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An in-depth analysis of organizational communication patterns as influenced by an organization's technology.

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AN IN-DEPTH ANALYSIS OF ORGANIZATIONAL COMMUNICATION PATTERNS AS INFLUENCED BY AN ORGANIZATION'S TECHNOLOGY

A Dissertation Presented

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VITA

Wallace Alan Randolph was born and raised in Atlanta, Georgia. He was born on December 4, 1946. He received a B.I.E. from the Georgia Institute of Technology in 1969 and will receive a M.S.B.A. in Personnel and Industrial Relations from the University of Massachusetts in 1975.

During undergraduate school, he was on a Co-operative Program of work and study and worked for Otis Elevator Company as an Elevator Mechanic and for Georgia Power Company as an Industrial Sales Engineer. Following undergraduate school, he worked for Humble Oil & Refining Company (now Exxon U.S.A.) as a Marketing Analyst for two years. Then he spent a year in Europe and the Middle East during which time he worked as an Inventory Manager for Siebler in Zurich, Switzerland and lived on a kibbutz in Israel. During the summer of 1972, he worked as a private Market Research Consultant on a project for Scripto, Inc.

From 1972 until 1975, he has worked as a teaching assistant in the areas of management and organizational behavior in the School of Business Administration at the University of Massachusetts. During this time he has also worked as a research assistant on a study of decision-making in organizations, as an organization development consultant, and as a workshop trainer in workshops on leadership and organization development. Beginning in the fall of 1975 he will be an

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AN IN-DEPTH ANALYSIS OF ORGANIZATIONAL COMMUNICATION PATTERNS AS INFLUENCED BY AN ORGANIZATION'S TECHNOLOGY

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ABSTRACT

The practitioners of Organization Development often attempt to bring about changes within an organization before adequately comprehending the present state of the system. Part of the explanation lies with the deficient organizational model they employ. The human element of organizations is heavily emphasized in the organization development literature, as if to say that other organizational inputs are not that important. But this is to take a naive approach to organizations which are complex socio-technical systems. There are many other inputs besides the human element which are equally important to the functioning of an organization, e.g., technology, control and accountability, and environment.

There is a need to study these other variables as well as their interactions. The central question of this research is: Are communication patterns within an organization a function of the technology employed? And if so, how are the two related? In this study technologies are classified ac-

cording to the number of exceptions encountered in performing the task and the degree to which problems encountered are analyzable. Communication patterns are defined according to the parties involved, the purpose, the media, and the timing, and the primary focus is on task-related communications.

Available research on the relationship between technology and communication patterns leads to ambiguous conclusions. Some information is available regarding the directionality of communications as it varies across technologies, but the other dimensions of communication patterns lie virtually unexplored. Organization development practitioners, who find communication problems in almost every organization, need to better understand the constraints placed on all dimensions of communications by the technology of the organization. A lack of this understanding will definitely handicap those who wish to facilitate organizations toward self renewal.

To begin to better understand the relationship between technology and communication patterns, field research was conducted in three departments of one organization, with each department employing a different technology. The methodology employed a combination of structured observation followed by administration of a questionnaire related to technology and communication patterns. Demographic data were collected on the observee-respondent, as well as on the unit's leadership climate, organization structure, and general en-

vironment.

The observational data were used to compare the three technologies along several hypotheses, regarding the dimensions of task-related communication patterns. In addition. the data were used to generate more refined hypotheses about the relationship between technology and communication patterns, and these hypotheses can be tested in followup studies. To assist in further research, the questionnaire data on communication patterns were compared to the observational data to test the validity of the questionnaire.

The overall results of testing the hypotheses do lend support to the general working hypothesis that an organization's technology does influence the communication patterns which emerge in the organization.

For the range of technologies represented in this study, the major findings can be summarized as follows:

(1) As the technology increases in certainty, the proportion of task-related communications which are vertical, horizontal and diagonal tend to decrease, increase and remain constant, respectively.

(2) As the technology increases in certainty, the frequency of task-related communications tends to decrease.

(3) As the technology increases in certainty, the proportion of task-related communications which employ the verbal medium tends to decrease, while the proportions which employ the sign, object and written media all tend to increase.

(4) There appears to be specialization of purpose for the various communications channels in all

levels of technologies, with a slightly greater degree of specialization as the technology increases in certainty. The purpose of specialization for the various channels in the different technologies does however appear to be different.

(5) The data collected by observation and tested for reliability were found to closely compare with the questionnaire data which were collected. The same test results would generally have been found whether the questionnaire data or the observational data were utilized.

Overall, the results are encouraging in regard to further research into the relationship between an organization's technology and its communication patterns. The major weakness of the research is that it was exploratory and consequently lacks generalizability, but the findings do promise a positive payoff from future research.

The study needs to be repeated in other settings to increase its reliability and also to expand the range of technologies to which the findings apply. Such research can help to answer the many questions raised by the present study, and in the mean time organization development practitioners can perhaps utilize the findings of this research as an incentive to heighten their awareness to the impact of an organization's technology.

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INTRODUCTION

The area of research interest in this study is the relationship between technology as an input variable to organizations and communication patterns as an emergent subsystem within organizations. As more and more research has been conducted into organizations, researchers have discovered the need to explain them as socio-technical systems. There are many input variables into an organization system, for example, people, technology, environment, and accountability and control, and within the organization many subsystems will emerge, for example, communication patterns, plant design, structure, rules and human behavior.

Students of organizations are concerned with explaining what transpires within an organization, and to understand what is happening depends upon an understanding of the relationships among the input variables and the subsystem variables, as well as the relationships among subsystem variables themselves and the interactions among all of the variables. Doubtless, the attempt to understand these complex entities called organizations is a difficult undertaking, but one which must be attempted. Organizations are vital to the efficient functioning of American society, and most people spend a great portion of their time in organizations. Then too, there are people called organization development prac-

titioners who try to help organizations become more efficient and become better places for the people who exist in them, and to do this they must be able to understand organizations.

One of the difficulties with the work of organization development practitioners is that they seem to ignore the importance of many of the organizational input variables and focus only on the human variable. This lack of consideration of other input variables is not solely due to the ignorance of organization development practitioners, but it is also due to a deficiency in the organization models which they employ. Nevertheless, this ignoring of important input variables can lead to serious problems as one attempts to work with a client organization. An example of the problem would be the attempt by an organization development practitioner to utilize the understanding of communications among people which has been developed from laboratory studies and which ignores the organizational setting in which the practitioner is working. This author believes the outcome of such an intervention could easily be frustration for the people in the client organization and inefficiency for the organization as a whole. The point is that the situation in which one attempts to utilize laboratory understandings about communications is likely to have an effect on the applicability of those understandings.

This author believes that one of the most important variables that is ignored by organization development practitioners and is not sufficiently accounted for in organization models is the technology employed by an organization. For over 70 years now, authors have talked about the importance of the technology of an organization in explaining its social structure. Still the relationship between organizational technology and social structure is not at all well understood. When one considers the investments made in technology by an organization and the speed with which technological changes occur today, it is simply illogical for students of organizations not to devote energy to the development of an understanding of the impact of technology on organizations. If this important variable is ignored, it is unlikely that a thorough understanding of organizations can be developed, and it is unlikely that organization development practitioners can help organizations become more effective while they are using a deficient model of organizations.

The Problem Addressed in This Study

Most simply and generally stated, the problem to be addressed in this study is that organization theorists and organization development practitioners do not know enough about the impact an organization's technology has on the communication patterns of the organization, a key variable in explaining the organization's social structure. Communica-

tions in organizations are the mechanism by which organizational goals are translated into definite actions which will lead to the accomplishment of those goals. Thus communication patterns are important to the efficient functioning of an organization, and since technology is an important input variable, one must consider what impact the organization's technology has on the communication patterns which emerge in the organization, if one is to understand the functioning of an organization.

A considerable amount of research has been directed at understanding communications among people, but most of this research has been conducted in laboratory settings which do not account for the technology variable which influences every organization. Because of the importance of communications in organizations as they relate to effective operations, organization development practitioners have used the findings of these laboratory studies to try to improve communications in organizations--a very different setting from the laboratory setting in which the findings were made. The author believes that this approach is unsound in that it ignores the impact of organizational variables which surround small groups found in organizational settings. The organization's technology is a powerful influence on organizational setting since it affects the boundaries within which other variables can fluctuate, and its influence is of utmost importance to organization development practitioners because of

the difficulty of changing the technology in the short run. The investment in technology and the impact it has on the emergent subsystems in an organization make it worthy of research. This study goes right to the difficult question of the influence an organization's technology has on the communications in the organization. The central question which is addressed is: How are communication patterns in an organization related to the organization's technology?

Purpose of the Study

The purpose of this research is to begin to develop an understanding of the relationship between an organization's technology and communication patterns in the organization. However, because of the systems nature of organizations, the research takes into account other variables which may also be related to the communication patterns found in an organization (e.g., leadership style, job climate, organization structure, and demographics of the organization members). The basic hypothesis of this work is that the technology employed by an organization influences communication patterns in the organization.

