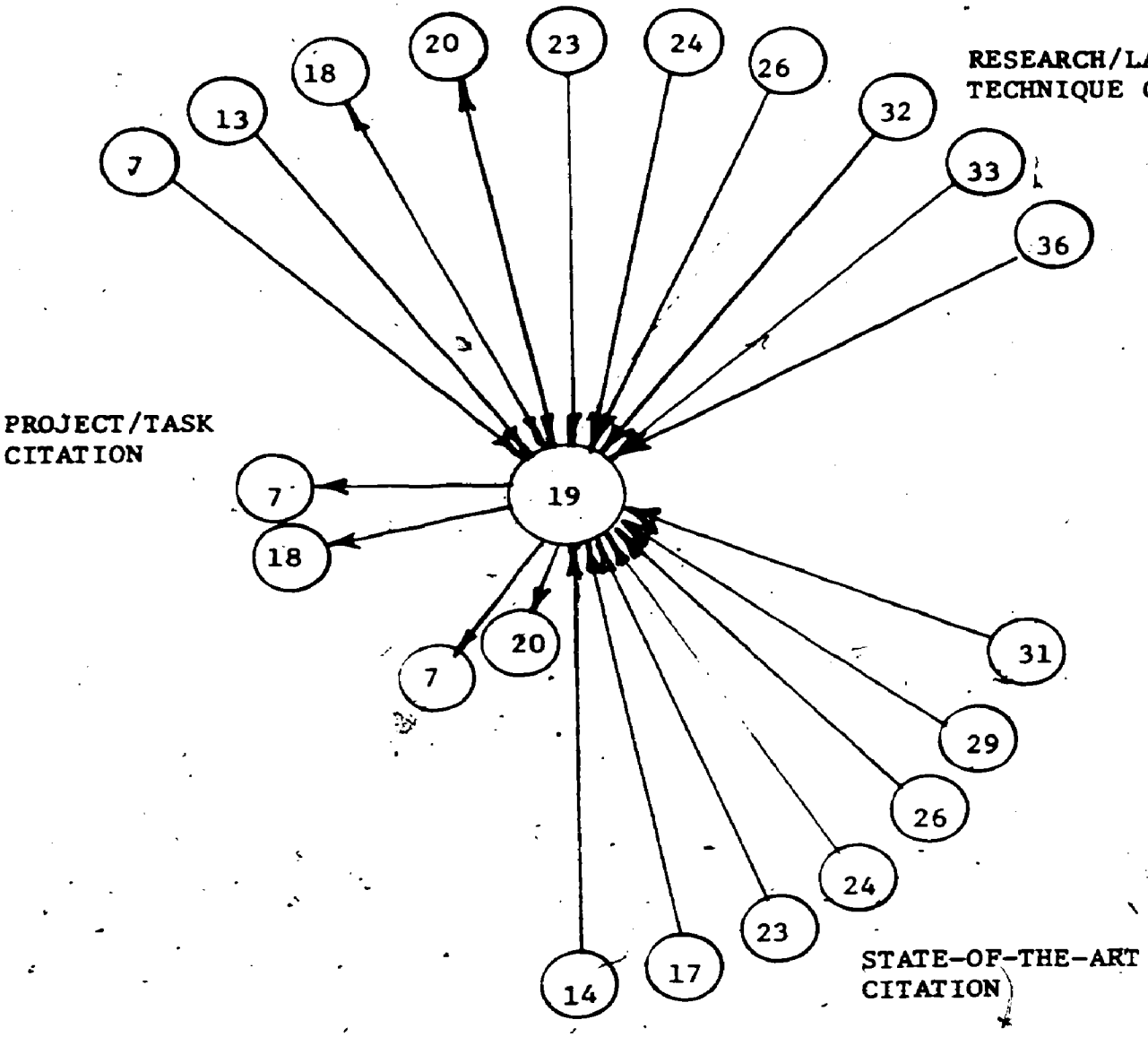
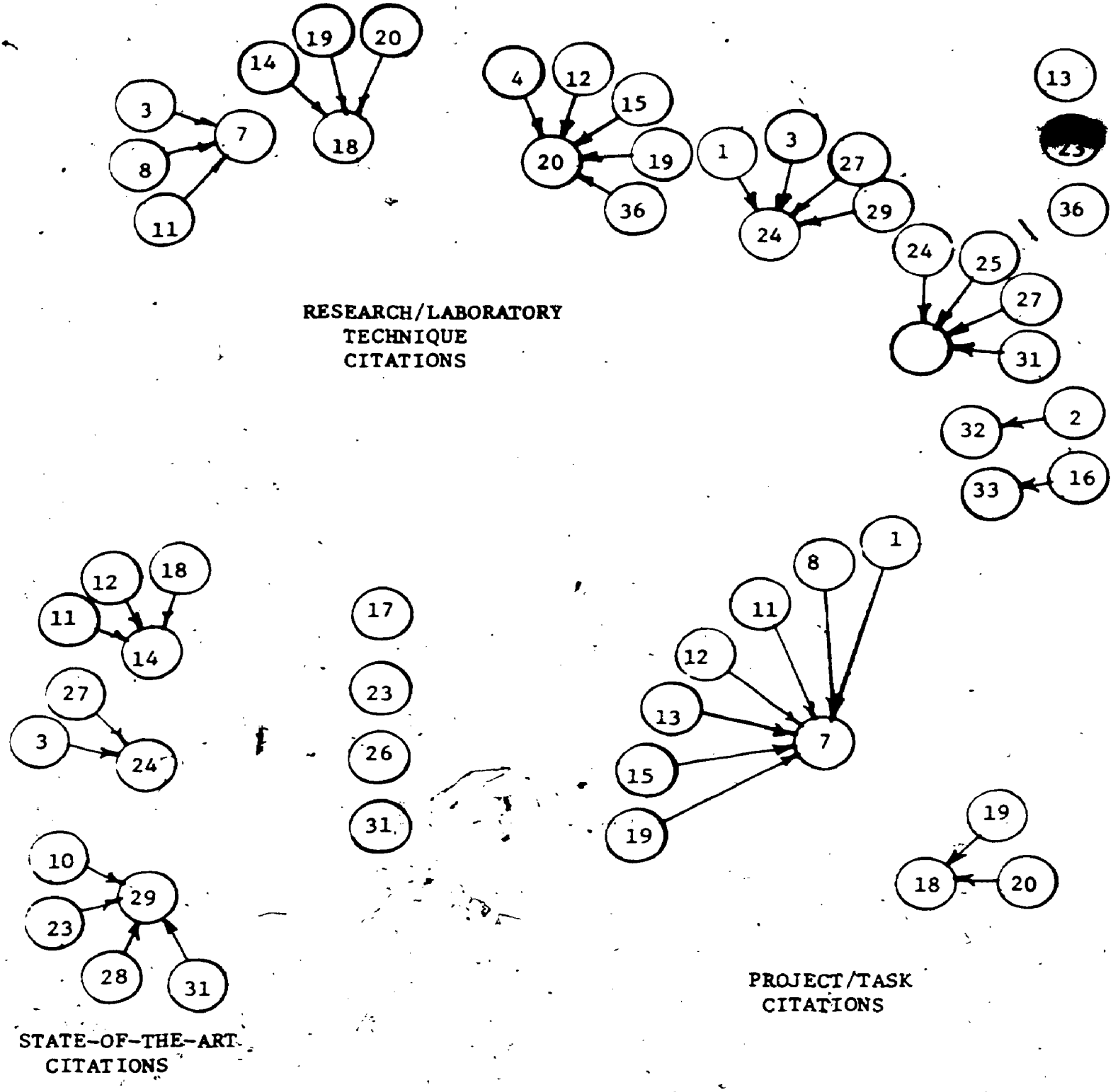


FIGURE 3-2

FIRST ROUND CITATIONS TO THOSE WHO CITED THE EXITED HIGH COMMUNICATOR AND CITATIONS TO THOSE HE CITED IN ORGANIZATION A: EXTENSION OF THE CITATION NETWORK



In the first mapping, the individual identified as #19 received 17 citations from 14 individuals (see Table 3-1). Ten of the citations were as a preferred source for research/laboratory information and the remaining seven as a preferred source for state-of-the-art information. In the second mapping, after #19 had exited from the organization, fourteen individuals were cited to replace him as a preferred source for the 17 citations that had formerly gone to him. Two of the individuals were outside the immediate organization. Two individuals received three each of the replacement citations, and one received two; two of them were cited by #19 as his preferred sources in the first mapping.

In only one of the citation replacement cases could 'propinquity' (within three offices on the same floor) be considered a possible influence on subsequent choice (see Figure 3-3). In the one case of propinquity, the substituted choice occupied an office next to the former information client of #19. In two cases 'reciprocation' could be considered an influence on the choices to replace #19. In one case of reciprocation, the second round citor of a replacement choice for research/laboratory information had been himself cited by his second round choice as a source of project/task information in the first mapping. Similarly, in the second case of reciprocation, the second round choice, replacing the exited high communicator, had cited his

TABLE 3-1

CITATIONS OF PREFERRED SOURCES OF INFORMATION IN FIRST AND SECOND ROUND DATA COLLECTIONS WITH REFERENCE TO SUBSTITUTIONS OF CHOICE FOR THE EXITED HIGH COMMUNICATOR (#19)

Individual #	Cited sources by those citing #19--First Mapping						Cited sources--Second Mapping						Substitutions for #19 in in second mapping		
	Project/ Task		State-of-art		Research/ Lab		Project/ Task		State-of-Art		Research/ Lab		Project/ Task	State-of-Art	Research/ Lab
7	3	*	1	11	8	19	3	11	1	11	8	12			12
13	7	11	12	15	12	19	7	11	12	11	12	7			7
14	7	*	*	19	20	*	3	7	*	11	20	*		11	
17	15	*	20	19	*	*	15	7	20	15	20	23		15	
18	20	*	14	*	7	19	7	*	14	*	39	20			20
19	7	18	7	20	18	20	---THE EXITED HIGH COMMUNICATOR----------								
20	18	-	18	19	18	19	18	7	18	7	18	7		7	7
23	21	-	29	-	-	19	21	*	29	--	--	20			20
24	3	*	5	19	26	19	3	*	26	43	26	43		43	43
26	24	40	5	19	*	19	24	52	43	*	*	19		*	43
29	3	28	5	19	24	28	3	28	--	31	--	31		31	
31	3	28	29	19	29	*	28	*	29	*	29	26		*	
32	2	44	2	--	2	19	2	44	33	2	2	34			34
33	44	*	2	5	34	19	3	*	2	5	34	29			29
36	2	20	2	5	20	19	2	44	2	5	34	2			2

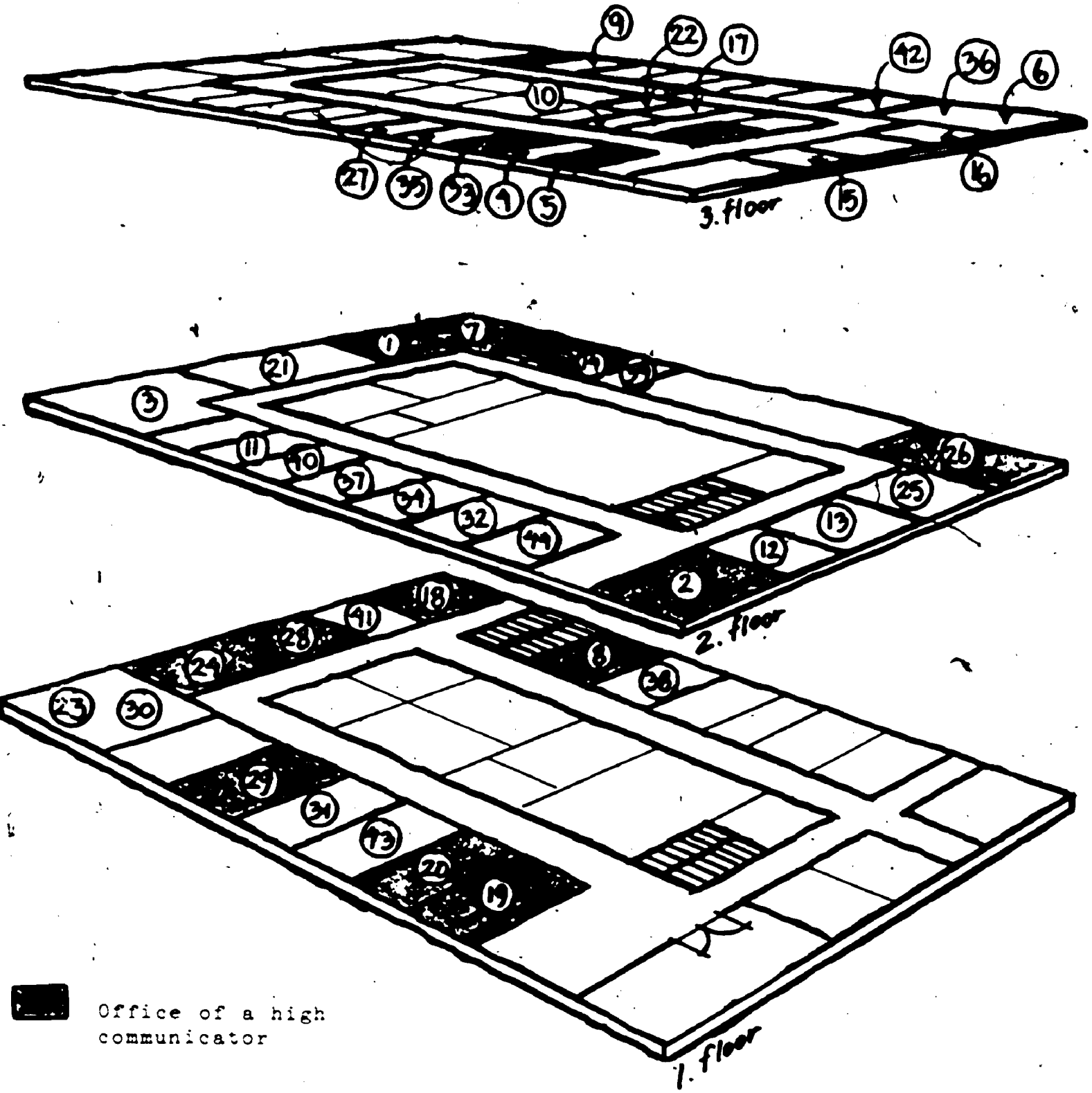
*Person outside the organization but within overall institute.

TABLE 3-1 (continued)

Individual #	Sources cited by those other than #19 cited in first mapping					
1	7	*	8	39	8	14
2	*	*	5	29	32	49
3	24	28	7	24	7	24
5	3	*	2	28	24	43
8	21	7	1	*	1	*
11	7	*	12	14	7	12
12	7	*	13	14	20	*
15	7	*	11	18	20	*
21	41	23	8	5	4	41
28	3	24	5	29	29	31
34	2	44	2	33	2	44

FIGURE 3-1

SPATIAL LOCATION OF THE OFFICES IN ORGANIZATION A



Office of a high communicator

Numbers in circles refer to individuals included in this survey

citor in the first mapping as a preferred source for state-of-the-art information.

Ten of the 14 former clients of #19 cited second round replacements for him who had each been previously cited as preferred sources by individuals who had been cited by the clients as preferred sources for some kind of information in the first mapping. Thus, an individual who was named as a preferred source for project/task information in the first mapping was named as a preferred source for research/laboratory information, replacing #19, in the second mapping effort. Interestingly, in six of ten such cases the new citations had been preferred sources for more than one of their other cited preferred sources, an indication of professional circles within the organization.

In five of the substitutions, the new citations went to individuals who had been cited as sources for the other kinds of information in the first mapping. Thus, in three cases, an individual who had formerly been cited only for project/task information was now cited for state-of-the-art or research/laboratory information. The three cases may reflect the necessity for a project leader to now function in a technical capacity that had not been necessary as long as #19 was in the organization.

Five of the new choices were individuals whom #19 had named as his sources of information in the first mapping; a logically

natural progression 'upstream' or a continuing dependence on a given professional social circle for information. The social-professional circle explanation is supported by the fact that all five of the new choices were also individuals who cited #19 as a preferred source for one of the two technical categories of information. Another two of the new choices were individuals who had cited #19 as a preferred source in the first mapping though they were not cited by him as sources at that time. The remaining eight new choices were linked to #19 in the first mapping by others that they cited for information who were also citors or citees of #19, a one step removal relationship.

The question naturally arises as to how many changes in citations would occur naturally over the same time period without any exits. To gain some notion of the extent of such changes an examination was made of changes in selections between the two time periods that did not appear to be directly related to the exit of #19. The examination was confined to citations of preferred sources for state-of-the-art and for research/laboratory information since, 1) the two technical categories were the only ones for which #19 was cited, and 2) project/task choices were considered governed to a considerable extent by the kinds of projects that happen to be flowing through the organization at the time.

Of the total of 56 citations that could possibly be made by #19's former clients (14 individuals citing their first two choices as sources of information for two different categories of information), 17 were substitutions for #19 and three were left blank, leaving 36 citations that could be considered unconnected with the exit of the high communicator. Of the remaining 36 second round citations 12, or one third, were different from their first round citations. An analysis of the changes considered unrelated to the exit of #19, showed the same patterns that marked substitutions for #19. Five of the 12 showed no explanation in terms of propinquity, reciprocity, having been given as a preferred source for other information or being a preferred referrant of a cited source. All of the other changes in citation reflected propinquity (three), reciprocity (three), preferences for other information (three) and referrants of former sources (three); some reflected more than one of the foregoing.

Do They Turn to the Other High Communicators?

One of the questions that arose with the exit of the high communicator was concerned with the extent to which remaining high communicators would be subsequently citated to replace the exited high communicator. Given the exit of a high communicator, it can be assumed that the people who used him as a prime source of information would then turn to the other high communicators in the organization. Though the literature says nothing specific on this point, it is implied through the emphasis given to the high communicator, and the networks of high communicators that have been reported to exist. If the foregoing is true then the remaining high communicators identified in the first round of data collection should be disproportionately

substituted for the exited high communicator; then the top four of five individuals in terms of numbers of times cited should be subsequently cited.

Referring to the data shown in Table 2-5 in Chapter II, it is possible to identify those in organization A who received the most citations as preferred sources for information in the first mapping. Those who were ranked highest as sources for the two technical kinds of information for which the exited high communicator was cited were identified as follows:

TABLE 3-1

Ranking as a source for state-of-the-art information		Ranking as a source for research/laboratory information	
Ranking (No.)	Individual (#)	Ranking (No.)	Individual (#)
1	5	1	19
2	2	2	20
2	19	3	24
3	29	4	26
4	1	4	2
	14		7
	28		8
	33		18
			29

Comparing the rankings shown above with the data in Table 3-1 showing the citations substituted for the exited high communicator, it can be seen that none of the substitutions were high communicators for state-of-the-art information, and only three of the highly cited individuals for research/laboratory information appear at the fourth rank in number of citations.

Do They Turn to Individuals Cited as Preferred Coworkers--
What is the Effect of Liking?

Another question that arose was concerned with 'liking' and subsequent changes in selection.

There were 63 citations of individuals as "members with whom you'd like to work" (See Table 3-2), six of which were citations of individuals within the overall institute but not within the organization being studied. Of the 57 citations of individuals within Organization A, 26.3% were accounted for by two individuals, or 4.5% of the people in the organization. Eight individuals, or 18.2% of the people, accounted for 57.9% of all the citations as like-to-work-with.

In terms of rankings, the individual with the highest ranking as preferred coworker was #5 with nine, next was #2 with six, and six individuals, with three citations each, were third in rank, #13, 19, 20, 26, 29, 33. Comparing the rankings with the data in Table 3-1 showing the citations made in the second mapping as replacements for the exited high communicator, #19, it can be seen that only three of the 17 new citations as sources for technical information were in the first three ranks of those named as preferred coworkers. It is not until the fourth ranking of those cited as preferred coworkers, those with two citations each, that we account for five more of the replacements (three of them accounted for by one individual).

TABLE 3-2

CITATIONS OF INDIVIDUALS IN ORGANIZATION A AS COWORKERS "YOU WOULD MOST LIKE TO WORK WITH" AT FIRST MAPPING OF DATA (TWO SELECTIONS WERE PERMITTED)

Individual Selecting #	Those Selected #		Individual Selecting #	Those Selected #	
1	8	*	20	19	13
2	5	36	21	5	8
3	–	--	22	17	36
4	5	29	23	29	24
5	2	28	24	26	5
6	2	5	25	2	5
7	11	19	26	19	*
8	1	*	27	24	26
9	–	--	28	5	29
10	2	*	29	–	--
11	13	20	30	5	28
12	14	7	31	26	*
13	12	16	32	2	35
14	18	*	33	5	35
15	11	13	34	2	33
16	33	15	35	33	34
17	20	43	36	2	34
18	--	--	3 7	--	--
19	7	20			

*Individuals in the overall institute but not in the organization studied.

TABLE 3-3

DISTRIBUTION OF SELECTIONS OF COWORKERS CITED AS THOSE "YOU WOULD MOST LIKE TO WORK WITH" AT FIRST MAPPING IN ORGANIZATION A

Number of Selections Per Individual Source (n)	Number of Sources (n)	Number of Sources Cumulative %	Number of Selections (n)	Number of Selections Cumulative %
9	1	2.3	9	15.8
6	I	4.5	6	26.3
3	6	18.2	18	57.9
2	8	36.4	16	86.0
1	8	54.5	8	100.0
0	20	100.0		
Total	44		TOTAL 57	

Summary

What happens to the patterns of technical information flows in an organization upon the exit of a high communicator from the organization? To whom do the former information clients of the exited high communicator turn? Do they turn to other highly ranked communicators, those who had received many citations as preferred sources of specific kinds of information at a time before the high communicator left? If so, we would expect to see an obvious substitution of the highest ranked communicators (equal to or close to the exited communicator in ranking) in the subsequent mapping of information source preferences. Do the clients turn to people they rank high as preferred coworkers? If so, we would expect to find an obvious substitution of the most liked coworkers, that is the individuals receiving the highest number of citations as preferred coworkers at the time of the first mapping.

More questions were raised about the social nature of information exchange in the sense that information is expected to flow in professional social circles or networks. If the latter is the dominant influence on our actual choices of sources of information, we would expect to find that the former clients of the exited high communicator would turn to others in his professional social circle or network and that the second round substitutions for the exited person would be to the following: 1) those to whom the exited individual went for information, 2) those to whom the clients had formerly turned for other kinds of information, 3) those who had come to the exited

individual for information, 4) those who formerly turned to the clients for information, and 5) finally, one step further afield, those to whom the other preferred sources of the clients turned for information. The data clearly point to the professional social circle as being the dominant path through which substitutions for the exited high communicator were made. The professional social circle explanation identified far more of the subsequent selections than did turning to other high communicators or to preferred individual coworkers.

Certain cautions must be added with regard to the data. Only two selections were permitted as preferred sources of information for each category of information and for preferred coworkers; introducing an arbitrary Bed of Procrustes that in some cases forced respondents to stop short at two selections thus obscuring the networks of interactions. In other cases the request for two selections may have added selections that were distant in value from the first choice of the respondent.

There is a certain natural shift in choices that has something to do with the progression of projects, the changes in interests on the part of individuals, and the transfer to new work. As has been pointed out in this chapter, approximately one-third of the selections as preferred sources might change in any event by the time 16 months have passed by. However, even an analysis of the changes in citations that had no apparent connection with the exit of the high communicator shows a bias towards the professional social circle pattern; most of the new second round citations being accounted for by previous professional

social connectivity; propinquity (to a limited extent), reciprocity, referrants of referrants.

CHAPTER 4

SPATIAL REARRANGEMENT OF PEOPLE: A DEPARTMENT'S GEOGRAPHY IS REARRANGED

> The organization is most stable and the fewest people are being moved on Sunday morning at 3 AM between Christmas and New Year.
>
> American corporate office folklore.

The high mobility of Americans between companies and regions has its micro-corollary in the almost continuous shifting of groups and individuals within an organization. The high rate of interoffice movement in organizations is a function of the dynamics of the organizations. Reorganizations usually generate spatial rearrangements, thus providing physical expression to the changed formats of the organization chart. Growth or decline of a market, a product or a function has organizational consequences which eventually affect the arrangements of facilities. Changes in technology, changes in markets, changes in management seldom leave the physical or spatial arrangements of an organization untouched even when they do not affect the organization chart. Consequently, the more an industry or function is subject to change, the more it is subject to spatial and/or geographic rearrangements.

At the extreme of change in the spectrum of change are found the organizations and activities that are non-routine, technology sensitive, and project oriented. Included among the most touched-by-change are those activities that are in the business of generating change, particularly R&D. R&D is deliberately charged with generating change, and is in constant change itself. In R&D new projects are constantly being fielded, and old projects being phased out. New instrumentation and new techniques are constantly being considered and installed. A good example of the magnitude of change in R&D might be found in the growth in number and variety of the computation equipment used in the country's R&D facilities.

For the R&D manager, the rearrangement of the 'geography' of the organization appears to be one of the most effective means available for changing the information communication patterns and the consequent productivity and character of the organization. Spatial and personnel rearrangements are clearly within the control of management, and, whether consciously planned or only a response to the latest stimulus, such rearrangements are among the most frequent interventions practiced by managements. Furthermore, the evidence available concerning the effects of office geography on technical communication patterns, strongly support the idea that the geography is one of the most influential factors affecting the flows of work related information.

The effects on who communicates with whom and how frequently of the physical arrangement of offices within a facility and of the ease of physical access between coworkers has been studied and reported on extensively by Allen and others. Allen (1977) provides a substantial discussion of the subject and of at least one actual effort to modify communications patterns in an organization by the design of its physical arrangements. Allen reports on his work and on earlier research on the effects of physical location on interpersonal relationships. The earlier studies go back to the field work of Festinger and his colleagues (Festinger, Schacter and Back, 1950) and to the laboratory work beginning with Leavitt (1951). Allen reports extensively on the research conducted by him and his colleagues on the effects of distance and organizational bonds on the probability of technical communications between individuals in the same overall organization. Allen and his colleagues found that the probability that two people will communicate on scientific and technical subject matter drops sharply with the distance between them. The curve fitted to the data takes on a hyperbolic form[1] with the probability of two person communication occurring once a week on technical matters dropping sharply from close to 0.98 at a separation distance of two meters to 0.41 at five meters, 0.22 at ten meters, .12

[1]The regression line for all of the data from 0 to 250 kilometers is given by Allen (1977) as follows:

$$P(c)=0.522s + 0.026 \text{ where } s = \text{distance (meters)}$$

at 20 meters, .06 at 50 meters and becomes practically asymptotic thereafter. Controlling for organizational relationships, Allen reports two parallel hyperbolic curves, one for those with an organizational bond and one for those that have none. The curve for those with an organizational bond show a higher probability of communication between members at each separation distance, with both curves following the same kind of drop in probability of communication with separation distance as described above.

From the viewpoint of management, the data reported by Allen concerning distance and communication are intriguing in terms of the possibilities implied. The great majority of organizational structures are based on some kind of logic. Groups are constituted on the basis of some binding element such as the technology employed, the function performed, the project being developed or the customer served. It should be expected, therefore, that members of the same organizational group ordinarily perform interrelated work, and that most work-related conversation takes place between members of that group. It is typical, also, that a group will usually be located in a contiguous space that seldom exceeds 25-30 meters from border to border. Despite the obvious conclusion that the members of a given group are most likely to exchange technical information with each other, the data suggest that first and second level management can influence who talks to whom, the way an organization integrates, and the volume and direction of information flows within their areas of responsibility.

Furthermore, since movement is so much a part of organizationa life, the data suggest that each time there is an organizational move the manager has an opportunity to add an interaction and communications dimension to his planning for the move and to achieve desired changes without additional disruption or costs.

The data are suggestive, but many relevant questions are raised that acnnot be answered by the available data. Is it possible to affect intragroup communications patterns to the extent of affecting the choices made for preferred sources for information by the way offices are located within the 30 meter diameter territorial limits? How do realignments of choices as preferred sources of data develop with respect to locational changes, if at all? How long does it take for new geographic alignments to be relocated in new information flow patterns? Since there is an implication that distance imposes a 'cost' on the seeker of information that affects the distance traveled several questions concerning exchange values are raised. How far will technical professionals travel to take advantage of the services of an identified high communicator within the same group, or, in other words, what is the exchange value of high communicatorhood? How will the distance a technical professional travels to talk with a preferred source of information vary with different kinds of information? Will an individual travel further for project/task information or for one of the types of technical information? Since the data on distance and probability of communication reported by Allen span distances up to 250 kilometers, questions

arise as to the particular character and sensitivity of distance and communication relationships at the micro-level, within the 30 meter limits; that is, within the purview of a single organizational unit.

To study the effects of the spatial rearrangement of people within a given organizational unit, advantage was taken of a natural intervention, the rearrangement of offices in a department in an organization that is engaged in the development of sophisticated electronics hardware, much of it for the military. The organization that was undergoing the move and which has been designated Organization B for this report had approximately the same number of people as found in Organization A.[1] In studying Organization B instead of continuing with Organization A the study encountered time constraints affecting the time period between the two mappings. The two data collection efforts were only four months apart and thus we can only report on the short term, and perhaps transitory, effects of the departmental rearrangement of offices.

What Could be Anticipated as the Effects of the Rearrangement of a Department

Again, Allen (1977) provides us with the most recent material on the effects of architecture and organizational geography on technical information communications. As was reported above, Allen reports on the effects of distance, both horizontal and vertical,

[1] Though there were one or two individual moves of personnel in Organization A during the time of our study, the number were too limited to obtain the kind of information sought.

and on the effects of architectural barriers on probability of communications. Since Organization B was rearranging offices to group individuals working together on specific projects and subprojects, it might be expected that the average distance traveled for project/task information might go down between the two moves.

Taylor and Utterback's longitudinal study (1974) of changes in organizational structure, technical assignment and geographic arrangements reported a reduction in technical communication intra- and inter-groups in the short run. In the short run, previous communication patterns persisted; people in newly formed groups retained their contracts with their previous sources of information even when they were separated organizationally. In the longer run, however, groups formed new internal communication patterns. It was hard to separate out, as Taylor and Utterback state, whether the new patterns were resultants of new administrative groupings or separate facilities. Both should play a role, and the data on distance and communications suggest that physical separation may play the greater role. The Taylor and Utterback data suggest that, for the short run, individuals would retain their previous communications patterns and we would expect to find the respondents in Orgranization B traveling further, on the average, to obtain information from preferred sources; choosing the same sources even when they were located further away than before the move.

As was pointed out in Chapter 3 discussion of the literature with regards to the effects of the exit of a high communicator or communicators, propinquity plays an important role in interpersonal attraction and liking, and it is posited that attraction and liking play some role in the selections made of preferred sources for information. It could be argued that the relationship between liking and selection as a preferred source for technical information should be stronger than that between liking and selection as a preferred source for project/task information since project/task information may be tied to administrative sources and there may be little chance to make a variety of selections.

Though propinquity is statistically related to liking and interpersonal attraction, the data on propinquity and liking does not provide enough evidence to support the notion that propinquity by itself explains liking. As is pointed out by Berschied and Walster (1969) propinquity may also be a necessary condition for hatred and repulsion. A number of other elements enter into liking and subsequent selection as a preferred source of information. Suffice it to report the comment of an interviewee on the subject, "I won't pay the emotional price required by some so-called experts every time you ask them for some information." Allen (1964) states that sources that exact a high toll when consulted will not be consulted even if he possesses superior knowledge. The data suggest that there should be a significant correlationship between identification as a preferred source of information and identification as a coworker the respondents 'would most like to work with'. After the move, in the short run, it might be

expected that preferred sources for information would still correlate highly with identification as preferred coworkers, and that individuals will travel further, on the average, to seek them out for information. In time, it would be expected that propinquity would affect the responses and begin to shift selections for both preferred coworkers and sources of information to those located closer by.