Since so little research has been directed at the relationship between organizational technology and communication patterns, the research must be exploratory in nature. Hypotheses were developed from the literature on organization

technology and the literature on communications to be used as guides in this research project, but the development of new hypotheses and even new variables associated with the two key variables of the study were anticipated. The desire was to attempt to answer some beginning questions related to the subject relationship, but it was hoped that these answers would lead to even better questions which could be answered in subsequent research. The study actually had two objectives: (1) to develop new understandings and hypotheses about the relationship between organizational technology and communication patterns, and (2) to develop more refined methodologies which can be used in subsequent research into that relationship. Thus, this study was viewed as the first step in a research program into the relationship between organizational technology and communication patterns.

Significance of the Research

As stated earlier, communications in organizations are extremely important to the efficient functioning of an organization and the satisfaction of its members, and the author believes the organization's technology is an important variable influencing the communication patterns which emerge. Therefore, the relationship between these two variables needs to be explored.

Regardless of the sophistication of an organization, its functioning can always be reduced to the interactions of humans, either directly or via machines of one type or another, and effective communications are necessary for the proper operation of any organization. But the attempt by organization development practitioners to teach people about effective ways to communicate while ignoring the organizational setting, which is influenced by the technology, can easily lead to frustration of the organization members and inefficiency of the organization.

Research that indicates certain communication patterns seem to be most effective for certain tasks needs to be linked with the theory of organizational technology and research which indicates that effective organizations have a structure which is compatible with the organization's technology. Little research has been conducted in an attempt to link organizational technology and communication patterns, and the result of understanding this linkage should be more efficient organizations, both in terms of productivity and in terms of human satisfaction.

Additionally, technologies do not remain constant. This fact both underscores the importance of understanding the impact of organizational technologies and also offers the possibility of designing technologies which help promote effective communications. If researchers can begin to understand the relationship between technology and communication

patterns in organizations, then organization development practitioners can better help develop more effective communication patterns for the client organization, and engineers can design future technologies which include consideration of factors in the technology which will promote effective communications. In either approach the result can be more effective organizations and more satisfied organization members.

Definitions of Key Concepts

Technology. As employed in this study technology is defined as the collection of plant, machines, tools and procedures available for execution of the task and also the rationale and knowledge underlying their utilization. In other words, technology is the "how" the task is accomplished. While a number of different technology typologies could be employed, the general typology outlined by Perrow (1970) is the one which will be used in this study. This typology classifies technologies according to: (1) the number of exceptions to the activity plan which are encountered in performing the task, and (2) the degree to which the problems encountered in performing the task are analyzable. This typology is depicted in Figure 1-1.

	Few Exceptions	Many Exceptions
Unanalyzable Problems	Craft Industry	Non-routine
Analyzable Problems	Routine	Engineering

Figure 1-1. Perrow's Two Dimensional Technology Construct

Communication patterns. The basic definition of communication patterns which this study employs is that there is a sender who initiates a message, a receiver who receives the message, and a channel through which the message flows. Communication patterns are classified along four dimensions: (1) the parties involved (i.e., directionality of the communication), (2) the purpose of the communication, (3) the media used to send the message, and (4) the timing of the communication.

Overview of the Report

This first chapter has introduced the area of study and the specific problem statement to be addressed. Also, the purpose and significance of the research were explained, and the key concepts were defined. The following paragraphs outline the remainder of this report.

The second chapter expands the understanding of the problem addressed in this research. Then the significance of the study is further explored, both as it relates to the theory of organizations and as it relates to the work of organization development practitioners and technology designers. Next, the key concepts are thoroughly defined in the manner which will be employed, and finally, the second chapter explores the literature for hypotheses regarding the relationship between an organization's technology and its communication patterns. One hypothesis which seems common in the

literature is proposed, but since it does not account for many of the dimensions of communication patterns, it leaves the need for further study of the relationship between technology and communication patterns.

The third chapter provides a statement of the hypotheses to be tested in the research, along with a rationale from theory for each of the five hypotheses. The fourth chapter then describes the research design and methodological tools employed in the research. Also included is a rationale for this design and a description of the subject organization for this field research.

The fifth chapter reports the results of testing the five hypotheses, and the sixth chapter provides an interpretation and further analysis of these findings. Additionally, the sixth chapter offers some new hypotheses to be tested in further research and some new dimensions of the key variables which may also be useful in subsequent research, and it compares the observational data collected in the study to the questionnaire data collected, as a means of validating the questionnaire.

The final chapter summarizes the conclusions of this research, which are promising and do encourage further research into the relationship between technology and communication patterns. The final chapter also summarizes the weaknesses and strengths of the research and offers some recommendations for future study and some recommendations for or-

ganization development practitioners.

C H A P T E R II

DEFINING THE PROBLEM AND THE CONCEPTS

This chapter will lay out the area of study and define the problem addressed in the study. Next the significance of the research will be discussed, afterwhich the key concepts will be defined. Finally, the literature will be surveyed for guidance in stating hypotheses to be tested in the study.

The Area of Study

Bennis (1969, p. 2) defines Organization Development as "a response to change, a complex educational strategy intended to change beliefs, attitudes, values and structure of organizations so that they can better adapt to new technologies, markets, and challenges, and the dizzying rate of change itself." The field of Organization Development is filled with people who are interest-d in changing organizations so that the organizations can become more successful at self renewal. The implicit assumption of such a statement is that a basic goal of organizations is efficient survival and growth, but this goal has different shapes depending on the pair of glasses one wears. Business managers view Organization Development as a means of attaining better economic efficiency within the organization; people within organizations view it as a means of making life in organizations more

bearable. Then too, there are viewpoints of the organization's clientele and the general public to mention only two others. All of these parties have ideas about changing organizations to better meet their own needs.

The organization development practitioner can easily become overwhelmed with all of the demands and pressures for change in organizations, and this concern for changing organizations can easily override the need for first understanding the organization. Schmuck and Runkel (1972, p. 310) outline the steps of the organization development process as: entering (including contracting), diagnosing, initial training, assessing, followup training, and withdrawing. It is extremely easy to become anxious to take action and thus ignore the importance of the diagnosis step of the process. The result is an incomplete understanding of what needs changing in a particular organization and what the end result of the change should look like. While Lewin (1951) has said that the best way to understand something is to try to change it, organization development practitioners have a responsibility to their clients to affect meaningful change, and this desired end result requires a certain degree of understanding before action is taken.

One of the typical actions for organization development practitioners is to deal with "communication problems" in the client organization (Marguiles and Raia, 1972; Schmuck and Miles, 1971). Almost any organization can improve com-

munications, and the assumption is that this improvement will make the organization more efficient at reaching its goals, as well as a better environment for the members of the organization. While this assumption may be fact, organization development practitioners often attempt to apply an understanding of communications of people in small groups to the communication problems of the mass of people known as an "organization". The assumption here, which is forced on the organization development practitioner by a void in organization theory, is that the understanding of communications among people, as gained in the laboratory with small groups, gives one an understanding of the communications of people in aggregate within organization systems.

The author cannot help but question this implicit assumption. Communication problems within organizations are influenced by many factors other than the human element, such as the technology employed by the organization, the organization control and accountability hierarchy, and the enviornmental influences from outside the boundary of the organization, to mention only a few broad categories. Although little research has been done on any of these organizational influences on communications, perhaps the most ignored is the technology employed by the organization. Yet, it is potentially a very important factor affecting organization communications and effectiveness. Several studies have indicated that the most effective organizations tend to have a structure adapted to

the organization technology (Burns and Stalker, 1961; Woodward, 1965). This finding is related to the level of behavior dealing with the organization's formal structure, but it is also related to the social structure or communication patterns of individuals which are the focus of this study. Understanding the constraints that the organization's technology places on communications should help in better defining the communication problems encountered, and this understanding should thus help the organization development practitioner better serve the needs of the client organization.

Organizations as Socio-Technical Systems

A promising and perhaps essential way for organizations to be viewed is via an open systems approach (Homans, 1950; Litterer, 1973; Rief and Monczka, 1973; Udy, 1959). This approach requires that one look not only at the key variables of organizations but also at the interactions of these variables. It also requires that one look at the changing nature of the variables and their interactions. Organization development practitioners, as well as organization theorists, can never say that a relationship holds true, all other things equal; these other things must be defined because of the systemic nature of organizations. The problem with this open systems approach is that it is virtually impossible to simultaneously consider all of the key organization variables and their interactions. Nevertheless, the nature of organizations

demands a systematic consideration of all of the variables and their interactions, and in this analysis one must guard against the closed system pitfall which awaits all who attempt to explain the functioning of organizations. For example, while studying the relationship between technology and communication patterns, one must not ignore the influence on communication patterns stemming from the people in the organization, the organization control and accountability hierarchy and the environment of the organization, as well as the influence of these factors on technology itself. The author offers Figure 2-1 as a depiction of the systemic nature of organizations.