Studying the Effects of the Rearrangement of a Department's Geography

To study the effects of the rearrangement of the office geography of Organization B on the subsequent information-communication patterns the following steps were undertaken:

- The information-communication patterns in Organization B were mapped at the beginning of their move to establish base lines for measurement of subsequent changes in pattern that might be attributed to the intervention of the move.

- The pre and post-organizational-move office arrangements were recorded

- The information-communication patterns in Organization B were mapped four months after the first mapping to determine new citation for preferred sources of information, if any.

- An analysis was made of the changes in citations of preferred sources and of preferences as coworkers and related to pre- and post-move spatial relationships.

First mapping of the information-communication patterns in Organization B (See Tables 4-1 and 4-2). Of the 44 professionals in Organization B (34 respondents to the questionnaire) ten were cited (given as first or second preferred source of information) at least once in each of the three categories of information with the number of citations per individual ranging from five to 20. Four individuals were cited at least once in each of two of the categories of information with citations ranging from three to five. Eleven individuals were cited in only one category with citations ranging from one (eight individuals) to four. Individuals outside the department being studied, but within the total organization, were cited 33 times. Eighteen individuals received no citations as preferred sources of information.

There were 68 citations of individuals as preferred sources for project/task information (see Table 4-2), 11 of which were to individuals outside the organization being studied but within the overall parent organization. Of the 57 citations within the organization, being studied, two individuals, or 5% of the people, received 30% of the citations. Five individuals or 14% of the individuals in the organization, received 54% of the citations. Organization B showed a wider dispersal of project/task selections than did Organization A.

There were 62 citations of individuals as preferred sources of state-of-the-art information, ten of which were to persons outside the organization being studied. In this information category, five people, or 11% of the people in the laboratory, received

TABLE 4-1

CITATIONS OF INDIVIDUALS IN ORGANIZATION B AS SOURCES OF INFORMATION: NUMBERS OF CITATIONS FOR EACH OF THREE TYPES OF INFORMATION FOR EACH OF TWO TIME PERIODS

Individual #	Project/Task Citations			State-of-the-Art Citations			Research/Lab Technique Citations		
	Time 1	Time 2	Change	Time 1	Time 2	Change	Time 1	Time 2	Change
1	0	2	+2	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0
4	4	6	+2	5	3	−2	1	5	+4
5	0	0	0	1	2	+1	2	3	+1
7	1	0	−1	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0
9	0	1	+1	0	1	+1	1	2	+1
10	0	1	+1	0	0	0	0	1	+1
11	0	0	0	0	0	0	0	0	0
12	2	0	−2	6	7	+1	3	5	+2
13	2	2	0	3	3	0	2	3	+1
16	4	4	0	8	8	0	4	4	0
18	2	1	−1	1	0	−1	0	0	0
20	0	0	0	0	0	0	0	0	0
21	0	0	0	1	1	0	0	0	0
22	0	0	0	0	0	0	0	0	0
26	6	6	0	1	0	−1	1	0	−1
29	0	0	0	2	3	+1	0	2	+2
32	0	0	0	0	0	0	0	0	0
34	0	0	0	0	0	0	0	0	0
35	0	1	+1	0	0	0	1	1	0
37	2	2	0	2	0	−2	3	2	−1
38	2	0	−2	0	0	0	0	0	0
39	1	0	−1	0	0	0	0	0	0
40	0	0	0	0	0	0	0	0	0
41	8	6	−2	0	0	0	0	0	0
42	0	1	+1	1	1	0	1	3	+2
43	0	0	0	1	1	0	2	0	−2
45	0	1	+1	0	0	0	0	0	0
47	0	0	0	1	0	−1	0	0	0
48	1	1	0	3	6	+3	4	6	+2
49	3	5	+2	0	0	0	0	0	0

TABLE 4-1

Individual #	Project/Task Citations			State-of-the-Art Citations			Research/Lab Technique Citations		
	Time 1	Time 2	Change	Time 1	Time 2	Change	Time 1	Time 2	Change
50	0	2	+2	0	0	0	1	1	0
51	3	2	-1	0	0	0	0	0	0
52	1	2	+1	0	0	0	0	0	0
55	0	0	0	0	0	0	0	0	0
56	0	1	+1	0	0	0	0	1	+1
57	1	0	-1	0	0	0	0	0	0
58	0	0	0	0	0	0	0	0	0
59	9	6	-3	4	5	+1	2	3	+1
60	0	0	0	0	0	0	0	0	0
61	3	2	-1	11	10	-1	6	5	-1
63	2	0	-2	1	1	0	2	0	-2
64	0	0	0	0	3	+3	0	0	0
65	0	1	+1	0	0	0	0	0	0
66	0	1	+1	0	0	0	0	0	0

34, or 65% of the citations as preferred sources of information. Three people received just under half of all the citations.

There were 48 citations of individuals as preferred sources of research/laboratoty information, 12 of which went to persons outside the immediate organization being studied. Five individuals, or 11% of the people, received 56% of the citations within the organization, again, as with the project/task information Organization B showed more people receiving citations than did Organization A.

Eight individuals received three or more citations as preferred sources of project/task information, seven received three or more citations as preferred sources of state-of-the-art information, and five as preferred sources of research/laboratory information. Ten individuals were cited in all categories, but only two individuals received three or more citations in each of the three categories of information. Eight of those who were cited as preferred sources of project/task information were only cited for project/task information and not for either of the technical categories of information. Nine individuals were cited as preferred sources for one or both categories of technical information and not for project/task information, four of them being cited in both of the technical categories.

Second mapping of theinformation-communication patterns in Organization B (see Tables 4-1 and 4-3)---Of the 44 professionals in Organization B that took part in the first mapping of data, 40 were still in the organization at the time of the second mapping. Of the

TABLE 4-3

DISTRIBUTIONS OF SELECTIONS OF PREFERRED SOURCES OF INFORMATION WITHIN ORGANIZATION B BY TYPE OF INFORMATION--SECOND MAPPING

Type of Information	Number of Selections Per Individual Source (n)		Number of Sources (n)	Number of Sources %	Number of Selections (n)	Number of Selections %
Project/Task Information	6		4	9.8	24	42.1
	5		1	12.2	5	50.9
	4		1	14.6	4	57.9
	2		7	31.7	14	82.5
	1		10	56.1	10	100.0
	0		18	100.0		
		Total	41		57*	

*There were an additional six selections of sources within the overall parent organization but not within Organization B

State-of-the-Art Information	10		1	2.4	10	18.2
	8		1	4.9	8	32.7
	7		1	7.3	7	45.5
	6		1	9.8	6	56.4
	5		1	12.2	5	65.5
	3		4	22.0	12	87.3
	2		1	24.4	2	90.9
	1		5	36.6	5	100.0
	0		26	100.0		
		Total	41		55*	

*There were an additional seven selections of sources within the overall parent organization but not within Organization B.

TABLE 4-3 (continued)

Type of Information	Number of Selections Per Individual Source (n)		Number of Sources (n)	Cumulative %	Number of Selections (n)	Cumulative %
Research/Laboratory Technique Information	6		1	2.4	6	12.8
	5		3	9.8	15	44.7
	4		1	12.2	4	53.2
	3		4	22.0	12	78.7
	2		3	29.3	6	91.5
	1		4	39.0	4	100.0
	0		25	100.0		
		Total	41		47*	

*There were an additional five selections of sources within the overall parent organization but not within Organization B.

40 continuing professionals, eight were cited at least once in each of the three categories of information with the number of citations per individual ranging from four to seventeen. Seven individuals were cited at least once in two of the categories of information with citations to individuals ranging from two to twelve. Fifteen individuals were cited in only one information category with citations per individual ranging from one to five. Ten individuals received no citations at all. Between the two mappings there was a distinct drop in the number of people cited as preferred sources who were in the overall organization but not within Organization B. The total number of such citations dropped from 33 to 18; from 11 to six for project/task information, from tne to seven for state-of-the-art information and from 12 to five for research/laboratory technique information. These data are in keeping with the findings of Taylor and Utterback (1972) who found that there was a distinct drop in technical communications between organizations in the short run after organizational and physical moves. In the first round, 16 of the respondents cited individuals outside Organization B as preferred sources of information. For the total population of respondents the average number of citations per 'outsider' was just under one (.97), and for those citing outsiders the average number of outsider citations was 2.1. In the second mapping, only eight people cited outsiders. The average number of citations of outsiders for all respondents was .44 and that of the citors was 2.3.

Overall, between the two mappings, there were many shifts in cited sources of information. There was an increase in the total number of individuals cited, from 26 to 30. Four individuals who had been cited in each of the three information categories in the first mapping were not so cited in the second mapping; with two individuals only cited in two categories and two in only one category in the second round. Two individuals were cited in each of the three categories in the second round who had been cited in only two categories and only one category in the first data collection effort. Two people were cited in only one category in the second round who had been cited in two in the first mapping, and one went from two to zero citations. Three individuals moved up from one to two categories, and from zero to two categories. The largest number of changes in numbers of categories per individual was in the shift from one to zero (four people) and from zero to one (five people).

The number of changes in selections for preferred sources of information that occurred in such a short period of time raises serious questions about the 'situationality' of the role of high communicator, and about the possibility that there are several roles that have become lumped within the omnibus category of high communicator. Three individuals, among the eight who were cited in all categories in the second mapping, were cited by more than three of their colleagues in each category, and only one of the three was cited by more than three colleagues in each category in the first mapping. If we broaden the category to those who were cited more than twice in each category the number of general purpose high communicators increases to four.

There were 63 citations of individuals as preferred sources of project/task information (see Table 4-3), of which six were to individuals within the overall parent organization but not in the organization being studied, Organization B. Of the 57 citations within Orgnization B, five people, or 12% of those cited, accounted for 51% of the citations. Six individuals, or 15% of those cited, accounted for 58% of the citations. In the second round there were more individuals cited as preferred sources of project/task information than in the first mapping, 23 as compared to 19. Furthermore, there was a far greater number of changes in numbers of citations to individuals for project/task information than there were for each of the two technical categories of information; 24 as compared to 13 for state-of-the-art sources and 16 for research/laboratory technique information. It may be inferred that the greater amount of variability in citations noted for project/task information reflects a period in which the number and variety or project tasks has risen and/or the industrial and technical character of a hardware-oriented, relatively hierarchical industrial firm. The latter inference is somewhat supported by a comparison with the change patterns experienced between the two mappings of Organization A. In the case of Organization A, the changes in number of selections for project/task informa totaled 15 as compared to 20 and 23 changes for the two technic mation categories. It should be remembered, however, that the between mappings in each organization varied greatly; in one case 10 months and in the second case four months.

There were 62 citations of individuals as preferred sources of state-of-the-art information, of which seven were to individuals within the overall parent organization but not within Organization B (See Table 4-3). Of the 55 citations to people within Organization B, ten were to one individual, or 18% of the citations went to 2% of the individuals in the organization. Five individuals, or 12% of the people, accounted for 66% of all of the citations. There was a drop in the number of people cited between the first and second mapping, from 17 to 15.

There were 52 citations of individuals as preferred sources of research/laboratory technique information, of which five were to individuals within the overall parent organization but not within Organization B (See Table 4-3). Of the 47 citations within Organization B, five people, or 12% of the people, accounted for 53% of all of the citations and nine people, or 22% of the people, accounted for 79% of the citations. There was no change in the number of people cited as preferred sources of research/laboratory technique information between the two mappings.

How Far Do They Travel for Information from a Preferred Source

The spatial locations of the members of Organization B were plotted both before and after the rearrangement of offices, and the distances between those cited as preferred sources of information and those citing them were plotted. The distances were plotted in terms of 'offices from' citor to source with an office distance translated

into meters at three meters per office distance. The distribution of distances between citor and preferred sources by the type of information sought both before and after the organization's offices were rearranged is shown in Table 4-4.

As can be seen from the data in Table 4-4, more than 94% of all of the people cited as preferred sources of information were located 30 meters or less from those citing them, both before and after the offices were rearranged. The data are in consonance with the data reported by Allen (1977) which show that the highest probabilities of technical communications are between people 30 meters or less from each other. Before the move 94.5% of all those cited were 30 meters or less from the citor, and after the move 88.7%.

Examining the distribution data in terms of different kinds of information sought we find that there was a post-move drop in the percentage of the citations found at 30 meters or less for each of the categories. Before the move, the distances separating citor and preferred sources for project/task information were 30 meters or less for 87.4% of the citations and after the move the percentage was 83.4%. For the two technical information categories the equivalent percentages were as follows: state-of-the-art selections premove-88.1% and postmove-80.9%; research/laboratory technique selections premove-100% and postmove-91%.

Taking a more fine-grained look at the distribution of information source selections by distance separating citor from source we see that before the move a little more than half of those cited,

TABLE 4-4

DISTRIBUTION OF CITED PREFERRED INFORMATION SOURCES IN ORGANIZATION B BY DISTANCE FROM CITOR TO SOURCE BY TYPE OF INFORMATION: BEFORE AND AFTER MOVE

Distance Citor to Source	TYPE OF INFORMATION											
	ALL		PROJECT/TASK		STATE OF ART		RESEARCH/LAB					
	Pre move		Pre move		Pre move		Pre move		Pre move		Pre move	
Average distance (meters)	(n)*	%	(n)*	%	(n)*	%	(n)*	%	(n)*	%	(n)*	%
3	15	10.4	21	13.2	5	8.8	9	15.5	6	11.5	8	14.5	4	11.1	4	8.7
6	40	27.6	29	18.2	16	28.1	10	17.2	15	28.9	10	18.2	9	25.0	9	19.6
9	20	13.8	18	11.3	7	12.3	8	13.8	7	13.5	6	10.9	6	16.7	4	8.2
12	10	6.9	14	8.8	2	3.5	1	1.7	6	11.5	7	12.7	2	5.6	6	13.0
15	12	8.3	9	5.7	4	7.0	3	5.2	4	7.7	4	7.3	4	11.1	2	4.4
18	9	6.2	12	7.5	5	8.8	6	10.3	1	1.9	3	5.5	3	8.3	3	6.5
21	10	6.9	12	7.5	3	5.3	4	6.9	5	9.6	5	9.1	2	5.6	3	6.5
24	9	6.2	11	6.9	4	7.0	3	5.2	3	5.8	4	7.3	2	5.6	4	8.7
27	5	3.5	10	6.3	2	3.5	3	5.2	1	1.9	3	3.6	2	5.6	5	10.9
30	7	4.8	5	3.1	2	3.5	2	3.5	3	5.8	5	1.8	2	5.6	2	4.4
33	1	0.7	9	5.7	1	1.8	4	6.9	1	--	4	5.5	-	--	2	4.4
36	4	2.8	4	2.5	3	5.3	3	5.2	1	1.9	2	1.8	-	--	1	3.2
39	1	.7	1	0.6	1	1.8	2	--	-	--	1	--	-	--	-	--
42	2	1.4	2	1.3	2	3.5	4	3.5	-	--	3	--	-	--	-	--

(n) = number of cited preferred sources.

51.4%, were no more than nine meters from the citor and after the move 42.7%. Within the nine meter range individuals were cited as technical sources who were further from the citor on the average than were those cited as sources of project/task information; 48.1% as compared to 53.9% and 53.3%. After the move the relative percentages reversed with more of the cited sources for project/task information being within the nine meter range than those cited for technical information; 46.5% as compared to 43.6% and 36.5%. When the distance data on the most distant preferred sources are examined we find that more of the sources cited for project/task information are found at the greater distances (21 meters or more) than sources cited for state-of-the-art or research/laboratory technique information before the move; the percentages were 32.2% as compared to 25.0% and 22.4%. After the move the percentages were 36.4% as compared to 30.6% and 39.0%.