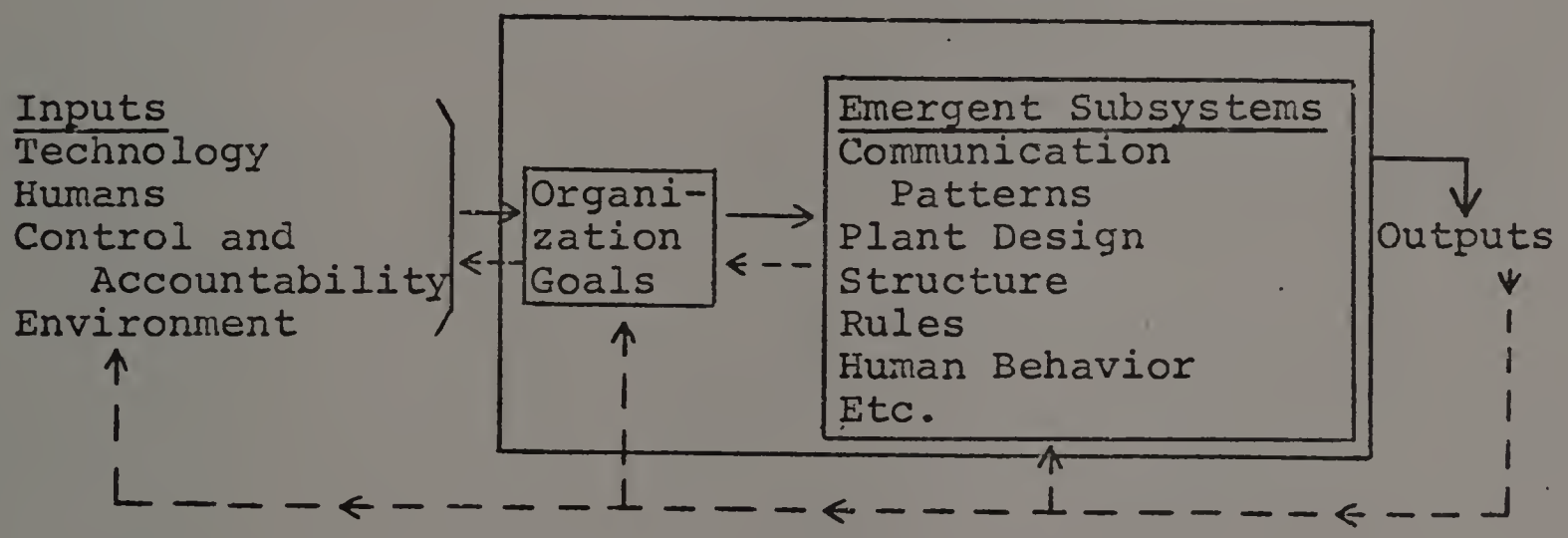


Figure 2-1. A Socio-Technical Systems Description of Organizations

With this model of organizations in mind, organizational efficiency can be defined in terms of the organization's ability to maintain equilibrium among and between:

(1) the needs of people in the organization
(2) the needs of the organization's technology

(3) the needs of organization control and accountability
(4) the needs of the organization's environment

This equilibrium is defined both internally to each of the four dimensions as well as interactionally among the four dimensions. In addition, the cybernetic idea of ultrastability of equilibrium is essential to the understanding of efficiency in an organization in today's rapidly changing environment (Cadwallader, 1959). A successful self renewing organization must maintain continuous equilibrium with its environment and itself, even though the above list of needs is continually changing.

Organizations and their efficiency are indeed complex, dynamic phenomena, and the need is to view organizations as they really are and not as students of organizations might want them to be. Let the first task be to understand what makes organizations tick, and let the second be to solve the dilemma Homans (1950) identifies as man's inability to live with or without organizations. The systems approach to the first task implies that the result will be not a theory of organizations but theories of organizations which apply to various situations and values of the key organization variables. Whatever the result, organization development practitioners need to make explicit the theory or theories of organizations they are employing so that they and the client can better diagnose the organization and so that the organization model can be continually tested, refined and further

developed.

The Problem

As alluded to earlier, the literature of Organization Development places a heavy emphasis on the human input of organizations and the human oriented subsystems within organization systems. This emphasis is probably well deserved, since organizations are inventions of humans designed to serve humans. No matter how sophisticated or complex the organization, its functioning can always be reduced to the interaction of humans, either directly or via machines of one type or another. It is through human interaction that organization goals are translated into the definite actions required to accomplish those goals (Barnard, 1938). One might also add that organization goals are determined through a process of human interaction.

While all of this emphasis on the human element is understandable, the lack of emphasis on other organization inputs, which interact with the human element in very influential ways, is not understandable. Organization development practitioners cannot afford to ignore any of the factors which affect the efficient functioning of the client organization. The open systems nature of organizations does not allow this luxury, and theories of organizations must be developed to account for such important variables as control and accountability, environment, and technology.

The author is particularly concerned about the technology variable because the logic of the idea that the technology variable affects communication patterns within the organization is compelling. Who, for instance, could deny that workers confined to an assembly line are not confined as to their interactions with other workers? Also, most organizations start with the technology as a given, and in that sense, as a constraint on the organization system. Many authors have made reference to the link between technology and communication patterns within organizations. As early as 1904 Veblen, in The Theory of Business Enterprise, postulated the link between technology and the social structure of an organization. After ten years of studying organizations, Woodward (1965) suggested that technology is causally related to structural and behavioral variations in organizations, and in their famous study, The Man on the Assembly Line, Walker and Guest (1952) hypothesize that the basic factor affecting the rate and quality of worker-supervisor interaction is the technology of mass production. Dubin (1959) agrees in saying that technology may be the most important single determinant of working behavior. And finally, Meissner (1969) surveyed the literature and found it had focused on production technology and its demands separate from the social organization of the workers and the emergent rules of conduct. Feeling it is important to link these two bodies of theory, he analyzed a number of case studies found in the literature in an attempt

to categorize technical culture and adaptive behavior in organizations. The findings of these and other authors will be explored later in greater detail.

The research to date, however, has tended to deal only superficially with the relationship between technology and communication patterns; therefore, their relationship remains blurred. The author believes that further research should be undertaken to develop an understanding of the links between technology and communication patterns, and that is the purpose of this study. There seems to be enough evidence and feeling that these two variables are related for one to hypothesize that an organization's technology influences the communication patterns which emerge in the organization. Empirical research needs to be conducted on the question raised by this hypothesis: Are communication patterns a function of the technology employed by an organization, and if they are, what is the nature of the relationship? Before exploring the literature in more detail for definitions of the key concepts and guidance in formulating empirical research on this question, the significance of such research will be discussed.

Significance of the Research

Few organization development practitioners, if any, would deny the importance of communications in influencing the efficient operation of an organization. Indeed, commun-

ications are vitally important to the functioning of an organization, and it is almost a truism that any organization needs more and better communications than it presently enjoys. Communications serve the role of coordinator of activities in an organization, but communications alone do not provide the coordination necessary for the accomplishment of organization goals. Another key element in creating coordination is the organization technology which is composed of two parts, namely, the tasks which must be performed and the techniques available for their performance (Litterer, 1973).

Thompson (1967) writes about the increasing burden on communications and decision making as coordination moves from accomplishment by standardization to plan to feedback, i.e., as the technology decreases in certainty. Thus, it seems that technology and communications are interrelated as the systems approach to organizations would indicate. Perrow (1972), Thompson (1967), and Woodward (1965) all write about the inefficiency which results if technology and organization structure do not enjoy a reasonably good degree of fit.

Woodward states that it appears that technology affects organization structure, and therefore, decisions relating to structure can only be effectively made by managers who have a knowledge and appreciation of the organization technology. While she is referring to structure rather than behavior within the organization, she also states that the individual worker is constrained by the organization technology. There-

fore, for the organization development practitioner who is concerned with improved communications within an organization, a knowledge of the organization technology should assist in the attempt to make decisions which move the organization toward better communications. Schein (1970) agrees in suggesting that the socio-technical systems application to organizations must determine what combination of technology, worker characteristics and organization structure will most likely result in effective work organizations.

This statement by Schein, however, complicates the problem of developing better organization communications by implying that the organization technology can be influenced by the communications as well as the reverse direction of influence. In other words, the social system of an organization and the technology of the organization are interrelated such that efficient organization operation depends on the interdependent satisfaction of the needs of both of these components of the system. Equally important, however, is the interdependent satisfaction of these needs along with the needs of organization structure, environment, organization goals, and a host of other organization components. This complicated interdependence is the nature of open socio-technical systems.

Unfortunately, psychologists, human relations trainers and organization development practitioners tend to restrict their effectiveness by ignoring the interdependence of social,

structural and technical requirements of the organization (Davis, 1966; Perrow, 1970). Too often the implicit assumption of the activities of organization development practitioners is that behavioral problems can be solved by training the entire organization in "effective ways to communicate." The fallacy in such an approach is that the training may encourage people to attempt to communicate in ways that do not naturally emerge from the technology and other organization constraints. The result can only be frustration for the trainee and inefficiency for the organization.

Before organization problems can be solved, it is essential that the nature of the organization, in the form of the environmental contingencies, be understood and taken into account in any plan of action. Good diagnosis is essential to effective organization development. Organizations face different sets of constraints on their operation, and there is no "one best way" to structure complex organizations. However, there are "best ways" to structure organizations given an understanding of the situation surrounding the organization.

But the situation is dynamic; organizations exist today in a world of rapid changes, including rapid technological advances. It will be necessary for organizations to adapt to changing technologies with rapid success if they are to survive. If technology then has an important influence on organization communications, as this study hypothesizes, it

will be essential to understand which communication patterns fit better with which technologies and why they fit better with these technologies. Such an understanding will facilitate the design of organization structures which complement the naturally emerging communication patterns in a way which leads to effective operation of the organization.

Then too, remembering that one does not have to begin with technology as a given and attempt to adjust the human system to the technology, a better understanding of the relationship between technology and communication patterns would allow the design of new technologies or the possible adjustment of existing technologies to better fit the needs of the human system. Already, research has been conducted on which communication patterns seem to be the most effective in which situations (Bavelas, 1950; Guetzkow and Simon, 1955; Leavitt, 1951). The basic finding has been that simple tasks are performed more effectively by groups organized in the highly structured wheel pattern, while complex tasks are performed more effectively by groups organized in the less-structured circle pattern (see Figure 2-7, p. 33 for depictions of these patterns). Guetzkow and Simon added that the ability to become organized acts as an intervening variable between the type of pattern employed and the performance of the group. In addition, the circle pattern was found to be the most satisfying for the group members. Doubtless, more research needs to be conducted on this subject, but as Sayles

(1958) suggests, it should be possible to design organizations and technologies to fit well with specific needs of the organization's human system.

To summarize, a model of organizations useful to organization development practitioners must include an understanding of the relationship between organization technology and communication patterns. This relationship must be understood within the systems concept of interrelatedness of these two variables, interrelated both with each other and with other variables, such as structure and environment. Again referring to Sayles (1958), a society characterized by changing technology cannot afford to ignore the impact technology has on the human system. Likewise, organization development practitioners cannot afford to ignore this impact if they are to successfully assist organizations in striving for effective operation, including satisfying the needs of the human system within the organization.

Now that the problem has been stated and the significance of studying the problem has been outlined, the author will turn to defining the key concepts. The reader will quickly note the difficulties in defining the concepts "technology" and "communication patterns" in a manner which will be operationally useful in classifying organizations.

Defining the Concepts

Technology. A number of authors would seem to agree on

a general definition of technology as being the collection of plant, machines, tools and procedures available for execution of the task and also the rationale and knowledge underlying their utilization (Litterer, 1973; Meissner, 1969; Perrow, 1967; Seiler, 1967; Taylor, 1971; Thompson, 1967; Woodward, 1965). The difficulty arises when one tries to search for a common definition of the typology of organization technologies.

Woodward (1970) propcses that technologies may vary along the amount of variety in the product range, the degree of discretion which must be exercised, the pace of the work, the freedom of movement allowed the workers, the possibilities for social interaction, the degree of responsibility for task required of the workers, the working conditions, the nature of the products, the sophistication of techniques and hardware available for processing raw materials, and the complexity of the production process itself. From this statement, she proceeds to define production technologies along the single continuum shown in Figure 2-2.

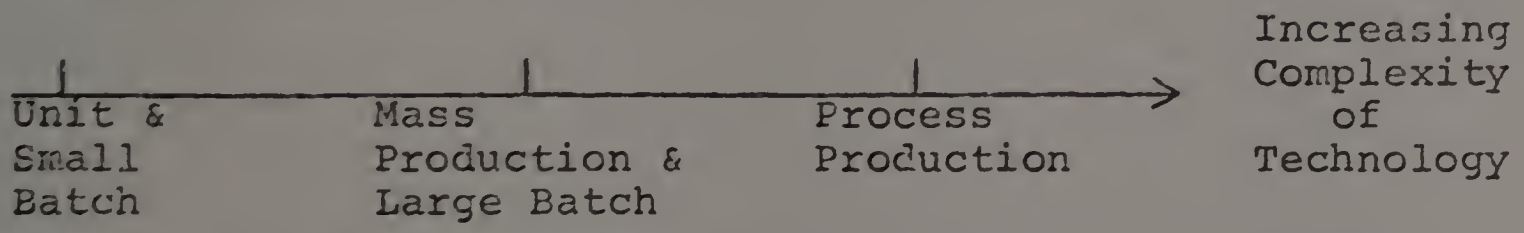


Figure 2-2. Woodward's Production Technology Continuum

Of course, organizations might employ more than one of these technologies and Woodward categorizes these situations as Combined Systems.

The definitions of the technology categories in Figure 2-2 are as follows:

(1) Unit & Small Batch--production to meet individual customer's requirements with low predictability and control over production; the manufacturing cycle proceeds from marketing to product development to production.

(2) Mass Production & Large Batch--standardized production on an intermittent basis with moderate predictability and control; the manufacturing cycle proceeds from product development to production to marketing (Woodward admits this classification may be so broad as to allow for very large variation within the classification and suggests that the degree of rationalization may be important in further subdividing the category).

(3) Process Production--standardized production on a continuous basis with high predictability and control; the manufacturing cycle proceeds from product development to marketing to production.

Thompson (1967) offers another classification scheme which is broader in perspective in that it applies to more than just manufacturing organizations, but it also allows for greater variation within the categories. The typology is outlined below in Figure 2-3.

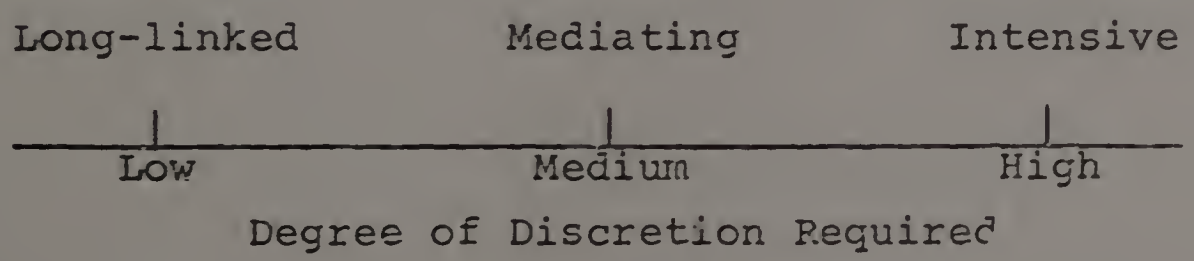


Figure 2-3. Thompson's Technology Construct

The definitions of the technology categories in Figure 2-3 are as follows:

(1) Long-linked--performing well defined acts which are serially interdependent; that is, act A must be performed before act B, act B before act C, and so forth (this category would seem to include all three of the categories Woodward defines).

(2) Mediating--linking in standardized ways parties who wish to be interdependent; Thompson's example is a bank.

(3) Intensive--using a variety of high skill techniques to achieve a change in some object or person, but the selection and ordering of the techniques are determined by feedback of information from the object or person; Thompson's examples are a military combat team and a hospital.

Perrow (1970) offers a third classification scheme which would appear to encompass both Woodward's and Thompson's schemes. He says that technologies can be distinguished along two basic dimensions: (1) the number of exceptional cases encountered in the work, i.e., the degree of predictability of the work, and (2) the nature of the search procedure followed when exceptions do occur, i.e., the degree to which problems encountered are analyzable. His typology is depicted in Figure 2-4. Perrow has compared his typology with Woodward's typology and data, and he indicates an overlay of the two typologies as shown in Figure 2-5. The author believes that Thompson's typology can also be incorporated into Perrow's scheme and shows this overlay in Figure 2-5 also.

	Few Exceptions	Many Exceptions
Unanalyzable Problems	Craft Industry	Non-routine
Analyzable Problems	Routine	Engineering

Figure 2-4. Perrow's Two Dimensional Technology Construct

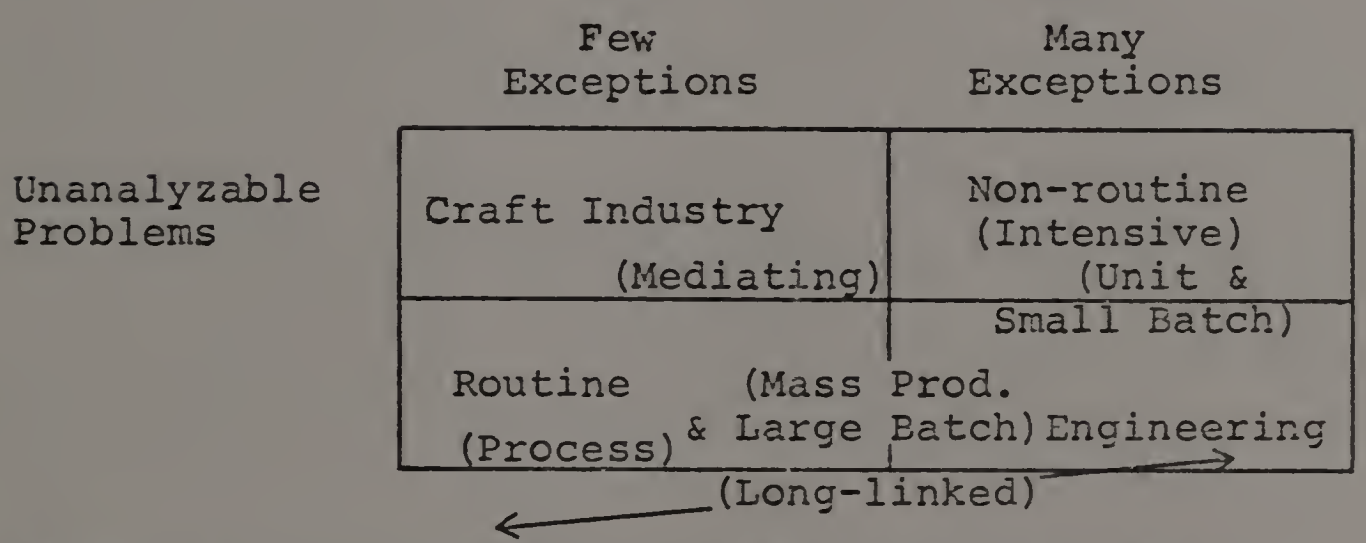


Figure 2-5. Perrow's Technology Construct with both Woodward's and Thompson's Technology Constructs Overlayed

Finally, Meissner (1969) in his case studies analysis distinguishes technologies as to the type of conversion equipment and operations employed, and the type of transfer equipment and operations used. He identified eight categories of technology which he kindly compares with Woodward's typology as shown in Table 2-1; as Meissner points out, the match leaves something to be desired. It seems, however, that Meissner's typology implicitly utilizes the degree of mechanization in the organization and the level of sophistication of the equipment employed, and it is therefore based

on the number of exceptions encountered in the work and the degree to which problems encountered are analyzable. This allows his typology to be recast within the framework of Perrow's scheme. It thus appears that Perrow's typology is general enough to cover many situations and yet specific enough to be useful in an operational way. Therefore, this study will use Perrow's model as the technology construct.