An analysis was made of the average distances between those cited as preferred information sources and those who cited them both before and after the rearrangement of offices in Organization B. The average distances were calculated by type of information in terms of all citations, citations to high communicators (those with three or more citations), citations to non high communicators, citations to those who were cited as 'like to work with' and to those cited but not as 'like to work with'. Pre and post-move distances were calculated for those cited in the first mapping (See Table 4-5).

TABLE 4-5

AVERAGE DISTANCES BETWEEN CITED INFORMATION SOURCES AND THOSE WHO CITE THEM--
BEFORE AND AFTER MOVE IN ORGANIZATION B

	AVERAGE DISTANCE TRAVELED			
	PRE-MOVE		POST-MOVE	
	Number of citations (n)	Average distance (meters)	Number of citations (n)	Average distance (meters)
To All Cited Sources For:				
All Information	145	12.5	159	14.4
Project/Task Information	57	14.0	57	15.0
State-of-the-Art Information	52	11.4	55	13.4
Research/Lab Technique Information	36	11.7	47	14.9
To High Communicators (Three or More Citations) For:				
All Information	100	12.9	118	14.8
Project/Task Information	40	14.3	31	17.1
State-of-the-Art Information	40	12.3	48	13.1
Research/Lab Technique Information	20	11.2	37	14.3
To Non-High Communicators (Less than Three Citations) For:				
All Information	45	11.0	41	13.2
Project/Task Information	17	13.3	24	11.5
State-of-the-Art Information	12	8.4	7	12.3
Research/Lab Technique	16	12.3	10	15.2

TABLE 4-5 (continued)

	AVERAGE DISTANCE TRAVELED			
	PRE-MOVE		POST-MOVE	
	Number of citations (n)	Average distance (meters)	Number of citations (n)	Average distance (meters)
To Those Cited as "Like to Work With:				
All Information	116	12.7	123	14.4
Project/Task Information	47	14.2	43	16.5
State-of-the-Art Information	43	11.9	44	13.0
Research/Lab Technique Information	26	11.4	36	14.0
To Those Cited not for "Like to Work With"				
All Information	29	10.5	36	13.8
Project/Task Information	10	11.2	14	9.9
State-of-the-Art Information	9	8.8	11	4.9
Research/Lab Technique Information	10	11.5	11	17.6

As can be seen in Table 4-5 the distances between cited and those who cited them were greater after the move than they were before the move. The average distance traveled to all cited sources for all three kinds of information went up from 12.5 meters to 14.4 meters. The increase in distance separating source of information from citor can certainly be attributed in part to the short term effects of the move. It is reasonable to assume that past preference was partially established by propinquity. Further, it is reasonable to assume in the short run a substantial number of perferred sources remain preferred and that the citor will travel further than in the past to contact the preferred source until new propinquities have their effect over time.

The data on average distance between citor and cited by type of information, both before and after the move, indicates that the average distance to a cited source for project/task information was greater than the distance to sources for state-of-the-art or research/ laboratory technique information. When the distances to cited sources of project/task information are compared to the distances to high-communicators and distances to preferred coworkers it is found that the average distance to project/task sources is greater than that associated with any other category of source. One inference that may be drawn from the data is that the administrative nature of project/task information may limit the operation of choice to some extent, and that technical professionals in an organization will 'pay the higher price'

of traveling further for project/task information because they have to. However, in terms of increase in average distance to cited sources as a result of the rearrangement of offices in Organization B, the data in Table 4-5 show a proportionately greater increase in the average distance to sources of state-of-the-art information (an increase of 18%) and for sources of research/laboratory technique information (an increase of 27%) than was obtained for distance to sources of project/task information (an increase of only 7%).

A Move, Distance and the High Communicators

In the first mapping, as was noted earlier, several individuals were identified as having received at least three citations in at least one of the three categories of information, and were judged to be high communicators. Twelve individuals received three or more citations per category in at least one category of information in the first mapping. The eight tho received three or more citations as preferred sources for project/task information accounted for 40 or 70.2% of the 57 citations made to sources in that category. As can be seen in Table 4-5, the average distance separating the high communicators from their clients for project/task information was 14.3 meters. Similarly, the distance between the seven high communicators of state-of-the-art information from their clients was 12.3 meters, and the average distance for the five high communicators of laboratory/research technique information was 11.2 meters.

When the non high communicator sources are compared with the high communicators, it is readily seen that the 'cost' of distance was no deterrent to going to a preferred source; the average distance to the high communicators for all information was 12.9 meters as compared to 11.0 meters to the non high communicators.

After the move the average distance separating high communicators and clients went up; the overall average was 14.8 meters compared to the premove 12.9 meters, an increase of 15%. The highest increase in distance was to the high communicator sources of project/task information, an increase of 22% as compared to increases of 13% and 17% for state-of-the-art and research/laboratory technique high communicators. As with the premove data, the average distance to the high communicators was higher than that to sources who were non high communicators; 14.8 meters as compared to 13.2 meters.

Several questions were raised concerning whether or not the respondents turned to the same sources for information after the move. How many of the respondents in the second mapping made the same selections of preferred sources they had made in the first mapping? How many selected the same people for the same kinds of information? How many selected some of the same people but for different categories of information? How many of the postmove selections as preferred sources of information were located further away than premove, nearer or the same average distance from their clients?

Of the 159 citations of preferred information sources made by the respondents in the second mapping,[1] 67 were repeats, citing the same sources for the same kind of information as had been cited in the first mapping. In addition to the repeats, there were 22 additional citations of the people who had been cited in the first round, but for new categories of information. Thus, 42% of the citations were identical with the first round, and an additional 14% went to the same people. There was no apparent trend with regard to distance since, of the 67 repeats, 29 were located closer than before the move, 11 were at the same distance, and 27 were further away. With the 22 additional citations to the same people, seven were closer than they were before the move, three were the same distance away from their clients, and 12 were further away than they were before the move. It would appear that change in location may have influenced the number of repeats since there was a slightly higher percentage of changes in selections in the four months after the move in Organization B, 39% as compared to the change of 1/3 of the selections in Organization A after 16 months.

"Like to Work With," Selection as a Source, and Distance--

Crosstabulating selections for "most like to work with" with selections as sources of information in a two by two cross-tabulation (See Table 4-7) it was found that in organization A

[1] In the first mapping there were fewer citations in total, 145, made by a greater number of respondents since two of the original respondents had transferred and one had been terminated between the two mappings. The larger number of ditations are accounted for by fuller response by the cooperating professionals in the second mapping.

TABLE 4-6

SELECTIONS AS SOURCES OF INFORMATION

Selections for "Most Like to Work With"	Project/Task	State-of-the-Art	Research/Lab Technique
ORGANIZATION A			
Raw Chi Square & df	7.36310 df-5	13.01518 df=5	14.03028 df=5
Significance	.1950	.0232**	.0154**
ORGANIZATION B			
Raw Chi Square & df	16.98538 df=6	13.69934 df=6	13.12045 df=6
Significance	.0093**	.0332**	.0412**

**Significant to $\leq$ .05.

TABLE 4-7

CROSSTABULATION OF SELECTIONS FOR "MOST LIKE TO WORK WITH" AND SELECTIONS AS SOURCES OF INFORMATION--TWO BY TWO

SELECTED FOR MOST LIKE TO WORK WITH	INDIVIDUALS SELECTED AS SOURCES OF INFORMATION					
	PROJECT-TASK		STATE-OF-THE-ART		RESEARCH/LAB. TECHNIQUE	
	LOW* (n)	HIGH (n)	LOW (n)	HIGH (n)	LOW (n)	HIGH (n)
ORGANIZATION A						
Low*	14	12	13	5	13	5
High	3	13	4	19	4	19
Corrected Chi-Square Significance	3.20338 .0735	1 df	10.35055 .0013**	1 df	10.35055 .0013**	1 df
ORGANIZATION B						
Low	16	3	15	7	15	8
High	4	14	5	10	5	9
Corrected Chi-Square Significance	11.91403 .0006**	1 df	3.07088 .0797	1 df	1.97783 .1596	1 df

*Individuals were assigned to a "high" group on the basis of whether or not at least one other selected him. The size of each of the "low" and "high" groups were as follows:

Variable	ORGANIZATION			
	A		B	
	Low (n)	High (n)	Low (n)	High (n)
Most like to work with	17	24	20	17
Project/Task Info. Source	26	15	19	18
State-of-the-Art Source	18	23	22	15
Research/Lab. Tech. Source	18	23	23	14

selection as "most like to work with" was significantly associated with selection as a source of state-of-the-art information and a source of research/laboratory technique information but not with selection for project/task information. In Organization B the reverse was found; selection as "most like to work with" was significantly associated with selection as a source of project-task information and not with selection for the two technical categories of information. In trying to explain the differences between the two organizations a more disaggregated crosstabulation was made of selection for "most like to work with" and the three categories of information. It was found that when the latter analysis was performed that "most like to work with" was significantly associated (.05) with selection as a source of information in every case except for project-task information in Organization A. The results of the latter analysis are listed in Table 4-6.

Of the 159 selections of preferred information sources in the second mapping, 126 were to 39 individuals who had been cited by the respondents in the premove data collection effort as someone the respondent would 'like to work with.' Five of the individuals cited preferred coworkers premove and who became postmove selections as preferred information sources had not been cited as such before the move. With regards to distance between those cited as 'like to work with,' as can be seen in Table 4-5, the average premove distance between those cited and those who cited them was 12.7 meters, very

close to the same distance for the high communicators. Postmove the average distance to those cited from their clients was 14.4 meters, again an increase over the premove distance.

When compared to those who were cited as sources of information but not as preferred coworkers by any of the respondents we see that the average premove distance to those cited as 'like to work with' was greater than the distance to those not so cited; 12.7 meters to 10.5. There was a similar difference, though smaller, post move between those cited and those not so cited; 14.4 meters to 13.8 meters.

Liking apparently does play a measurable role in determining who one goes to for information and how far one will travel (the price paid) for information-communication exchange. It is interesting to note that more citations as information sources were made to those cited as 'like to work with' than to the high communicators (however, there is considerable overlap between the two categories).

Past Propinquity and Present Selectios as a Source of Information

A detailed analysis was made of the premove spatial relationships between newly cited (not cited in the premove mapping) preferred sources of information and those citing them. It was found that 15 of the newly cited had been neighbors (in the next office or two offices away) of those citing them before the move. In 12 of the 15 cases the separation distances between cited and citors were greater postmove than they had been before the move. In nine of the cases the new

citations were for project/task information which could be explained by administrative considerations. Another, partial explanation that raises some interesting points, is that the value of casual day-to-day interactions may not be consciously realized until after a move that disrupts such exchanges.

Summary

Spatial rearrangements of the people within an organization is a frequent event in most organizations. Moving between offices is a reflection of organization changes, technology changes, growth and decline of products and functions, and is one of the most frequently exercised management interventions. The literature also is rich with data and suggestions as to the important effects of the internal geography of organizations on the technical communication flows within that organization. Thus a number of questions were raised in conjunction with the study being reported here as to the dynamics of information-communication change that are apparently generated by changes in spatial relationship between the members of an organization. Questions of particular interest were concerned with the flows of communications within a diameter of 30 meters, since previous research has shown a sharp drop in communication from zero to 25-30 meters of separation and a rather flat curve of probability of communication from that distance outward. Furthermore, it was reasoned that most organizational units at the basic level, where most interaction takes place, are groups of departments (first two levels) which seldom occupy areas that extend beyond 30 meters from boundary to boundary.

The questions that were raised prior to the collection of data relevant to movement of people were concerned primarily with the short term realignments of selections for preferred sources for different kinds of information. The questions that were asked concerned the effects of distance in changes in selections the 'cost' in distance that the individual technical professional would be willing to incur to seek out somecne identified as a high communicator in the premove situation or to seek out someone identified as a preferred coworker, and the differences that might be found in the relationships between separation distance and selection as a preferred source by type of information.

Data were collected on the premove and postmove information source preferences of the technical professionals in an organization that is engaged in electronic development for aircraft companies and for the defense establishment. Though only reflecting short time effects (four months) the data threw light on many of the questions that had been raised, but raised as many interesting questions as they answered. There were many shifts in selections between the two mappings. There was an overall increase in the number of citations made by the respondents (through more response to the request for two names for each category of information) and the number of people cited from 26-30. There was a distinct drop in the number of people cited as preferred sources who were outside the immediate organization

being studied. There was a wider selection of people cited for project/task information after the move than there was found for the two technical categories of information.

In the short time period between the two mappings, the average distance between citor and cited source of information increased from 12.5 to 14.4 meters with the relative increases in distance for technical information being greater than that for project/task information. Both before and after the move, the distance traveled to a preferred source for project/task information was greater than for technical information. Though, the increase in distance to a preferred source of project/task information went up the least proportionately, it still remained the greatest distance separating citor and selectee for the three categories of information. It is plausible to infer that selections for project/task information are not as freely made as are those for technical information since project/task information is linked to administrative relationships.

The increase in distance traveled postmove was not unexpected since, in the short run, it was assumed that most of the respondents would use the same information sources they had used before the move until propinquity would work its effects on changes in selections. The distance increased, but, surprisingly, 46% of the postmove citations were to people who had not been cited by the individual respondents in the premove mapping of information-communication patterns.

Of those identified as high communicators in the first mapping, 90% were identified as high communicators in the second mapping, and the distance between citors and high communicators went up from an average of 12.5 meters to 14.8. Both pre- and post-move distances to identified high communicators was greater than to those cited who were not high communicators. More citations were made to individuals identified as 'like to work with' and a greater distance was measured to preferred coworkers both before and after the move; 12.7 and 14.4 meters as compared to those cited but not identified as preferred coworkers, 10.5 and 13.8 meters.

The data collected support the notion of the price/cost of information that an individual is willing to pay as being measurable in terms of the distance that an individual is willing to overcome in order to use a particular individual as a source. An individual is apparently willing to travel further to someone 'liked,' to a high communicator, to a necessary source of administrative information (at least in the short run). There is probably some threshold of distance or price beyond which the price is too high, and the data pre- and post-move do show that the great majority of sources cited fell within the 30 meter limit identified in Allen (1977). There is an apparent trade that can be measured between source quality and distance, liking and distance (the emotional price paid) as there has been established between organizational bond and distance (Allen, 1977).

CHAPTER 5

THE PASSAGE OF TIME AS AN INTERVENTION, THE USE OF TIME, AND DISAGGREGATING THE HIGH COMMUNICATOR

"There are few things which time does not destroy; many which it removes."

Varro, De Lingua Latina

The Intervention of Time

Time intervenes in the course of events within an organization aside from the comings and goings of individuals as they express their own agendas over time. With the passage of time some projects are finished, others are cancelled, new projects are undertaken, and, certainly, projects move from one phase to another, from conceptualization to breadboard, to prototype, to test or to final report. It is reasonable to assume that the kinds of information required by the technical professional working on them also change with the passage of projects through their life cycles, and that, perhaps, selections for sources of information are likely to change with the changing needs of the technical professionals in the organization. Though the literature has not been too explicit on this point, it seems unlikely that a few high communicators can be the dominant sources, preferred at all times. From the literature one might expect to find a persistent citing of a few people

throughout different time periods but with changing ranking and a changing makeup of the major body of those cited at each period of measurement.

Referring to the data in the Table 2-5 which shows the numbers of citations for Organization A by information category at the times of the two mappings, sixteen months apart, we see that there have been a number of changes in rank. Only counting those that had changed at least two ranks (e.g., #11 went from rank seven in the first mapping of project/task selections to rank four in the second mapping) since there had been one major exit (i.e., #19, the exited high communicator) and since minor shifts of a rank could occur by a shift in one or two citations, we find that there were 15 shifts of at least two ranks. The shifts were both up and down, and occurred in all three categories of information. Interestingly, there were only two shifts in ranking for project/task information selectees, compared to seven shifts of two or more ranks for state-of-the-art information and six for research/laboratory technique information. The relatively higher shift in technical information categories lends support to the notion that projects shift in their STI content as they cycle through their phases.