Table 2-1

Comparison of Meissner's Technology Typology to Woodward's Technology Continuum

	Meissner	Woodward
Type I	Handling (no conversion, hand transfer)	Large Batch
Type II	Hand Work (hand conversion and transfer)	Mass/S. Batch
Type III	Machine Work (machine tools, hand transfer)	Mass/S. Batch
Type IV	Machine Work Sequence (machine tools, dead line)	Mass
Type V	Assembly Line (hand tools, live line)	Mass
Type VI	Hand and Machine Line (hand and machine tools, live line)	Large Batch
Type VII	Remote Controls (steered automatics, steered line)	Large Batch
Type VIII	Automation (self-regulating automatics, live line)	Process/Mass/ Large Batch

Communication patterns. To define communication patterns, both communication and patterns must be defined. Litterer (1973) defines communications as involving transactions between people, as shown in Figure 2-6.

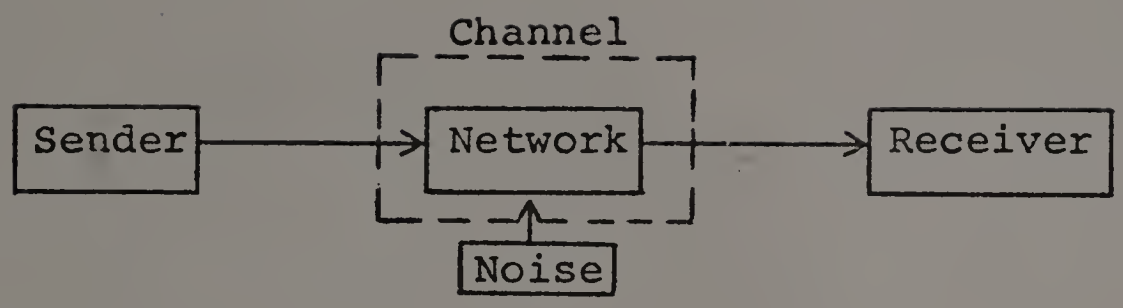


Figure 2-6. Depiction of the Communication Process

The sender must select what information is to be transmitted, translate the information into the specific form in which it is to be transmitted, and transmit the information into the communication channel. Skipping over the channel for a moment, the receiver must detect the message, make sense of what has been transmitted, and select that portion of the information which is useful to the receiver. Unfortunately, the communications are seldom perfect because of noise from the environment which enters the system, uncontrolled by either the sender or receiver, and which distorts the message. The channel is the vehicle through which the message is relayed from sender to receiver, and the parties on either end may be both senders and receivers. Usually, the channel consists of a network (or pattern) which can be defined as a number of connected links in the system such that two or more people can be both sender and receiver. The pattern thus consists of the various parties and media in the organization which act as the channel linking senders and receivers (Litterer, 1973).

As with the technology variable, it is much easier to reach agreement on what a communication pattern is in general terms than it is to agree upon the dimensions for distinguishing among various communication patterns. However, a considerable amount of work has been done in attempting to understand differences in communication patterns, and the following dimensions of distinction are outlined below and discussed in the following paragraphs:

(1) purpose of the communication
(2) media used for transmission
(3) directionality of the communication
(4) timing of the communication
(5) geometry of information flow

Regarding purpose of communications, the distinction can be made as to whether communications are "required" to complete the task (i.e., task-related communications) or are simply "permitted" within the context of completing the task (i.e., non-task-related communications)(Meissner, 1969). One can further delineate the purpose dimension of communications as follows (March and Simon, 1958):

(1) Conducting non-programmed activities
(2) Initiating and establishing programs, including adjustments to existing programs
(3) Providing data for execution of programs
(4) Evoking programs, i.e., providing stimuli for action
(5) Providing information on results of activities

Two others can be added: (1) Alerting people regarding the existence of a crisis, and (2) Social interaction.

The media dimension can include the following distinctions (Allen, 1966; Meissner, 1969):

(1) Verbal use of words, which can be subdivided into face-to-face, telephone, meeting, discussion with several people, etc.
(2) Written use of words, which can be subdivided into letters, rules, procedures, manuals, reports, memorandums, periodicals, etc.
(3) Signs, e.g., body movements, arm movements, whistling
(4) Signals, e.g., dials, horns, lights
(5) Objects, i.e., the work piece for the task

The directionality of the communications can be considered as follows (Allen, 1966; Simpson, 1959): (1) Degree to which communications are vertical, horizontal and diagonal in relation to the organization chart, (2) Who initiates the communication?, and (3) Who receives the communication?

The timing of communications can be considered as follows (Allen, 1966; Simpson, 1959): (1) Frequency with which parties interact, and (2) Duration of interactions between parties.

Finally, if the researcher has enough information to define groups of people within the organization, communication patterns can be distinguished as to the geometry of information flow (Bavelas, 1950). Bavelas distinguishes four patterns, and others could also be useful in describing certain situations (see Figure 2-7).

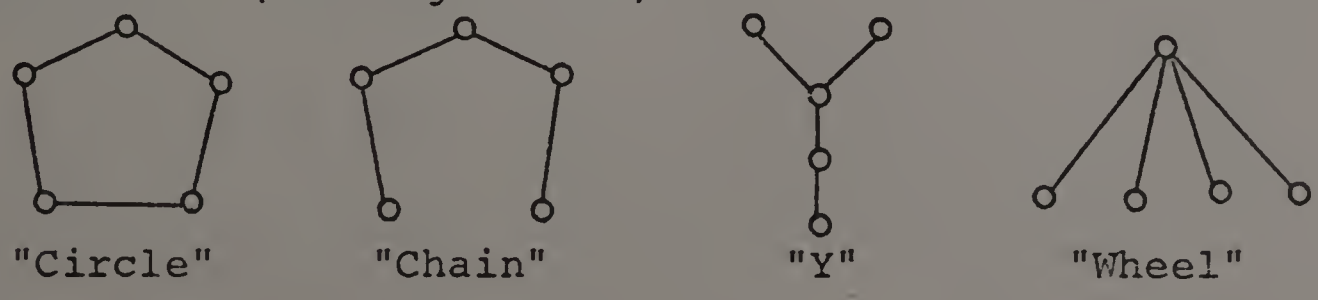


Figure 2-7. Bavelas' Patterns of Information Flow

However, one must be careful not to distort the reality of the situation in trying to apply this geometrical approach. For example, it is questionable if the technique would be valid on an assembly line since the groups tend to be slightly different for each worker and yet also overlap to some extent (Walker and Guest, 1952).

One must always remember that the communication patterns in an organization are an emergent subsystem in the systems approach to organizations (see Figure 2-1, p. 16). As such they may be partly prescribed by the structural plan of the organization (i.e., the organization structure subsystem in Figure 2-1), but primarily communication patterns develop as a consequence of being in the organization and are influenced by technology and all of the other inputs and subsystems, as well as their interactions.

To summarize, technology has been defined according to Perrow's scheme (see Figure 2-4, p. 29), and communication patterns have been defined according to purpose, media, directionality, timing, and geometry of information flow. Now that these concepts have been defined as will be used in this research, the literature can be explored for answers to the question of how communication patterns and technology are related and for guidance in formulating empirical research on this question.

The Relationship Between Technology and Communication Patterns

The basic hypothesis of this study is that the technology employed by an organization influences the communication patterns in the organization. While many students of organizations would agree with this statement, the author believes there exists sufficient evidence for the importance of this relationship to delve further and ask the fundamental questions: What is the nature of the relationship between technology and communications? What factors account for the relationship as it exists? An understanding of the nature of this relationship would be a valuable tool for the organization development practitioner to use in gaining insight into the functioning of the client organization and for the organization theorist to use in explaining the functioning of an organization.

A survey of the relevant literature reveals that this relationship has often been mentioned, but the nature of the relationship remains relatively unexplained. Basically, the literature offers a great deal of confusion about the subject, and the author interprets this to mean that the issue is both complex and relatively unexplored.

This section of the report will employ Perrow's model as a framework for hypothesizing about the relationship between technology and communication patterns. Other research will

be introduced as it relates to the deductions from the model. Sometimes the other authors will support and clarify these deductions; other times they will cloud the issue. In any event, it will become clear that the relationship under study has so far been explained only in terms of the directionality dimension of communication patterns, and then only in production technologies.

Perrow's two dimensional framework of technology can be used to predict how communication patterns might correlate with different technologies (see Figure 2-8, p. 37). As can be seen in the figure Perrow delineates among task-related interactions utilizing four factors: discretion, power, coordination within groups, and interdependence among groups. He refers to two groups within organizations. The first is Technical Management which includes the technical control and support of production and marketing, e.g., accounting and quality control, and the second is Supervisors which includes the direct supervisors of those dealing with the basic raw materials (Perrow, 1970).

Routine (or Process) technology. With Routine (or Process) technology Perrow's model (see Figure 2-8, p. 37)

suggests that the supervisors have very little discretion or power and that coordination is by plan, thus suggesting an organization characterized by vertical communication which is primarily downward. Perrow's characterization of non-task-related interactions in a Routine technology as dealing with security and protection from arbitrary power would seem to indicate that permitted communications tend to be horizontal in direction. Horizontal communications relating to task might also be more prevalent during crisis situations which lie outside the domain of the plan.

At one point in her work, Woodward (1965, p. 147) seems to agree with Perrow that Routine (or Process) technology is associated with low interdependence between the Supervisors and the Technical Management, thus implying action by plan and a greater proportion of vertical communications under normal conditions. However, in the same work (p. 199) she seems to contradict herself by reporting that in Process industry 70% of a manager's communications are with other managers at the same level and 30% are with superiors and subor-

Technology Variable

	Few Exceptions	Many Exceptions
Unanalyzable Problems	Craft Industry (Mediating) 1	2 Non-routine (Intensive) (Unit & Small Batch)
Analyzable Problems	4 Routine (Process) (Mass Prod. & Large Batch)	3* Engineering

(Long-linked) →

Task-Related Interactions (Task Structure)

	Discretion	Power	Coordination within groups	Interdependence of groups	Discretion	Power	Coordination within groups	Interdependence of groups
Tech. Mgt.	Low	Low	Plan	Low	High	High	Feedbk.	High
Super.	High	High	Feedbk.		High	High	Feedbk.	
	Decentralized			1	Flexible, polycentralized			2
Tech. Mgt.	Low	High	Plan	Low	High	High	Feedbk.	Low
Super.	Low	Low	Plan		Low	Low	Plan	
	Formal, centralized			4	Flexible, centralized			3

Non-Task-Related Interactions

Social identity (communal) 1	2 Goal identification (mission)
4 Security, protection from arbitrary power	3 Task identification

* The number "3" box in the other two charts in fhis figure describe task-related and non-task-related interacitons in Engineering technology. The same form is true for the other numbers.

Figure 2-8. Comparison of Perrow's Four Technologies as Regards Task-Related and Non-Task-Related Interactions

dinates. She does agree with Perrow that discretion is limited in Process technologies, except in crisis situations where delegation and horizontal communications are more prevalent. Then, however, she uses this finding of normally limited discretion to support her assertion that normal, on-the-job communications are predominantly horizontal. Woodward adds that superior-subordinate communications off the job tend to be more frequent in Process technologies than with other technologies.

Thompson and Bates (1957) conclude that a high degree of mechanization has the result that the specialization of function and the integration of functions is primarily within the machine domain as opposed to the human domain. They therefore suggest that a high ratio of mechanization (i.e., Routine or Process technology) means that the task-related communications will tend to be vertical, but the non-task-related communications will likely be more horizontal because of the freedom allowed the worker. This finding agrees with the prediction based on Perrow's model and supported by some of Woodward's data. Simpson (1959) adds support to this conclusion but confuses the issue by stating that the reason for greater vertical communications in Routine industries is the need to deal with breakdowns in the plan, i.e., crises. His reasoning seems to contradict the predictions based on Perrow's

model, as well as the findings of Woodward.

Other authors have also indicated that vertical communications predominate in Routine (or Process) technology under normal conditions (Bell, 1965; Blau and Scott, 1963; Faunce, 1958; Lawrence and Lorsch, 1969; Litterer, 1973; Udy, 1959). Therefore, in spite of the confusion in the literature, one hypothesis to be tested is that normal communications tend to be more vertical than horizontal in organizations with technologies built on few exceptions and analyzable problems. Possible reasons for this result would be the high degree of predictability and certainty of the tasks and techniques encountered and the high degree of mechanization of the technology. The tasks can be well planned in advance so that not only are required communications predominantly vertical but also the volume of required communications is less relative to other technologies (Litterer, 1973). In crisis situations, however, the volume of communications will doubtless increase dramatically, and as mentioned above, a number of authors believe horizontal communications will become predominant during crises. Tausky (1970) disagrees in stating that vertical communications increase during crises due mainly to an increase in upward communications. Then too, it may be that both horizontal and upward vertical communications increase during crises with the predominating type depending on the nature of the crisis.

Unit & Small Batch technology. Considering now the Unit & Small Batch technology (see Figure 2-8, p. 37), Perrow's model suggests that Supervisors have a moderate degree of discretion and power and that coordination is both by plan and by feedback. Also, the model indicates a moderate degree of interdependence between the Supervisors and the Technical Management. All of this suggests an organization characterized by more horizontal communications than in Routine technologies. Perrow's characterization of the non-task-related interactions in this technology is that they are based on identification with the goals and tasks of the organization, which would seem to indicate that the permitted communications tend to be both horizontal and vertical in nature. During a crisis the communications would likely tend to be both horizontal and vertical, too.

Woodward (1965) concurs about non-crisis communications in saying that Unit & Small Batch technology calls for a great deal of horizontal communications due primarily to the interdependent nature of the main tasks. She reports that departmental activities must be integrated on a daily basis, thus calling for horizontal communications at every level of the hierarchy. This explanation seems consistent with the Perrow model indication of many exceptions and only moderately analyzable problems with Unit & Small Batch technology. Lawrence and Lorsch (1969) concur in their characterization of organizations on a certainty-uncertainty dimension. They

conclude that organizations in an uncertain environment (i.e., Non-routine technology) need a flatter organization structure and more all-channel communications, which means more horizontal communications than in organizations in an environment of certainty (i.e., Routine technology).

Thompson and Bates (1957) conclude that a low degree of mechanization has the result that the specialization of function and the integration of functions is primarily within the human domain as opposed to the machine domain. This low ratio of mechanization (i.e., Unit & Small Batch technology) creates integration problems which can be solved only by largely horizontal, task-related communications. Simpson (1959) however, disagrees in saying that low level mechanization necessitates vertical communications. In fact, Simpson suggests the following typology: Low mechanization--high vertical communications, medium mechanization (e.g., assembly line)--low vertical communications, high mechanization--high vertical communications (see Figure 2-9).

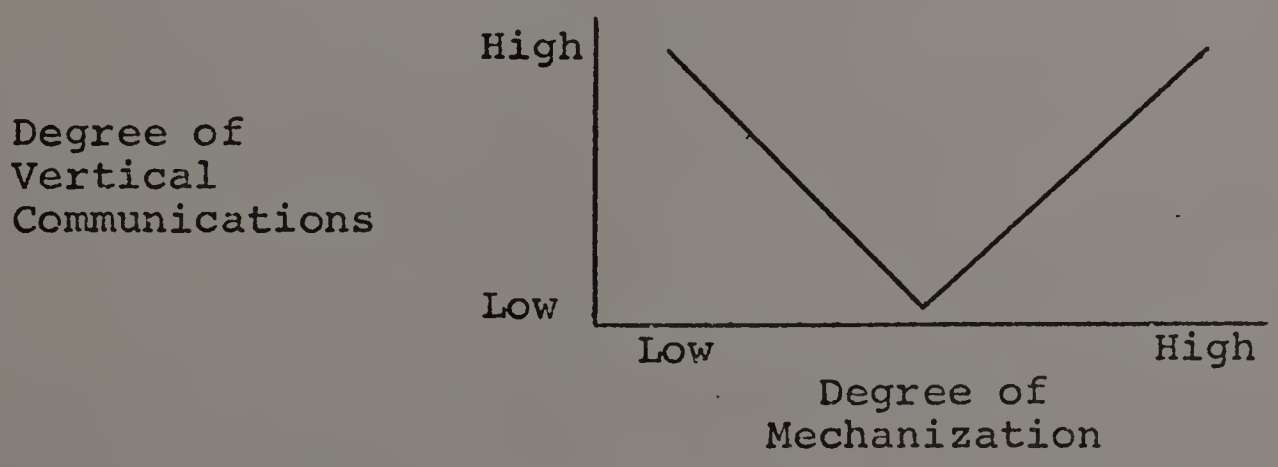


Figure 2-9. Simpson's Typology Relating Degree of Mechanization and Degree of Vertical Communication

Tausky tends to agree with both viewpoints saying that Unit & Small Batch technology is characterized by two-way communications both among workers and between workers and managers (Tausky, 1970). Overall, however, the sentiment seems to be that horizontal communications predominate in Unit & Small Batch technology under normal operating conditions; other authors seem to concur with those mentioned above (Bell, 1965; Litterer, 1973; Udy, 1959). Therefore, another hypothesis to be tested is that normal communications tend to be more horizontal than vertical in organizations with technologies built on many exceptions and moderately analyzable problems. Possible reasons would be the low degree of predictability and certainty of the tasks and techniques encountered and the low degree of mechanization of the technology. The tasks cannot be well planned in advance so that not only are the required communications predominantly horizontal but also the volume of communications is great relative to other technologies. In fact, the level of vertical communications with Unit & Small Batch technology may actually exceed the level with Process technology, but the ratio of vertical to horizontal communications will be lower.

Mass Production & Large Batch technology. With Mass Production & Large Batch technology (see Figure 2-8, p. 37), Perrow's model suggests that Supervisors have a degree of discretion and power which falls between that found in Unit & Small Batch technology and that found in Process technology.