Referring to Table 4-1 we can examine the numbers of citations by category of information for Organization B at the times of the two mappings, four months apart. The pattern is very different than the one found after sixteen months with Organization A. The changes in ranking for sources for project/task information are far more numerous than those for technical information. There are 11 changes in two or more rankings for project/task citations. There are two

in state-of-the-art rankings and five for research/laboratory technique. The large number of shifts in project/task rankings may have reflected administrative changes that instigated the reorganization of offices and people. In any event, the number of changes in all categories reflects the changes that occur in even the short run in the content and organization of projects in an organization engaged in R&D.

At the time of the second mapping in Organization A there were a number of changes in who was cited as preferred sources of information. Some of the changes could be accounted for by the exits of people who had been in the organization at the time of the first mapping. One of the individuals who had left was the high communicator whose exit was discussed in Chapter 3. Seventeen changes in citation were directly attributable to the exit of the high communicator. Three other individuals had left who had accounted for six citations in all three categories of information in the first mapping; thus, a total of 23 changes were to be expected. In all there were 160 citations made in addition to those that could be considered direct replacements of exited sources. Of the 160 citations, 108 were repetitions of citations made 16 months previously leaving 52, or 32.5%, that had been changed. The parallel numbers for Organization B were discussed in Chapter 4, showing 58% changes in citations only four months following a move. In any case the point is made that changes occur simply through the intervention of time, working its effects in addition to the effects attributable to high communicators, social relationships and changes in physical location.

The Use of Time in Information-Communication

Throughout the conduct of the study it became increasingly evident that the high communicator is an aggregate; that the label high communicator is an envelope that encloses a variety of people and functions that should be separated for purposes of research, understanding, and managerial applications. The efforts to identify those newcomers in the organization who would most likely become high communicators at some later date, and the discriminant functions that were developed for that task and described in Chapter 2, underlined the differences in characteristics associated with those selected as preferred sources for different kinds of information. In addition the differences between the two organizations studied and the apparent effects of those differences on their discriminant functions for high communicators, reemphasized the existence of differences in high communicators by technology, type of work being performed, organization and industry.

To further clarify the differences associated with the various kinds of high communicators that seemed to be surfacing, an attempt was made to measure the way several professionals in Organization A distributed their time, particularly those identified as high communicators.

The Sample---Ten technical professionals from Organization A were used in a limited time study to determine how their time was actually used with regard to information-communication behaviors. The 'sample' of technical professionals was a compromise between the desire to obtain a good distribution of individuals in terms of rankings as cited sources of information, the dependence on

volunteers to participate in what can be a rather irritating measurement technique, and the pressures of project time. The final group of ten professionals that participated was a fair sampling of high communicators including individuals highly cited in each of the three categories of information, individuals cited highly in two of the three categories, individuals cited highly in only one category and individuals who were not cited highly at all (See Table 5-1).

The Time Study Method---The time studies were carried out using self time study equipment which is commercially supplied by the Extensor Corporation of Minneapolis. The system uses a random signal generator developed in Sweden that gives both an audio and visual signal at random intervals. At the time a signal is given the study participant "clears" the signal by punching a coded card with the codes describing the categories of activity occurring at the time of the signal. Provisions are made for coding activities that occur when the individual is away from the time study equipment. The principle on which the system is based is the same principle that has been applied for decades under the headings of 'ratio-delay studies' and 'work sampling'; the work activities of an individual distribute in the form of a Poisson distribution and random readings will provide a fairly accurate description of the actual distributions of that individual's time. (See Appendix for illustration and copy of instructions on operations.)

The cooperating professionals were asked to enter information concerning their activities at the time of each signal sounded into

TABLE 5-1

CITATIONS OF INDIVIDUALS USED IN TIME STUDIES IN ORGANIZATION A:

CITATIONS INCLUDE BOTH FIRST AND SECOND MAPPINGS

Individual (#)	Project/Task Citations		State-of-the-Art Citations		Research/Laboratory Citations	
	Time 1	Time 2	Time 1	Time 2	Time 1	Time 2
2	6	6	7	10	3	4
3	8	9	0	0	0	0
5	1	2	12	8	1	0
7	8	11	2	4	3	4
8	0	1	2	2	3	4
16	0	0	0	0	1	3
20	0	0	2	2	5	8
25	0	1	0	1	0	0
26	0	0	0	1	4	4
29	1	0	4	3	3	5

a coded card. The coded card was punched by the respondent with three items of information: Activity, Contact and Function. The specific terms used and their meanings are given below:

A. Activity

Activity describes what you are doing.

1. Talk/Meet 1:1--you are talking or meeting one other person face to face.
2. Talk/Meet group--you are talking or meeting with a group. You may be presenting before a group; you may be in the group being presented to; or you may be in an informal discussion.
3. Telephone IN--you are talking on the telephone where someone else originated the call. (could be a conference call)
4. Telephone OUT--you are talking on the telephone where you originated the call. (could include a conference call)
5. Write/Dictate--you are writing or dictating a written piece (letter, report, paper, proposal, etc.).
6. Read--you are reading.
7. Laboratory Work/Data Collection--you are performing the laboratory work and/or data collection.
8. Analyze--you are analyzing something (e.g., data, experimental results, a new concept, etc.).
9. Think/Plan--you are thinking and/or planning.
10. Travel/Transit--you are going from one location to another.
11. Personal--Self explanatory.
12. Other--you are doing something that is not described in the above categories.

B. Contact

Contact describes who you are interacting with.

1. Self--you are interacting with only yourself or there is no interaction.
2. Same Division - Professional--a professional from your division at SwRI.
3. Same Division - Non-Professional--a non-professional from your division at SwRI.
4. SwRI Other Professional--a professional from another technical division at SwRI.

5. SwRI Other Non-Professional--a non-professional from another technical division at SwRI.
6. SwRI Central Administration--someone (professional or non-professional) from one of the general support groups (e.g., library, accounting, etc.) at SwRI.
7. Client--current client.
8. Potential Client--potential or prospective client.
9. Vendor/Subcontractor--vendor or subcontractor
10. Other professional--a professional (not a vendor or subcontractor) from outside SwRI.
11. Personal/Family/Friend--self explanatory.
12. Other--Someone not described in the above categories.

N.B. If the contract is with a group comprised of several of the categories, use the category of those most important for the success of the group. For example, if the purpose of the meeting is a presentation to a potential client, then the contact is with "Potential Client" even though there were others at the meeting.

C. Function

Function is the intended use of the activity. In some instances this may be apparent from billing practices.

1. Project Research--activities which directly advance a project. This may include a project from another division.
2. Project Report Preparation--activities directly connected with report preparation.
3. Project Presentation--completion and selling the results.
4. Project Management/Administration--all project related administrative activities.
5. New Project Development--development of new capabilities, techniques or markets for future projects.
6. Proposal Preparation--activities directly connected with the preparation of a proposal.
7. Proposal Presentation--presentation of a proposal to a prospective client.
8. In-house Research--research on internally funded projects. This does not include externally funded projects for another division.
9. Non-project Management/Administration--all non-project related administrative activities.
10. Personal Professional Development--all activities primarily intended to provide professional development. These could include seminars, formal college courses, reading journals, etc.
11. Personal--self explanatory.
12. Other--any function not described in the above categories.

Time Study Results---The total number of observations (individual coded entries) was 3,097; ranging from little over 100 to over 600 per individual. A group summary is shown in Table 5-2, and a fuller summary showing distributions of the interactions of who one talked with and what one talked about or did is shown in the next table (See Table 5-2).

On the average, the time studied group of individuals during the period studied spent 40.4% of their time talking with others; 20.2% one-to-one and face-to-face and 6.8% one-to-one on the phone, 13.4% meeting with a group. Of the time, 12.0% was spent reading, and 10.5% of the time dictating materials that eventually others would read. On the average, laboratory work and data collection took 17.2% of the time. Cerebrating took 11.6% of the time with 7.4% in analysis and 4.2% in thinking and planning.

Who the time was spent with gives us some insights into the amount of in-house activities within Organization A and how much of the time was spent with professionals. On the average, the cooperating professioals spent 39.8% by themselves, 28.6% of the time with people in Organization A (21.2% of the Organization A interaction with professionals), 7.5% with others in the overall organization (5.3% of that with professionals), 5.6% with clients and potential clients, 0.8% with vendors and subcontractors and 2.3% with other professionals. All in all, the respondents spent 28.8% of their time with other professionals.

What the time was spent on provides us with some insights into life in a nonprofit, contract-project environment. As might be

TABLE 5-2

TIME STUDY OF ORGANIZATION A-I

GROUP SUMMARY

TALK/MEET 1:1	X 20.2	SELF	X 30.8		X100.0
TALK/MEET GROUP	X 13.4	SAME DIV.- PROFSSNL	X 21.2		X
TELEPHONE IN	X 3.2	SAME DIV.- NON-PROFSS.	X 7.4		X
TELEPHONE OUT	X 3.6	SMRI OTHER PROFSSNL	X 5.3		X
WRITE/DICTATE	X 10.9	SMRI OTHER NON-PRO.	X .8		X
READ	X 12.0	SMRI CENTRAL ADMIN.	X 1.4		X
LAB WORK/DATA COLLCTN	X 17.2	CLIENT	X 4.7		X
ANALYZE	X 7.4	POTENTIAL CLIENT	X .9		X
THINK/PLAN	X 4.2	VENDOR/SUBCONTRACTOR	X .8		X
TRAVEL/TRANSIT	X .2	OTHER PROFESSIONAL	X 2.3		X
PERSONAL	X 5.2	PERSONAL/FAMILY/FRIEND	X 2.7		X
OTHER	X 2.0	OTHER	X 1.9		X
ADJUSTMENTS	X .8	ADJUSTMENTS	X 10.7	ADJUSTMENTS	X

TABLE 5-3

TIME STUDY OR ORGANIZATION A-I

GROUP SUMMARY

TALK/MEET 111	% 20.2	PROJECT RESEARCH	% 47.0		%
TALK/MEET GROUP	% 13.4	PROJECT REPORT PREP.	% 1.9		%100.0
TELEPHONE IN	% 3.2	PROJECT PRESENTATION	% 1.7		%
TELEPHONE OUT	% 3.6	PROJECT MGMT/ADMIN	% 7.1		%
WRITE/DICTATE	% 10.5	NEW PROJECT DEVEL.	% 4.8		%
READ	% 12.0	PROPOSAL PREP.	% 3.7		%
LAB WORK/DATA COLLCTN	% 17.2	PROPOSAL PRESENTATION	% .3		%
ANALYZE	% 7.4	IN-HOUSE RESEARCH	% 5.0		%
THINK/PLAN	% 4.2	NON-PROJECT MGMT/ADMIN	% 11.4		%
TRAVEL/TRANSIT	% .2	PERSONAL PROFSNAL DEVEL	% 5.9		%
PERSONAL	% 5.2	PERSONAL	% 5.8		%
OTHER	% 2.0	OTHER	% 5.3		%
ADJUSTMENTS	% .8	ADJUSTMENTS	% .4	ADJUSTMENTS	%

expected, the largest fraction of time was spent directly on the process of project research, 47.0%. Presenting or communicating the project work occupied 3.6% of the time (1.9% in preparation and 1.7% in presentation), new project and proposal development and presentation took 8.8% of the time. Administration of one kind and another took 18.5% of the time. In-house research took 5.0% of the time. Personal professional development took 5.5% and personal matters took 5.8% of the group time.

A few of the interrelationships between form of communication, who was communicated with and subject matter are worth noting. Of the 33.6% of the time spent by the group on the average, in talking and meeting one-to-one or with a group, 21.5% was spent with others in Orgnization A and 5.1% with others in the overall organization; another way of viewing the density of interactions as related to organizational bond. Management and administration in an R&D organization is essentially personal and informal with 41% of the time spent on project administration, 7.1% of the total spent in one-to-one meetings, 20% spent in group meetings, 7% spent on the telephone, and only 9% of the time spent on writing/dictating or reading. In most respects non-project management and administration revealed a similar overall pattern with 61% of the time spent in meetings, but with one-to-one meetings accounting for 34% of that. A far larger percentage of the time, 33% was spent on writing/dictating and reading with regard to non-project management, and only 3% spent on the telephone.

There was considerable variation among the individuals in their use of time. For example, the time usage of an individual identified as a high communicator with regard to project/task information

varied in many ways from that of an individual identified as a high communicator for research/laboratory information only. The individual time usage differences are shown in the Tables 5-2 and 5-3.

A comparison of the pattern of time usage of the three individuals who were highest ranked in the organization as most preferred sources for project/task information was made with the time usage of the seven remaining individuals in the time studied group. The pattern of the three project/task high communicators (individuals #7, #3 and #2) was found to differ substantially from that of the others in the study with regards to time spent in communicating with others, time spent in lab work/data collection, time spent with professionals in other divisions, time spent with potential clients and current clients, time spent by themselves, time spent with professio-als in their own division, and time spent in administration as compared to time spent in project work.

The three project/task high communicators spent substantially more of their time in communications with others, face-to-face or on the phone. The three spent 61.5% of their time in one-to-one meetings, group meetings and on the telephone as compared to the rest of the time studied group (minus the three) who spent an average of only 31.4% of their time in similar interpersonal communications. The three spent less time in lab work/data collection that the rest of the group, 0.8% as compared to 24.3%. The three spent substantially more of their time with professionals in other divisions than did the others, 11.0% as

compared to 2.9%, and more time with professionals in their own division, 33.4% as compared to 16.0%. The three spent more time with prospective clients and less time with current clients than did the others who were studied; with prospective clients, 1.9% compared to 0.5%, and with current clients, 4.1% as compared to 5.1%. The three spent less time by themselves than did their colleagues, 24.9% as compared to 46.2%.

What emerges about the three project/task high communicators is that they are managers who spend a good deal of their time with others in their organization and with outsiders, linking their organization with the rest of the parent organization and with the outside world. The picture of the three as managers is borne out by the data on their time distribution by task. The three spent 20.4% of their time on project research compared to an average figure of 58.4$ for the other seven in the group. The three spent 10.8% of their time on project management and 31.0% on non-project management as compared to 5.5% and 3.0% for their colleagues. Two of the three- the two highest ranked as project/task sources, spent 47.7% and 36.6% of their time respectively on non-project management.

The pattern of the two highest ranking cited sources for state-of-the-art information (individuals #2 and #5) differed from the rest of the group in several regards: talk/meet with groups, reading, lab work/data collection, analysis, time spent alone, with other professionals in the overall organization, with clients, with

potential clients, time spent in project research and in project presentation and proposal presentation and time spent in personal professional development.

It is not unexpected to find that those who rank as sources of state-of-the-art information would spend more time than their colleagues in personal professional development, 9.1% as compared to 4.6% of their time, but it is surprising to find they spent less time reading, 11.3% vs 12.2%. The two spent less time in lab work on the average and more time in analysis than their colleagues, 0.6% vs 21.4% and 14.1% vs 5.7% respectively. They spent less time in project research than their colleagues, 39.1% vs 49.0%; and more time on project presentation and proposal preparation, 3.9% vs 1.2% and 7.2% vs 2.8% respectively. The two spent less time in project and nonproject administration than their colleagues and more time by themselves; in both kinds of administration, 11.9% vs 20.1% and by themselves 45.1% vs 38.5%.

The state-of-the-art high communicators emerge as people who spend much time in analysis, personal professional development, reading, presenting to others. The two men present a picture of people concerned with the analytical as differentiated from the experimental, who deal with the written and spoken language and with the abstractions of analysis.