Coordination within groups tends to be by plan, although some feedback is utilized. Also, there is low to moderate interdependence between the Supervisors and the Technical Management. All of this suggests an organization characterized by a mixture of vertical and horizontal communications, neither of which is predominant. Perrow's characterization of the non-task-related interactions in this technology is that they are based on an identification with the task and on security needs, which would seem to indicate that the permitted communications tend to be horizontal but may be restricted by the technology. During a crisis it is not clear how the communications would develop, but conflicts might easily develop due to the moderate interdependence between Technical Management and Supervisors.

Woodward (1965) concurs that in Mass Production & Large Batch technology one finds both horizontal and vertical communications under normal conditions, but she makes the distinction that horizontal communications among departments tend to be in writing. She also reports that the differentiation of labor is so minute that the workers can be relatively unskilled, which accounts for the horizontal communications being in writing at the departmental level (i.e., formalized integration of tasks performed by the workers).

Thompson and Bates (1957) conclude that a moderate degree of mechanization will result in the specialization of function and the integration of functions lying in both the

human and machine domains. Therefore, they conclude that Mass Production & Large Batch technology will be characterized by both vertical and horizontal communications. Simpscn (1959, see Figure 2-9, p. 41) seems to agree if one looks at his medium mechanization--low vertical communications relative to his high mechanization--high vertical communications. However, he seems to disagree if one looks at his medium mechanization--low vertical communications relative to his low mechanization--high vertical communications. Therefore, Simpson's typology again offers a seemingly different hypothesis.

Fortunately, several in-depth studies have been made of assembly line technologies and should help clarify the confusion (Sayles, 1958; Walker and Guest, 1952). Walker and Guest reported that most workers on assembly lines tend to share the same physical space rather closely but perform independent tasks. The result is that there is little need for required communications, and permitted communications tend to be of a social nature but are impeded by the noise and speed of the line. They alsc reported that the interaction rate between workers and their foremen tends to be frequent, friendly and informal, but the interaction rate between workers and supervisors above the foremen is very infrequent compared to other technologies. Sayles reported that the constant horizontal communications at the worker level are required by the assembly line technology, thus appearing to contradict Walker and Guest.

However, if he meant communications via the media of the work piece, then this statement would concur with the findings of Walker and Guest. Litterer (1973) suggests that this may be the case in saying that Mass Production technology reduces the need for superior-subordinate communications because the machine tells the worker what to do; this machine control of tasks would also reduce the need for task-related horizontal communications as well.

Taking all of these viewpoints into account, as well as the confusion in the literature, the indication seems to be that both horizontal and vertical communications are present in relatively equal quantities in Mass Production & Large Batch technology. Thus, another hypothesis to be tested is that normal communications tend to be equally horizontal and vertical in organizations with technologies built on a moderate number of exceptions and moderately analyzable problems. Possible reasons would be the moderate degree of predictability and certainty of tasks and techniques encountered and the moderate degree of mechanization of the technology. The tasks can be planned to only a certain degree thus leaving a number of possible exceptions to the plan, but there is also a growing need to rationalize the differentiated tasks. The result of this situation is more room to maneuver in this mid-range of technologies which means more organization structure flexibility, more ambiguity, and more organization conflict (Woodward, 1965).

One hypothesis relating technology and directionality of communications. Although certain discrepancies do exist in the literature about the nature of the relationship between technology and directionality of communications, there seems to be support for hypothesizing the relationship depicted in Figure 2-10.

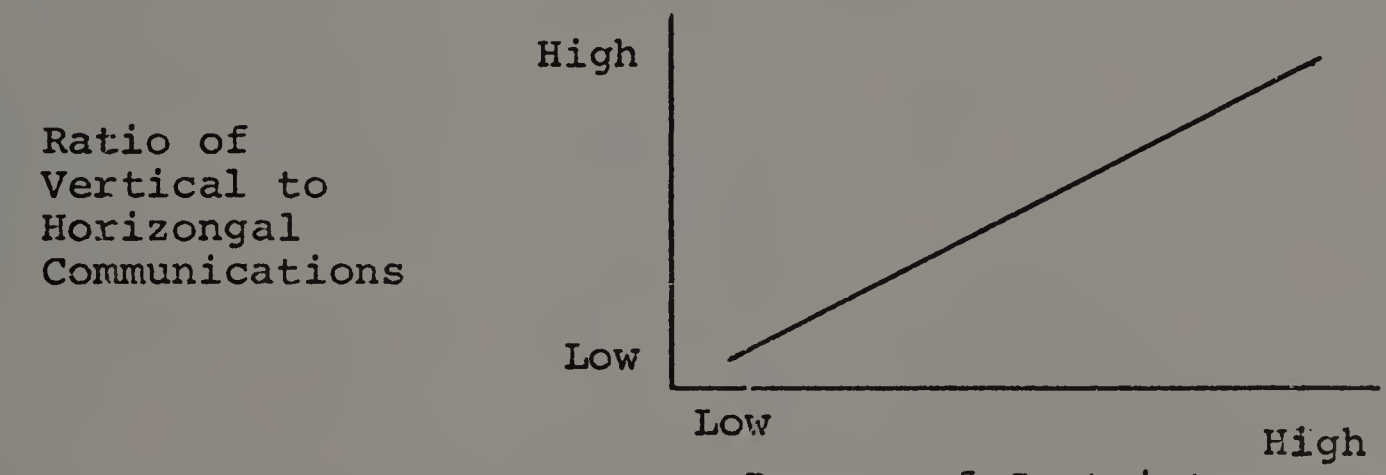


Figure 2-10. Hypothesized Relationship between Technology and Ratio of Vertical to Horizontal Communications

The problem with the relationship is that it ignores many of the dimensions of communication patterns. For instance, nothing is indicated in Figure 2-10 about diagonal communications because no one has really dealt with this subject. Also, few references have been found which attempt to distinguish among communication patterns in various technologies on the basis of purpose, and then only in the gross categories of required and permitted communicatiors (Litterer, 1973; Meissner, 1969; Perrow, 1970). Neither has much research been done to distinguish among communication patterns in various technologies on the basis of media (only Meissner, 1969; Wood-

ward, 1965). Finally, only Walker and Guest (1952) even come close to alluding to the geometrical approach to classifying communication patterns in various technologies, and then only to mention that grouping of people in studies of assembly lines does not represent reality.

Meissner's (1969) attempt to categorize communications in various technologies on the bases of purpose, media and pattern is probably the most complete, but it tends to be confusing in its relation to what others have written. His categorization can be depicted as shown in Table 2-2, p. 48. However, it must be remembered that his analysis is based on data collected from case studies reported in the literature and is therefore subject to all the limitations of secondary data, the most serious of which is incompleteness of data.

In addition to all the shortcomings of research to date, as mentioned above, all of the studies reported in the literature seem to deal only with production technologies. No one has attempted to study communication patterns in organizations which have Mediating or Intensive technologies as per Thompson's typology of technologies (Figure 2-3, p. 27). One might attempt to utilize Perrow's work (Figure 2-8, p. 37) to hypothesize regarding communication patterns in Mediating and Intensive technologies. This analysis would suggest that Mediating technology emphasizes both horizontal and vertical communications, much like Mass Production & Large Batch technology with perhaps slightly more vertical communications since

Table 2-2. Meissner's Case Studies Results Relating Technology and Communications

Networks of Permitted Communications		Required Communications*: Objects and Words	Required Communications*: Objects, Signs and Signals	Required Communications*: Signals and Words
		Permitted Communications: Continuous and Culturally Complete**	Permitted Communications: Intermittent and/or Culturally Incomplete	Permitted Communications: Absent
Unrestricted choice of partners	Open boundaries (includes people outside work group)		Tech. I,III	
	Closed boundaries (includes only people inside work group)		Tech. I,II, III***	
Restricted choice of partners	Floating boundaries (different group for each person)		Tech. V	
	Closed boundaries		Tech. II, IV	Tech. VIII
Permitted communications absent				Tech. VI, VII

* See p. 33 for definitions of communication media categories.
** Culturally complete means using at least four of the following five items: (1) Gesture, (2) Facework, (3) Literacy, (4) Completion of discourse, (5) Choice of partners (Meissner, 1969).
*** See p. 30 for definitions of technology types.

it tends toward Routine (or Process) technology. Non-task-related communications should also tend to be both horizontal and vertical since they are based on task identification and security needs, as well as goal identification and social needs.

As for Intensive technology, which is rather Non-routine, this analysis would suggest a high degree of discretion and power for the Supervisors, a high degree of coordination by feedback among Supervisors and among Technical Management, and a high degree of interdependence between Supervisors and Technical Management. Such high discretion, interdependence and unpredictability suggests that the communications would be vertical, horizontal and diagonal and that the communication patterns would tend to be flexible depending on the situation as reported in the feedback. Thompson (1967) concurs with this hypothesis, but it remains an untested hypothesis.

It seems that the relationship between technology as an input variable and communication patterns as an emergent subsystem of the organization is yet a rather undefined relationship. Some information is available about the directionality of communications as it varies across technologies, but the directionality picture is incomplete, and still nothing is known about the variations in communications on the bases of purpose, media and pattern geometry as the technology varies.