Two of the three individuals who had the highest ranking as cited sources for research/laboratory technique information were included in the time study (individuals #20 and #26). It should be noted, however, that six of the nine individuals who received three or more citations in the research/laboratory technique category were included

in the time study, and, it was expected that the differences between the two highest ranked individuals would not differ too radically from the rest of the group. However, the pattern of the two higher ranked sources differed from that of the rest of the group in terms of the following: talk/meet with individuals or groups, reading and write/dictate patterns, time spent in lab work/data collection, time spent with self and others, time spent in project research, management and personal professional development. The differences between the research/laboratory technique high communicators and the rest of the group delineate almost a popular image of the laboratory scientist. The two research/laboratory technique high communicators, as would be expected, spent more time in the laboratory than their colleagues, 58.8% vs 6.8%, and more time on project work, 60.6% vs 43.6%. The two spent less time talking and meeting with individuals, 13.5% vs 21.9%, less time in group meetings, 4.5% vs 15.6%, and less time writing/dictating and reading, 1.5% vs 12.8% and 1.8% vs 14.6% than their collegaues. The two spent more time by themselves, 49.9% vs 44.6%, less time with professionals in their same division, 13.5% vs 23.1%, and more time with non professionals in their division (the technicians), 24.1% vs 3.2%. Though the two spent a little more time in project management than their colleagues they spent far less time, on the average, in non-project management, 9.3% vs 6.6% and 1.0% vs. 14.0% respectively.

What emerges about the project/laboratory technique high communicators is that they spend their time in the laboratory on

project work, and, in the course of their laboratory work, they spend a great deal of time at the bench with the nonprofessionals of the organization. Though they are sought out as preferred sources for research/laboratory techniques they do not fit the popular image of the high communicator in that they do not spend much time in reading, analyzing, traveling, or talking with their colleagues.

Disaggregation of the High Communicator

The flow of information-communication in an organization engaged in R&D is a dynamic process that occurs within a highly dynamic environment. Scientific and technical information is an ever-growing and changing body, changing the activities in which it is used and being changed in turn. The actual flows of STI primarily occur as a social process in a social matrix. Internationally (as was discussed in Chapter 2) a critical and primary organism in science information flows is called the 'invisible college', a social professional circle in which new information flows long before it is published, in which norms and values are established for those in the field, in which recognition is achieved outside the formal mechanisms. At the level of a technical organization, the social matrix has been recognized, studied and described by several, but particularly by Allen and his colleagues and students. The social mechanism of exchange has been described in the organization in terms of connectivity, social exchange, physical arrangements and type of work.

In all of the studies a central actor is identified and described under many headings, but always as a linker between the literature and the members of the organization and as a linker between networks, each with its central figure. The information habits of the central figure, some of his demographics, and some of his attitudes have been studied. Throughout, there is an implicit assumption that the central figure is a unitary entity, a particular kind of person, who develops the role in vivo. The study reported here raises the question of whether or not we are including a number of individuals and functions under a unitary label which is convenient but also confusing.

The data that have been obtained and analyzed for this study strongly support the notion that, though there are a very few individuals who persist as highly cited sources of all kinds of information through time, the high communicator function and individual is better described and considered as an aggregate of roles and individuals. The data in this study suggest that the role of major preferred source for work related information, is one that varies by technology, function, organizational type and project phase.

The data supporting the foregoing statement has been presented throughout the body of this report and includes the following:

The large percentage of changes in selections for preferred sources of information with time in both Organization A and Organization B; 33% in Organization A after 16 months and 44% in Organization B four months after a reorganization of spatial arrantements.

The variation in selections made by kind of information identified; though some individuals were identified in all three areas of information as sources, very few were heavily cited in all three, and some individuals were very heavily cited in only one or in two areas.

The differences in the characteristics of those identified as preferred sources of information in the two organizations studied; the discriminant functions for the two organizations identified important differences in emphasis between the two organiztions.

The differences in information-communication behaviors between those identified as high communicators for each of the three different kinds of information used in the study; the limited time studies indicated a very large diversity of information-communication activities in those identified as high ranking as preferred sources for information depending on the information area in which they were preferred.

Each of the statements of 'findings' given above are subject to valid criticisms in terms of amounts of data, extent of sample, time periods, controls and many other questions of methodology. As an engineering trial they point out very useful trends and raise very useful questions from the viewpoints of both manager and researcher.

SUMMARY AND CONCLUSIONS

This study was undertaken to explore the feasibility of systematically applying the research results from studies of scientific and technical information (STI) usage by scientists and engineers to improvement of the management of research and development (R&D).

The specific objectives of the study were: 1) To design and implement interventions in cooperating R&D organizations with a view a view to modify their subsequent information-communication behaviors, and 2) To measure and analyze the effects of the interventions undertaken.

The overall approach taken in this study was characterized by an emphasis on 'pull' rather than 'push' and a design perspective as differentiated from the more familiar science research perspective. The emphasis on 'pull' meant that the effort was based on the apparent wants and predilictions of users rather than on the push of some particular form of information dissemination. The design perspective meant a concern with 'how' rather than 'why', and that the interventions used in the study were treated as engineering trials in which proof is an agreement that the design will work well enough in the intended direction in practice.

As originally planned, the study was to be carried out as a series of field experiments in which deliberate interventions were to be undertaken in cooperating organizations and the effects of the interventions measured over time. As finally carried out, the study consisted of a number of natural experiments in which advantage was taken of natural interventions by management to measure the effects of those interventions over time.

Many interventions were discussed with the primary cooperating organizations, and agreement was reached to proceed with some of them. However, each intended intervention was delimited by 'events' that intervented on their own. People left the organizations being studied. New people were hired. Contractual pressures changed the tempo of work and the availability of key people. Fortunately, as might be expected in any dynamic situation (particularly in an American R&D organization), a number of events occurred naturally which made it possible to carry out genuinely relevant natural experiments.

Study Methodology

The study was carried out in terms of four selected natural interventions that occurred in two R&D organizations. In each case a suitable intervention was identified, the relevant research literature was reviewed to determine what might be expected over time as a result of the intervention, and the actual information-communication patterns were mapped at two points in time to see if desired changes had occurred.

The four 'interventions' that were studied were, in each case, human-caused, intentional perturbations in the natural flow of events in organizations that caused changes in that flow that would not otherwise have occurred. The interventions were selected on the basis of their pervasiveness in management practice, their apparent relevance to information-communication behaviors as indicated by the research literature on STI usage, and their amenability to unequivocal identification and measurement. The four interventions studied were the following:

a. The hiring of a high communicator.

b. The resignation of a high communicator who had been with the organization for a long period of time.

c. The rearrangement of offices and people within a department.

d. The progress of individual projects through time.

The organizations that cooperated in the study were designated as Organization A and Organization B. Organization A is a department in a nonprofit, contract-project organization that is continuously engaged in proposing and carrying out a large variety and number of projects of differing size and duration. There is very little hierarchy in Organization A and control consists of continuous budgetary control. A large amount of responsibility and autonomy is exercised at the level of project leader and individual professional, and there is a high premium placed on technical capability.

Organization B is a technical development department in a profit making corporation with defense commitments. It is organized hierarchically in the corporate mode, is bound by military security, and deals with projects, that on the average, are far larger than those commonly received by Organization A. Organization B is engaged in the development and test of avionic hardware while Organization A is engaged in a large variety of physical science projects.

The sample of respondents in Organization A consisted of 41 scientists and engineers with a mean age of 35.8 years, 11.7 years of technical experience, who had worked for an average of 2.4 organizations and had been with Organization A for an average of 8.5 years. The sample of respondents in Organization B consisted of 37 technical professionals with a mean age of 36.9 years, 12.4 years of technical experience, who had worked for an average of 3.3 organizations and had been with Organization B for an average of 5.0 years at the time of the study.

The prime means of data collection was a questionnaire that elicited demographic data from the respondents and asked each respondent to indicate preferences (first and second choice) of others as sources of project/task, state-of-the-art, and research/laboratory technique information. In addition, each respondent was asked to indicate preferences of who they would 'like to work with'. The questionnaire was also used to collect data on information-communication behaviors such as numbers of journals regularly read, meetings attended and use of the telephone. The questionnaire was administered at two points in

time; sixteen months apart for Organization A and four months apart for Organization B. Other data were obtained from existing documentation such as library, telephone and travel records.

The Interventions

Entry: A High Communicator is Hired--The First Intervention

The research literature on STI usage features a central figure, the high communicator/technological gatekeeper/star communicator/opinion leader. The literature would suggest that hiring a high communicator is one of the most efficacious actions that a manager could take to improve the quantity, flow and use of technical information in an organization. However, a number of practical implications arise. What can be expected to happen once a high communicator is hired? How long would it take an individual with the potential to begin to function as a high communicator? Most important of all, how would we identify a person who is most likely to become a high communicator in an organization?

The question of identification of a potential high communicator was particularly acute since all of the studies of high communicators to date are essentially a posteriori, and tell us who became a high communicator, but not who will become one. Since no appropriate method was available, it was necessary to develop means which would permit us to identify a priori which organizational newcomers would most likely become high communicators in Organization A. Two different methods were developed, each using data that would only be available to a manager at time of hire such as an employment application blank and

interview responses.

Seven of the respondents were judged to be 'newcomers,' that is they had been with the organization for less than two years. The two year criterion was based on Allen (1977) who stated that no high communicator develops into that role in less than two years. The data on the seven newcomers were subjected to two kinds of analysis. The first method of analysis compared the seven newcomers in terms of individual charadteristics that have been associated with high communicators in the literature and ranked them in terms of potentiality for fulfilling the role of high communicator at the time of subsequent measurement. By the ranking method, one individual stood out as 'obvious' candidate for the role of high communicator.

Despite the ease with which the 'eyeball' analysis selected an obvious candidate, the method raised serious q[illegible] for the study team. Which of the variables really discriminate a potential high communicator? How strong must an individual be with regard to any variable or combination of variables to be identified as a potential high communicator? What is the relative weight of the variables with regard to discriminating the high communicator candidate from others? To answer the foregoing questions a discriminant analysis was made of the responding professionals within Organization A to develop discriminant functions which would discriminate between those cited and those not cited as preferred

sources of project/task, state-of-the-art and research/laboratory technique information.

Three sets of discriminant scores were developed for all of the respondents in Organization A, one for each of the kinds of information specified. In terms of the three sets of scores, the same individual who had been identified by simple ranking was found to have the highest score in the entire organization with regard to project/task information and state-of-the-art information, and, though having the midpoint score in the entire organization, he had the highest score among the seven newcomers with regard to research/laboratory technique information. Three standardized discriminant functions were developed which identified the relative contribution of the variables used to discriminate the cited from the non-cited.

At the second mapping, sixteen months after the first round of data collection, the identified individual by both methods of analysis as a likely high communicator achieved the greatest gain in number of citations as a preferred source for all three kinds of information in the entire organization (a total of eleven additional citations as compared to the second highest who received six new citations). Since the only variables used in the analysis were those that would have been available at the time of consideration for hire, it was concluded that it is possible for R&D management to identify individuals who have a high potential for becoming high communicators within the organization.

The success with the use of the discriminant functions in Organization A raised a question as to whether or not the same discriminant functions were generalizable to other organizations. To answer the foregoing question a set of three discriminant functions was also developed with the data obtained for Organization B and compared to the functions obtained for Organization A. Interesting similarities and important differences were found in the functions obtained for the two organizations.

In the case of those selected as preferred sources for project/task information in both organizations it was found that those cited were highly connected with the world outside their immediate organizations; they were boundary spanners who communicated with more outsiders, attended more professional meetings, read many more unpublished reports than their colleagues. The differences in the functions for the two organizations reflected their differing connections with hardware and level of technology. In Organization B, the hardware development organization, there was more emphasis placed on patents and professional journals read. In the project/contract, nonprofit organization there was more emphasis placed on experience, education, number of career organizations, honors and awards and age.

In the case of those selected as preferred sources for state-of-the-art information both organizations placed a high value on the experienced technical worker who is denoted by production of published and unpublished papers. Those selected as preferred

sources for research/laboratory technique information were older, were listed in more directories and were more hardware oriented than those selected for other kinds of information. In Organization B, the hardware development organization, more weight was given to years of experience, university training, and professional journals read (which could reflect the specialized technology in which the company is engaged---electronics countermeasures).

Exit: A High Communicator of Long Standing Leaves--Second Intervention

Exit is an organizational event that is almost as frequent in American organizational life as entry. Exit poses different questions for the exiting individual and management. Entry is far more within the obvious control of management than is exit. No one is hired without the explicit or implicit agreement of the manager. Exit, on the other hand, is far more difficult to see coming and difficult to do anything about once it has been announced.

Whether an employee exits autonomously or because of some deliberate management action such as firing, promotion or transfer, the manager of the affected group is faced with the consequences of the exit. The exit of a high communicator would appear to be a special case that might affect the subsequent productivity and patterns of communication in the organization from which he has exited.

Early in the study, the individual who was most cited as a preferred source for the two categories of technical information state-of-the-art and research/laboratory technique information

left Organization A. His exit raised many questions with regard to the exit of a high communicator. What happens to the patterns of flow of technical information within the organization with the exit of the high communicator? To whom do the former information 'clients' of the high communicator turn for their information subsequent to the exit? Do they turn to other high communicators, to those to whom the high communicator turned for information? Do others rise to fulfill the role of the exited high communicator or is there a measurable decrement in the information flows in the organization? Is there something a manager can or should do to maintain the information flows subsequent to the exit of the high communicator?

There is little available in the literature that is of direct use in anticipating what would happen on the exit of a high communicator, and it was necessary to search for clues from studies of networks in the international science community ("the invisible colleges"), research on social networks, social exchange and interpersonal attractions. The literature on networks, social exchange and interpersonal attraction suggest that the exit of a high communicator from his social circle would result in a transfer of information source preference to others in the same social circle as the exited high communicator and to others in the client's social circle if it is different than that of the exited high communicator. The literature also suggests that subsequent citations would reflect propinquity, reciprocity and similarity, all factors that go into interprrsonal attraction and the formation of social circles.

The second round of data collection, sixteen months after the first round raised more questions about the social nature of information exchange in the sense that information is expected to flow in professional social circles or networks. If the latter is the dominant influence on our actual choices of sources of information, we would expect to find that former clients of the exited high communicator would turn to others in his professional social circle or network and that the second round substitutions for the exited person would be to the following: 1) those to whom the exited individuals went for information, 2) those to whom the clients had formerly turned for other kinds of information, 3) those who had come to the exited individual for information, 4) those who formerly turned to the clients for information, and 5) one step further afield, those to whom the other preferred sources of the clients turned for information.

The data clearly point to the professional social circle explanation as being the dominant path through which substitutions for the exited high communicator were made. The professional social circle explanation identified far more of the subsequent selections than did turning to other high communicators or to preferred individual coworkers. Certain cautions must be added with regard to the data. Only two selections were permitted as preferred sources of information for each category of information and for preferred coworkers; introducing an arbitrary Bed of Procrustes that in some cases forced respondents to stop short at two selections

thus obscuring the networks of interactions. In other cases the request for two selections may have added selections that were distant in value from the first choice of the respondent.

There is a certain natural shift in choices that has something to do with the progression of projects, the changes in interests on the part of individuals, and the transfer to new work. As has been pointed out in this chapter, approximately one-third of the selections as preferred sources might change in any event by the time 16 months have passed by. However, even an analysis of the changes in citations that had no apparent connection with the exit of the high communicator shows a bias toward the professional social circle pattern; most of the new second round citations being accounted for by previous professional social connectivity; propinquity (to a limited extent), reciprocity, and referrants of referrants.

Spatial Rearrangement of People: A Department's Geography is Rearranged--The Third Intervention

Changes in technology, market locations, management, growth or decline of a product, market or function, all have organizational and eventual facilities consequences. Changes of almost any sort seldom leave the physical or spatial arrangements of an organization untouched. The more an industry or function is subject to changes the more it is subject to spatial rearrangements, and R&D, which is dedicated to change, is particularly subject to the consequences of change.

A large number of studies have shown the relationship between

spatial distance, ease of access and the probability of communication between two people. Clearly, the greater the distance the lower the probability that two individuals will have a work related conversation. Studies show that the probability of communication drops with distance until at approximately 30 meters separation a low probability is reached and maintained.

The data are suggestive, but many questions are raised. Since most primary and secondary organizational groups are located within contiguous spaces that seldom exceed 25-30 meters from border to border, it would be useful to know more about the communications patterns within the 30 meters limit. Is it possible to affect the intergroup communications patterns in prescribed directions by spatial arrangements within the 30 meter diameter territorial limit? How long does it take for new geographical alignments to be reflected in new information flow patterns? How far will a technical professional travel (what price will he pay) to go to a high communicator? How far will the technical professional travel to obtain different kinds of information? In other words, will a technical professional travel further for technical information than for project/task information?

To study the effects of the spatial rearrangement of people within a given organization unit, advantage was taken of a change in office arrangements in Organization B. The same questionnaire used in Organization A was administered in Organization B at two points in time, four months apart; one, at the time of the rearrangement of offices, and the second four months after the move.

Based on previous studies by Allen (1977) and Taylor and Utterback (1974) it was anticipated that, for the short run, individuals would retain their previous communications patterns even though it meant traveling further than previously. The literature on interpersonal attraction suggests that there would be a significant relationship between those identified as preferred sources of information and those identified as preferred coworkers (like to work with), and consequently, individuals would travel further, after the move, to a preferred coworker.

Data were collected on the premove and postmove information source preferences of the technical professionals in Organization B. Though only reflecting short time effects (four months) the data threw light on many of the questions that had been raised, but raised as many interesting questions as they answered. There were many shifts in selections between the two mappings. There was an overall increase in the number of citations made by the respondents (through more response to the request for two names for each category of information) and the number of people cited from 26 to 30. There was a distinct drop in the number of people cited as preferred sources who were outside the immediate organization being studied. There was a wider selection of people cited for project/task information after the move than there was prior to the move, wider than was found for the two technical categories of information.

In the short time period between the two mappings, the average distance between citor and cited source of information increased from 12.5 to 14.4 meters with the relative increases in distance for technical information being greater than that for project/task information. Both before and after the move, the distance traveled to a preferred source for project/task information was greater than for technical information. Though, the increase in distance to a preferred source of project/task information went up the least proportionately, it still remained the greatest distance separating citor and selectee for the three categories of information. It is plausible to infer that selections for project/task information are not as freely made as are those for technical information since project/task information is linked to administrative relationships.

The increase in distances postmove was not unexpected since, in the short run, it was assumed that most of the respondents would use the same information sources they had used before the move until propinquity would work its effects on changes in selections. The distance increased, but, surprisingly, 46% of the postmove citations were to people who had not been cited by the individual respondents in the premove mapping of information-communication patterns.

Of those identified as high communicators in the first mapping, 90% were identified as high communicators in the second mapping, and the distance between citors and high communicators went up from an average of 12.5 meters to 14.8. Both pre- and post-move

distances to identified high communicators was greater than those cited who were not high communicators. More citations were made to individuals identified as 'like to work with' and a greater distance was measured to preferred coworkers both before and after the move; 12.[illegible] and 14.4 meters as compared to those cited but not identified as preferred coworkers, 10.5 and 13.8 meters.

The data collected support the notion of the price/cost of information that an individual is willing to pay as being measurable in terms of the distance that the individual is willing to overcome in order to use a particular individual as a source. An individual is apparently willing to travel further to someone 'liked', to a high communicator, to a necessary source of administrative information (at least in the short run). There is probably some threshold of distance or price beyond which the price is too high, and the data pre- and post-move do show that the great majority of sources cited fell within the 30 meter limit identified in Allen (1977). There is an apparent trade that can be measured between source quality and distance, liking and distance (the emotional price paid) as there has been established between organizational bond and distance (Allen, 1977).

The Passage of Time as an Intervention

Time intervenes in the course of events in an organization. In time, projects are finished, some are cancelled, new projects are undertaken, projects progress from phase to hpase. As projects

change or make progress it would appear reasonable to assume that different kinds of information are needed, and, it is possible, that different people might be drawn upon as preferred sources of information. It seems unlikely that a few individuals are the high communicators under all circumstances through all changes. The literature has not been explicit on this point. The general, unitary, description of the high communicator in the literature suggests that the same people would tend to be cited for all purposes at subsequent intervals in time.

Examining the data for both organization A and organization B, taken at different time periods we are able to get some notion of the extent to which there is a shift in the selections made of preferred sources of information. In Organization A, we counted those individuals cited as sources who had shifted two ranks in citings (e.g., one individual went from rank seven to rank four between the two mappings) since a shift of one rank might only reflect the exit of someone in the organization. It was found that there were 15 shifts of at least two ranks. The shifts were both up and down and occurred in all three categories of information. The least change occurred in the selections made for project/task information (only two shifts of two or more ranks) suggesting: 1) that projects do change in their technical demands with time and that new sources are sought, and 2) project/task information is essentially administrative in nature and there might be less of a choice than with technical information sources in a stable organization.

In Organization B, only four months after the first mapping (and the physical move) there were far more shifts in ranking as cited sources than found in Organization A after 16 months. Further, there were far more changes in project/task citations than there were in the technical information categories. In the case of Organization B the physical changes was partially a reflection of administrative changes that had their consequences in the citation patterns at the second point in time. In any event it had to be concluded that the high communicator may be a shifting role rather than a stable one.

The Use of Time in Information-Communication

To further clarify the differences associated with the various kinds of high communicator that seemed to be surfacing in the study an effort was made to measure the way several of the professionals in Organization A actually distributed their time; particularly the high communicators. To measure the use of time, time studies were conducted with ten of the professionals, using a self time study device that gives both audio and visual signals at random intervals. At each signal, the cooperating professionals punched a coded card with a structured identification of the activity occurring at the time of the signal. The information recorded included activity, contact and function.

A total number of 3,097 observations (individual entries) were made. On the average, the time studied group of individuals during the period studied spent 40.4% of their time talking with others (20.2% one-to-one and face-to-face and 6.8% one-to-one on

the phone), 13.4% meeting with a group. Of the time, 12.0% was spent reading, and 10.5% of the time dictating materials that eventually others would read. On the average, laboratory work and data collection took 17.2% of the time. Cerebrating took 11.6% of the time with 7.4% in analysis and 4.2% in thinking and planning.

There were distinct differences between those who had been identified as high communicators in wach of the three categories of information. Those who were highly cited as sources for project/task information were managers who spend a good deal of their time with others in their organization and with outsiders, linking their own organizations with the outside world. Those, highly cited as sources of state-of-the-art information, differed from the rest of the group in several regards. They spent more time in analyzing data, personal professional development, reading, presenting to others, and appeared to be more concerned with the analytical than the experimental. Those highly cited as sources of research/laboratory technique spent more time on project work, more time at the bench with nonprofessionals, and did not spend much time reading, traveling, or talking with colleagues.

Disaggregation of the High Communicator

The flow of information-communication in an organization engaged in R&D is a dynamic process that occurs within a highly dynamic environment. Scientific and technical information is an ever-growing and changing body, changing the activities in which it

is used and being changed in turn. The actual flows of STI primarily occur as a social process in a social matrix. Internationally (as was discussed in Chapter 2) a critical and primary organism in science information flows is called the 'invisible college', a social professional circle in which new information flows long before it is published, in which new information flows long before it is published, in which norms and values are established for those in the field, in which recognition is achieved outside the formal mechanisms. At the level of a technical organization, the social matrix has been recognized, studied and described by several. The social mechanism of exchange has been described in the organization in terms of connectivity, social exchange, physical arrangements and type of work.

In all of the studies a central actor is identified and described under many headings, but always as a linker between the literature and the members of the organization and as a linker between networks, each with its central figure. The information habits of the central figure, some of his demographics, and some of his attitudes have been studied. Throughout, there is an implicit assumption that the central figure is a unitary entity, a particular kind of person, who develops the role in vivo. The study reported here raises the question of whether or not we are including a number of individuals and functions under a unitary label which is convenient but also confusing.

The data that have been obtained and analyzed for this study strongly support the notion that, though there are a very few individuals who persist as highly cited sources of all kinds of information through time, the high communicator function and individual is better described and considered as an aggregate of roles and individuals. The data in this study suggest that the role of major preferred source for work related information, is one that varies by technology, function, organization type and project phase.

The data supporting the foregoing statement has been presented throughout the body of this report and includes the following:

The large percentage of changes in selections for preferred sources of information with time in both Organization A and Organization B; 33% in Organization A after 16 months and 44% in Organization B four months after a reorganization of spatial arrangements.

The variation in selections made by kind of information identified; though some individuals were identified in all three areas of information as sources, very few were heavily cited in all three, and some individuals were very heavily cited in only one or in two areas.

The differences in the characteristics of those identified as preferred sources of information in the two organizations studied; the discriminant functions for the two organizations identified important differences in emphasis between the two organizations.

The differences in information-communication behaviors between those identified as high communicators for each of the three different kinds of information used in the study; the limited time studies indicated a very large diversity of information-communication activities in those identified as high ranking as preferred sources for information depending on the information area in which they were preferred.

Each of the statements of 'findings' given above are subject to valid criticisms in terms of amounts of data, extent of sample, time periods, controls and many other questions of methodology. As an engineering trial they point out very useful trends and raise very useful questions from the viewpoints of both manager and researcher.

Managerial Implications

Several managerial implications emerge from this study concerned with hiring, the supply of information resources within an organization, dealing with exits, spatial arrangements and the effects of time.

Hiring

Perhaps the most important managerial decision in an R&D organization is hiring. If we hire competent people we have 'control' in the sense that projects go as expected or better. Implied in the literature on STI usage to date has been the notion that we should hire high communicators for all that they can do for our organizations. Doubt has been raised as to whether it is even

possible to identify a high communicator before the fact. The results of this study indicate that it is possible to systematically identify potential high communicators at the time of hiring with the kind of information that is available at that time.

The results of this study also suggest that, though there are certain common variables that identify the potential high communicator, they vary in weight with the technology, the nature of the organization. It is suggested that each organization can develop its own screening instruments through the use of discriminant analysis.

There is a strong relationship between identification as a person with whom it is preferred to work ('like to work with') and citation as a preferred source of information. People will not pay an emotional price to obtain information from someone no matter what credentials the potential source has. This is not quite as true where project/task (administrative) information is concerned, but is certainly evident when it comes to technical information. The data suggest that personality factors must be taken into account as much as technical comeptence, if it is desired to see that technical competence shared. The data make a strong case for hiring 'nice' people, suggesting that a very superior curriculum vita combined with an abrasive manner will result in little information transmission.

Professional Circles

The data on exit underline the fact that we function through social circles, professional and otherwise, and that we depend on our professional social circles for information. When a high

communicator exited during this study his former clients turned to others who turned to the exited colleague, those he had turned to, and those who had turned to the clients. All the foregoing suggests that information may be stored in the network as well as in the individual, and that, perhaps, an individual may function as high communicator because of his position in the professional circle as well as his own personal store of knowledge.

The findings of this study and the many findings on the use of informal channels for information suggest that management should take an active part in encouraging the widest kind of social interaction and informal exchange within their organizations; special efforts to tie new people into the existing coffee circles, the establishment of informal lunch groups, the encouragement of bull sessions.

Dealing with Exits

Since exit is a frequent feature of American organizational life, and people turn to others in their social circle for information when a preferred source has left, management should make every effort to see that information is widely spread within the existing networks. Management can do much to encourage the use of a variety of information sources, through liberal budgets for travel and literature and through exposure to outsiders who have useful information. The data suggest that instead of concentrating resources and opportunities for information on the high communicators (as is suggested by some writers) the opportunities must be pushed

widely on all professionals in the organization.

Spatial Arrangements

Spatial relationships do affect who talks to whom. This has been pointed out by the many studies which found that distance is inversely related to frequency or probability of communications. The findings of this study show that, in the short run at least, people will travel further for project/task information than they will for technical information. This suggests that it is not quite as necessary to locate administrators close to their professionals as it is to locate key professionals close to their potential information clients. In the long run propinquity will usually result in increasing interchange among individuals, liking and exchange of information. The foregoing suggests that an aware manager can take advantage of the frequent moves that occur in an organization to deliverately locate people near others from whom they can gain technical knowledge, and to locate combinations of people with a view to generation of new ideas.

Time, the Disaggregation of the High Communicator and Resources

As was pointed out above, some writers have written that the high communicator should be specially favored with resources for information and time to acquire information. The results of this study suggest that the high communicator is an aggregate of many people who are called upon at different times and for different kinds of information. The findings suggest that resources should

be made available to all, and pushed upon all. High communicators leave. High communicators develop. Different people serve as high communicator under different situations and in different companies.

Some Research Implications

Several research implications grow out of this study concerning the notion of the high communicator, the nature of the professional social circle at work and its effect upon the flow of technical information, and on the way information is actually obtained and used by individuals.

The identification of different kinds of high communicators for different kinds of information raises a question as to how many kinds of information might be systematically segregated and studied in terms of who provides each kind of information. The finding that preferred sources for research/laboratory technique information seem to conform to popular image of the laboratory scientist as a person who spends his time in the laboratory, who doesn't read as much as his colleagues, who doesn't travel, doesn't use the phone, and doesn't spend much time talking to his colleagues raises many interesting questions concerning the nature of the information acquisition process that takes place with regard to laboratory techniques. It is different than the one that enriches the more analytical state-of-the-art source of information? Should we identify 'repertoires' of information acquisition?

The findings of this study suggest that there is a need for a close look at the high communicator/technological gatekeeper concept to account for the differences in function, differences in style, and the differences encountered over time. The self time study method is one fruitful means for examining differences in situation, seeker and source. The time study technique provides some measurement of process which is necessary if we are to further understand the phenomena encountered.

There should be further exploration of the social professional circle as it functions within a given organization. We have come to the limits of the sociometric approach, and are sorely in need of some fine-grained in vivo process observation, measurement and analysis.

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APPENDIX A

THE QUESTIONNAIRE

September 19, 1975

Dear Sir:

Who are the sources of scientific and technical information in a research organization? Do some professionals play different roles in the information environment?

The goal of this research is to get answers to these and many other questions of vital interest to the scientific professional. This study deals with an aspect of technical information flow in a working organization.

This is an independent study. Your replies will be held in strict confidence. The responses will be analyzed and reported back to you in group statistics. Your anonymity is guaranteed.

This study is unique in that it looks at the way an entire organization uses technical information. The research cannot be completed unless all questionnaires are returned. Your cooperation and thoughtful consideration will be greatly appreciated.

In completing this questionnaire, please consider Southwest Research Institute as "your organization".

Thank you very much.

Sincerely,

Albert Shapero
Professor of Management

AS:md

STUDY OF TECHNICAL INFORMATION FLOW

Below are some questions about your use of information and about sources of information in your organization. This form is being used in several very different organizations--from a college department to a physics laboratory--so questions will not fit your situation exactly. You will find some of the questions very difficult to answer; please give the best answer that you can.

1. Name _____ 2. Age _____

3. University training: Bachelors degree Date _____ Field _____

   Masters degree Date _____ Field _____

   Doctorate Date _____ Field _____

   Some College Date _____ Field _____

4. How many years have you been with this organization? _____

5. How many years of technical experience do you have in the specific field in which you are currently working? _____

6. How many different organizations have you been with in your professional career? _____

7. Do you now have any connection with an academic institution as a teacher or part-time/full-time student? ___ If "yes," please specify _____

8. What is your organization title or rank? _____

9. Are you a supervisor? ____ If "yes," how many people do you supervise? _____

10. To how many different people do you report? _____

11. Do your duties require you to contact people outside of your own organization? _____

12. How many patent applications have you filed in the previous five years? _____

13. How many papers or articles have you published in the past five years? _____

14. In how many professional meetings have you been a participant (on the program or presenting a paper) in the past year? _____

15. How many unpublished papers or reports have you written in the past year? _____

16. Are you listed in professional directories? _____ How many? _____

17. What professional recognition (in the form of honors, awards, special committees, editorships, etc.) have you received in the past three year? _____

Definition: For the purposes of this questionnaire, the term "Technical Information" is composed of:
(a) Project/task information--information related to the work to be done for a customer or client; contract specifications; research proposals; schedules and deadlines; costs; resource availability; etc.
(b) State-of-the-art information--information related to the general scientific or technical capabilities of a scientific field or discipline; and
(c) Research/laboratory technique information--information related to the success or feasibility of different kinds of research and laboratory techniques.

18. Please name the two members of your organization who are the most likely sources of project/task information for you.

(1) _____ (2) _____

19. Please name the two members of your organization who are the most likely sources of state-of-the-art information.

(1) _____ (2) _____

20. Please name the two members of your organization who are the most likely sources of research/laboratory technique information for you.

(1) _____ (2) _____

21. How many technical or professional meetings have you attended during the past year? _____

22. Please list the professional journals or periodicals that you read in the average month.

_____ _____ _____
_____ _____ _____
_____ _____ _____

23. How many unpublished professional or scientific reports do you read in the average month? _____

24. How many of these unpublished reports originate outside of your organization? _____

25. With how many professional acquaintances from outside of your organization did you communicate during the past month? _____

26. With how many of these acquaintances did you discuss technical information? _____

27. How many of these outside acquaintances contacted last month do you consider within your technical field? _____

28. What other fields do these acquaintances represent? (example: electrical engineering, nuclear physics, etc.) _____

_____

29. How many of the outside communications contacts made last month with professional acquaintances were: face-to-face _____% by phone _____% in writing _____%

30. With how many people in your organization do you regularly (once a month) communicate about: the project or task at hand? _____
the state-of-the-art in any field? _____
research/laboratory techniques? _____

31. Of the total number of communications that you make within your organization, how many are face-to-face? _____% by phone _____% in writing? _____%

32. How many of the people referred to in Question 30 above do you consider to be in your field? _____

33. What fields or specialities are represented by the people you contact regularly in your organization? (example: personnel manager, chemist, propulsion expert, etc.) _____

_____

34. Please name the two members of your organization with whom you would most like to work.

(1) _____ (2) _____

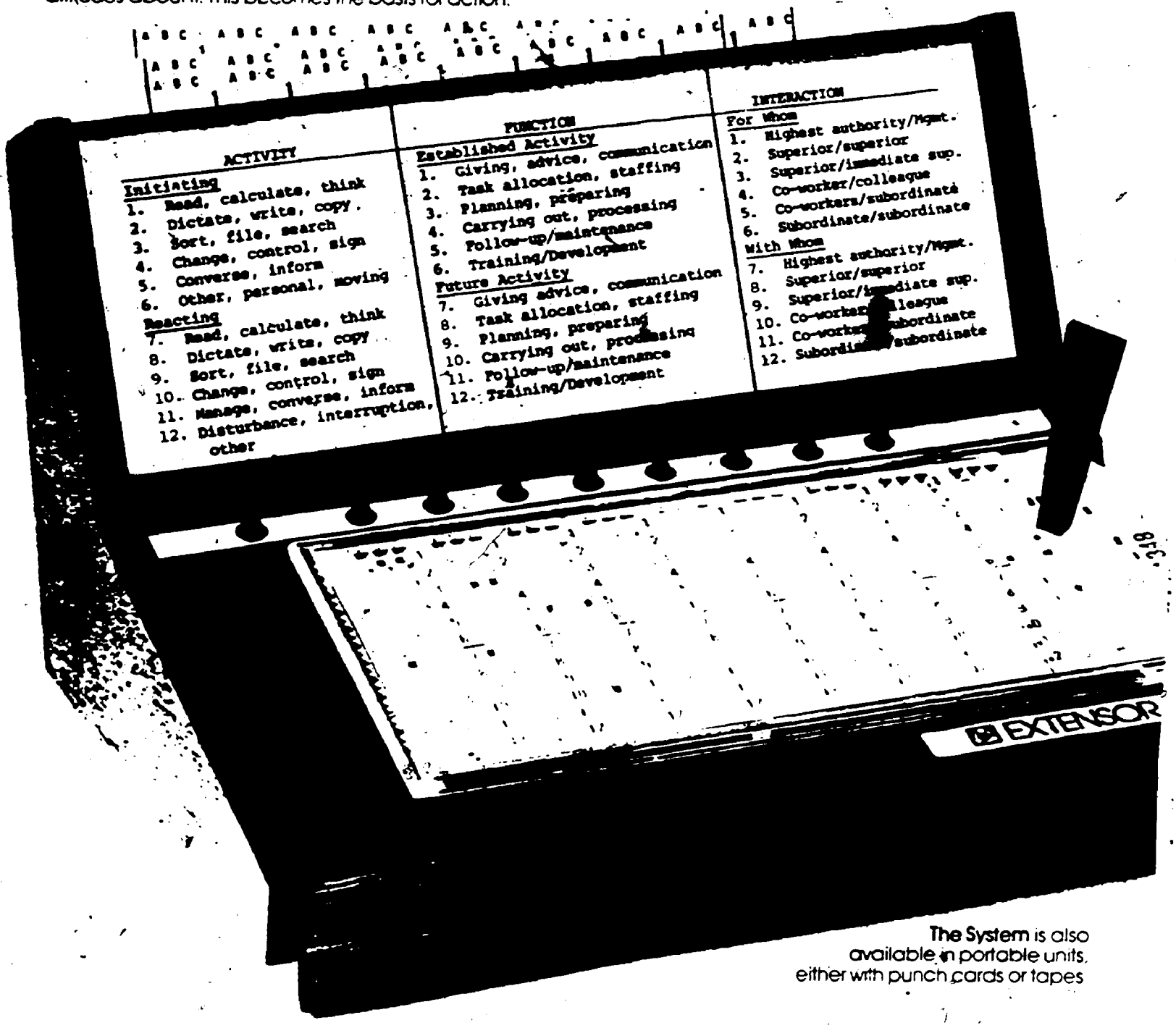
THANK YOU VERY MUCH!!

APPENDIX B

TIME STUDY METHOD AND INSTRUCTIONS

THE EXTENSOR TIME STUDY UNIT

The Extensor unit uses a random impulse generator to signal the user to record what is happening. The punch cards use a coded itemization of job content. After several weeks of use the cards are computed to describe actual behavior and to summarize attitudes about it. This becomes the basis for action.



The System is also available in portable units, either with punch cards or tapes

HOW TO OPERATE YOUR EXTENSOR CONSOLE

1. Connect the line cord to any 115 volt, 60 Hz outlet. If your Extensor has a European plug, use the adaptor provided.
2. Turn on the switch (1) on the back side of the Extensor - up is "on", down is "off". The indicator lamp (2) will light, showing that the unit is operating.
3. Your Code List can be slipped under the plastic window for ready reference.
4. A punch card is inserted under the plastic guide. Check to be certain that the card is properly placed.
5. Place the stylus in its holder - the small hole at the right end of the row of lamps. When not being used to punch the card, the stylus must be kept in its holder. Replacing it in its holder properly extinguishes a group indicator lamp.
6. About four times an hour, at random intervals, your Extensor will emit a tone. The volume of this tone can be adjusted to your comfort by means of the red wheel (5) on the back of the unit.
7. At the same time as the tone is emitted, a lamp will light over one of the groups of columns on the punch card. This lamp will remain lit until you extinguish it by replacing the stylus in its holder, or until the next tone is emitted, and a new lamp is lit.
8. The tone tells you when to punch the card; the lamp indicates <u>where</u> to punch.
9. The Code List tells you <u>what</u> to punch. Note what you were doing when the tone was heard. Punch the appropriate numbers from the Code List in columns A, B and C in the column group directly under the indicator

which is lit.

10. After punching, replace the stylus in its holder, pressing down firmly until the indicator lamp is extinguished.

Changing Cards

A card lasts one to two hours. When changing to a new card, keep them in sequence.

Cards are changed each time the Extensor is turned on, or when the eighth column group (3) is punched. Keep the completed cards in the card holder on the back of the instrument.

Absence from Work

If the absence lasts more than half a day, turn off the Extensor. Turn it off on leaving for the day. Turn it back on upon you return to work. In absence from the immediate vicinity for less than half a day, it is quite likely that a light will be on upon your return. Punch the column group indicated, using the code appropriate to the task that occupied you. Should your absence involve more than one signal, only the last relevant column group need be punched, since data processing will assign the code of the last punching to the open columns. If it is necessary to change cards after an extended absence to avoid punching previously used columns, punch both the eighth (not the ninth) column group in the card, and the indicated column group

in the new card.

Overtime, Odd Hours, Lunch Period, Breaks

Under usual circumstances the Extensor is to be "on" at all times, from start of work in the morning until leaving. Overtime is treated as regular working time. If for some reason you are required to return to your work site at some unusual hour, turn on your Extensor upon arrival, record your observations as appropriate, and turn it off when you leave. Leave your Extensor turned on during lunch and break periods.

It is not uncommon to have to take work home with you. Be sure you give yourself credit for this work either by taking your Extensor unit home with the work (on the weekend, for example), or, by punching the required number of cards (1 card for each 2 hour's work) first thing upon returning to your job site. Remember, to get full credit for the card, you only need punch your data in Column Group 8; the computer will assign the same information to all other Column Groups on the card automatically.

- ALWAYS punch every dimension -- omissions count as errors.
- REMEMBER -- when in doubt, consult your Contact Person.

ERRORS IN PUNCHING: How To Correct a Mistake

When a punching error is made it can be quickly and easily corrected by making use of the card's Column Group 9: the "Correction Column". Here's how to do it:

1. Complete your punching of all dimensions, just as if a mistake had not been made.
2. "Erase" the mistake by punching out all the holes only in the single dimension where the mistake appears. (Punch out all the holes, and only in the dimension containing the mistake -- don't accidentally punch into a neighboring dimension or miss a hole.)
3. "Correct" the mistake by punching the proper response into Column Group 9 -- just punch the dimension you wish to correct. Do not punch all the dimensions in Column 9, but just the dimension you wish to correct. (Column Group 9 is the group of three columns farthest to the right.)

That's all there is to a correction: punch out all the holes in the mispunched dimension only, and punch the right holes in the proper dimension in Column 9. You can correct at least one error per card by this method, and more, if errors are in different dimensions. However, if you make more than one error (at different times) in the same dimension on the same card, the only thing you can do is to take an unused card, copy the erroneous card completely and correctly on it and destroy the faulty card. Copying the card is easy -- remove it from the Extensor, place it on top of an unused card, and punch

Errors in Punching (continued)

out all corresponding correct entries. Where faulty entries have been made, correct them on the new card. Be sure you made an exact, complete and correct copy. Fortunately the need to correct more than one error per dimension per card is a rarity after Test Week. Check with your Contact Person if you have any questions.

ACCOUNTING FOR TIME AWAY FROM THE EXTENSOR UNIT

Everyone knows that the general rule is to punch in the pertinent information just as soon as the Extensor Unit signals -- but what about those times when that's not possible?

1. The Extensor signals -- but: you are on an important phone call and can't stop to punch; a stockholder demands your attention; you are treating a patient; etc.

   The rule is: Remember what you were doing when the Extensor signalled -- then punch just as soon and as accurately as possible.

2. The Extensor signals - but: you have left the office for a lengthy meeting; you are out to lunch; you are in the other building; etc.

   The rule is: Leave the Extensor turned on, and punch in the information immediately upon returning. (Just how to do this, together with some easy short-cuts, appears later.)

3. The Extensor isn't turned on, because: you are working at home in the evening; you are attending a morning meeting before going to your place of work; you are spending the day at a seminar; etc.

   The rule is: Keep track of your activities while away, and punch in the information as soon as you get back to your Extensor. Remember to give yourself full credit for all the hours you have put in. The following section describes an easy way to do this.

You certainly want to get full credit for time spent on work-related tasks away from the Extensor Unit, as just described. There fortunately is a very simple and fast way to do this, thanks to the computer.

If you have been away a short time, say 10 minutes, and upon your return you find one of the red lamps on, it indicates that the Extensor signalled in your absence. All you need do is to punch in the information regarding what you were doing into the column group under the lamp immediately. Make it a habit to glance at your Extensor whenever you have been out of signal range, to see if a lamp is lit.

If you have been away a longer time, it may be that the Extensor has signalled several times in your absence, and the lamp has advanced several column groups past the place you had last punched. This has left several groups of unpunched columns for you to deal with on your return. The procedure is simple: if you have been occupied essentially with one particular task during your absence (such as eating lunch, conference with vendor, etc.), simply punch in your data in the column group under the lamp. The computer which will process your card has been programmed to "back-fill" all empty column groups occurring since you last punched, with this data. Having the computer do this saves you from a great deal of effort.

It may be, however, that you performed more than one task during your absence. In that case, remembering that the Extensor produces about four signals an hour, simply allocate your data for each task to the number of column groups that will account for the time spent on that task (using the back-filling capability whenever possible). For example, if you were gone for about an hour, during which time you had lunch (one-half hour) and conferred with a client (one-half hour), upon your return you'd note that the lamp had advanced about four column groups. You could punch two column groups for your lunch data, and two column groups for your client data, but there's an easier way. Using the back-fill method, punch your lunch data into the column group under the lamp, allowing the computer to back-fill the column preceding it; punch the client data in the third column group, allowing the computer to back-fill the fourth column group.

When you are faced with punching in data after long periods of time (over one hour) away from the Extensor, the back-fill method will prove to be a real time saver. A card lasts about two hours; two hours spent on the same general subject away from the unit can be recorded in a few seconds upon returning by punching only column group 8 (not the correction column group), allowing the computer to back-fill the total card. Of course, if your time was used for several tasks, you can pro-rate the number of column groups to be used accordingly.

When you've worked at home, or at another location, it may well be that your Extensor was off at the time. Upon your return, and before you turn on the unit, give yourself credit for the time you've spent by punching the appropriate number of cards (one card for two hours; about four column groups per hour). When this has been completed, insert a new card and then turn on your unit for the day.

EXTENSOR SYSTEM

CODE LIST

Column A — ACTIVITY

List No. | P/C 17–40

1 Telephone
2 Meeting, 1:1
3 Meeting, 3-4
4 Meeting, 5+
5 Write, Dictate, Punch
6 Read, Study, Prepare, Eval
1+2 Edit, Sign, Update, Review
1+3 Think, Plan
1+4 Sort, File, Retrieve
1+5 Waiting
1+6 Transit
2+3 Other

Column B — CONTACT

List No. | P/C 17–40

1 Self
2 Commissioner
3 Assistant Commissioner I
4 Assistant Commissioner II
5 Director I
6 Director II
1+2 Director III
1+3 Supervisor A
1+4 Supervisor B
1+5 Manager X
1+6 Manager Y
2+3 Other

Column C — IMPROVABILITY

List No. | P/C 17

1 Can Be Improved
2 Maybe Can Be Improved
3 Cannot Be Improved
4 Other/Don't Know/Does Not Apply

PLANNING

List No. | P/C 17

5 Planned
6 Unplanned

FUNCTION

List No. | P/C 17–40

7 Budget A
8 Budget B
9 Personnel
10 Legal
11 Purchasing
12 Public Relations
7+8 Administration
7+9 Project Control
7+10 Real Estate
7+11 Quality Assurance
7+12 Compliance
8+9 Other

IDEAL TASK PERFORMER

List No. | P/C 17–40

7 Supervisor
8 Secretary
9 Receptionist
10 Inspector
11 Lawyer
12 Engineer
7+8 Office Boy
7+9 Maintenance Person
7+10 Supply Clerk
7+11 Assessor
7+12 Surveyor
8+9 Other

SATISFACTION

List No. | P/C 17

7 High Satisfaction
8 Moderate Satisfaction
9 Neutral
10 Moderate Dissatisfaction
11 High Dissatisfaction