Summary

This chapter has served to define the area of study, the specific problem to be addressed in the research, and the significance of the research. In addition, the key concepts have been thoroughly defined, and finally the literature has been explored in search of hypotheses to guide the study. The result of this survey was the definition of one hypothesis for testing. The next chapter will state four other hypotheses, and the fourth chapter will explain the research design for collecting the data to test these hypotheses.

C H A P T E R III

HYPOTHESES

Now that the problem of study and the key concepts have been defined, and the literature has been searched for guidance in stating hypotheses to be tested, the hypotheses of this study can be stated.

As stated earlier, the research to date on technology and communication patterns has tended to deal only with the relationship between technology and the directionality dimension of communications within organizations, and even then ignoring the diagonal direction. Consequently, the relationship between technology and communication patterns remains virtually uncharted, and at this stage of researching the relationship, hypotheses must be general in nature. The purpose of this study was to begin to develop an understanding of the relationship between an organization's technology and the communication patterns which emerge in the organization.

Therefore, hypotheses were formulated to help explore communications along several of the basic dimensions:

(1) Directionality of communications

- Who initiates? Who receives? Why this person?
  - immediate superior or higher in the hierarchy?
  - peers in the same work group or outside-the-group peers?
  - indirect superiors in same department or another department?

(2) Timing of communications

- how frequently do people communicate?
- what is the duration of communications?

(3) Media employed in the communications

- verbal use of words
- written use of words
- signs, e.g., body movements, whistling
- signals, e.g., dials, lights
- objects, i.e., the work piece for the task

(4) Purpose of communications

- information needed to do the tasks as prescribed
- stimulus to do various tasks of the job
- problem-solving of non-routine aspects of the job
- learning new aspects/tasks of the job
- alerting the existence of a crisis
- feedback on results of the job
- social

The general working hypothesis for this research is that an organization's technology influences the nature of the communication patterns in the organization. The specific working hypotheses are stated below, followed by a brief theoretical rationale.

Hypothesis H_1. As the degree of certainty in the organization's technology increases (i.e., as the number of exceptions enccuntered decreases and the problems encountered become more analyzable), the ratio of vertical to horizontal task-related communications increases under normal conditions (i.e., non-crisis conditions).

Rationale. This hypothesis is the one suggested rather commonly in the literature, and its rationale was thoroughly explained in the previous chapter. The argument will be summarized below. The hypothesis states that as the certainty of the organization's technology increases, vertical communications will become more important than horizontal communications in completing the task; the reader should note that this hypothesis does not relate to social or non-task-related communications.

Utilizing Perrow's technology construct, as the number of exceptions drcreases and the problems become more analyzable (i.e., as the technology increases in certainty), one would expect the tasks to become more defined and probably more independent. Hence the worker in more certain technologies would have a decreasing need to communicate with fellow workers (i.e., horizontal communications), but the worker would have a continuing need to communicate with superiors and subordinates (i.e., vertical communications) in order to know what task to do when and to pass along information needed to both perform the task and make decisions. Thus, as the need to communicate horizontally declines and the need to communicate vertically does not decline, the ratio of vertical to horizontal communications should increase.

Hypothesis H_2. As the degree of certainty in the organization's technology increases (i.e., as the number of exceptions encountered decreases and the problems encountered become more analyzable), the ratio of vertical to diagonal task-related communications increases under normal conditions (i.e., non-crisis conditions).

Rationale. This hypothesis states that as the certainty of the organization's technology increases, vertical communications will become more important than diagonal communications (i.e., interdepartment communications) in completing the task. Again, the hypothesis does not relate to social or non-task-related communications.

Utilizing Perrow's technology construct, as the number of exceptions decreases and the problems become more analyzable (i.e., as the technology increases in certainty), one would expect the tasks to become more defined and probably more independent, especially when referring to interdepartment comparisons. This statement is supported by Thompson's idea of organization rationality, which says that sophisticated organizations attempt to buffer out the effects of the environment, which includes other departments. Hence, the worker in more certain technologies would have a decreasing need to communicate with workers in other departments (i.e., diagonal communications), but the worker would have a continuing need to communicate with superiors and subordinates (i.e., vertical

communications) in order to know what tasks to do when and to pass along information needed to both do the task and make decisions. Thus, as the need to communicate diagonally decreases and the need to communicate vertically does not decline, the ratio of vertical to diagonal communications should increase.

Hypothesis H_3. As the degree of certainty in the organization's technology increases (i.e., as the number of exceptions encountered decreases and the problems encountered become more analyzable), the volume (i.e., frequency and duration) of required interpersonal task-related communications decreases under normal conditions (i.e., non-crisis conditions).

Rationale. This hypothesis relates to the need to communicate in order to complete tasks, and the communications can be in any direction using any medium but do not include social or non-task-related communications.

Utilizing Perrow's technology construct, as the number of exceptions decreases and the problems become more analyzable (i.e., as the technology increases in certainty), one would expect the tasks to become more defined and thus reduce the need for people to communicate to complete the tasks. Since fewer exceptions are encountered as the certainty increases, the frequency of task-related communications should decline since they are no longer as necessary for people to

know what to do. Once the workers learn their tasks, there is little need to communicate as they perform the tasks, since the tasks are so routine and repetitious each day. Then, too, because the problems which are encountered are more analyzable, the communications which are necessary regarding problems should become shorter in duration.

> Hypothesis H_4. As the degree of certainty in the organization's technology increases (i.e., as the number of exceptions encountered decreases and the problems encountered become more analyzable), the task-related communications media shift from verbal, signs (e.g., body movements), and objects (i.e., the work piece) to written and signals (e.g., dials) under normal conditions (i.e., non-crisis conditions).

Rationale. This hypothesis relates to the prediction that different media tend to be used for task-related communications in different technologies, because they are more suited for particular kinds of technologies. As with the first three hypotheses, this hypothesis does not relate to social or non-task-related communications.

Utilizing Perrow's technology construct and the case studies analysis by Meissner (see p. 48), the technologies of low certainty (i.e., many exceptions and unanalyzable problems) must utilize many types of communications media in order to convey the complex ideas needed to solve the frequent and difficult problems, but sophisticated media do not

offer the necessary flexibility. Thus one would predict a frequent usage of the verbal medium, but also communications via signs and objects may be necessary in order to transmit the necessary information. On the other hand, signal and written media are too inflexible for the dynamic environment of low certainty technologies. In low certainty technologies, the information which must be transmitted to complete the task is often uncertain as to its complete form; hence, signal devices cannot be designed and written messages may be too slow to handle the frequent exceptions encountered.

In technologies of higher certainty, the infrequent and analyzable problems make for a rather static environment, and hence the more inflexible and more sophisticated signal and written media can be utilized. It does seem reasonable to use these more sophisticated media as soon as possible because of the increased accuracy of transmission and reception which can accompany them. Thus one would predict a growing use of written and signal media with a declining use of verbal, sign and object media as the technology increases in certainty and thus becomes more inflexible.

> Hypothesis H_5. As the degree of certainty in the organization's technology increases (i.e., as the number of exceptions encountered decreases and the problems encountered become more analyzable), the purposes of various communications channels become increasingly specialized under normal conditions

(i.e., non-crisis conditions); e.g., downward vertical communications tend to be for giving orders and instructions, upward vertical communications tend to be for supplying information for decisions, and horizontal communications tend to be for satisfying social and non-task-related needs.

Rationale. This hypothesis relates to the prediction that greater certainty in the organization's technology tends to produce a more highly structured organization. In this hypothesis both task-related and non-task-related communications are addressed; the focus is on the purpose for which the various communications channels are used.

Utilizing Perrow's technology construct, as the number of exceptions decreases and the problems become more analyzable (i.e., as the technology increases in certainty), one would expect the responsibilities of various organization members to become better defined. Then people should know who to contact when dealing with a certain kind of information, and the organization would be capable of defining which people should have certain kinds of information. For example, the people higher in the organization would know more about the overall operation of the technology, and they would be the most logical organization members to give orders because of this knowledge of the overall operation. Thus, one would predict that stimuli to perform tasks would flow in the downward vertical channel if the organization has a higher cer-

tainty technology. In a low certainty technology, the people higher in the organization may not have all of the information necessary to handle the frequert exceptions; thus one would predict stimuli might flow more in an all-channel pattern.

As for upward vertical communications in a high certainty technology, the information needs to get to the people higher in the organization if they are to give orders and make decisions. Thus, one would predict information transmission to be the purpose for upward vertical communications in technologies of high certainty. On the other hand, in low certainty technologies the information would flow in all directions depending on who needed information to deal with the exception at hand and who had the needed information.

Finally, since the structured nature of usage of the various communication channels leaves little need for horizontal task-related communications in high certainty technologies, it would seem logical to predict that peers who are physically close would communicate for non-task-related reasons. Again, in low certainty technologies, social communications would tend to flow in all directions due to the low structure associated with the various channels of communications.

In short, this hypothesis predicts a more structured use of each communications channel in the high certainty technology than in the low certainty technology. Such structure

would appear more efficient than a non-structured use of the channels, and this structure is more feasible in the more static high certainty technology than in the dynamic low certainty technology.

Summary

The five hypotheses stated above deal with important dimensions of communication patterns. These hypotheses are summarized pictorially in Figure 3-1 (p. 61). Tests of the hypotheses should help in beginning to understand the relationship between organizational technology and communication patterns. The next chapter will explain the methodology to be employed in collecting the data necessary for testing these hypotheses.

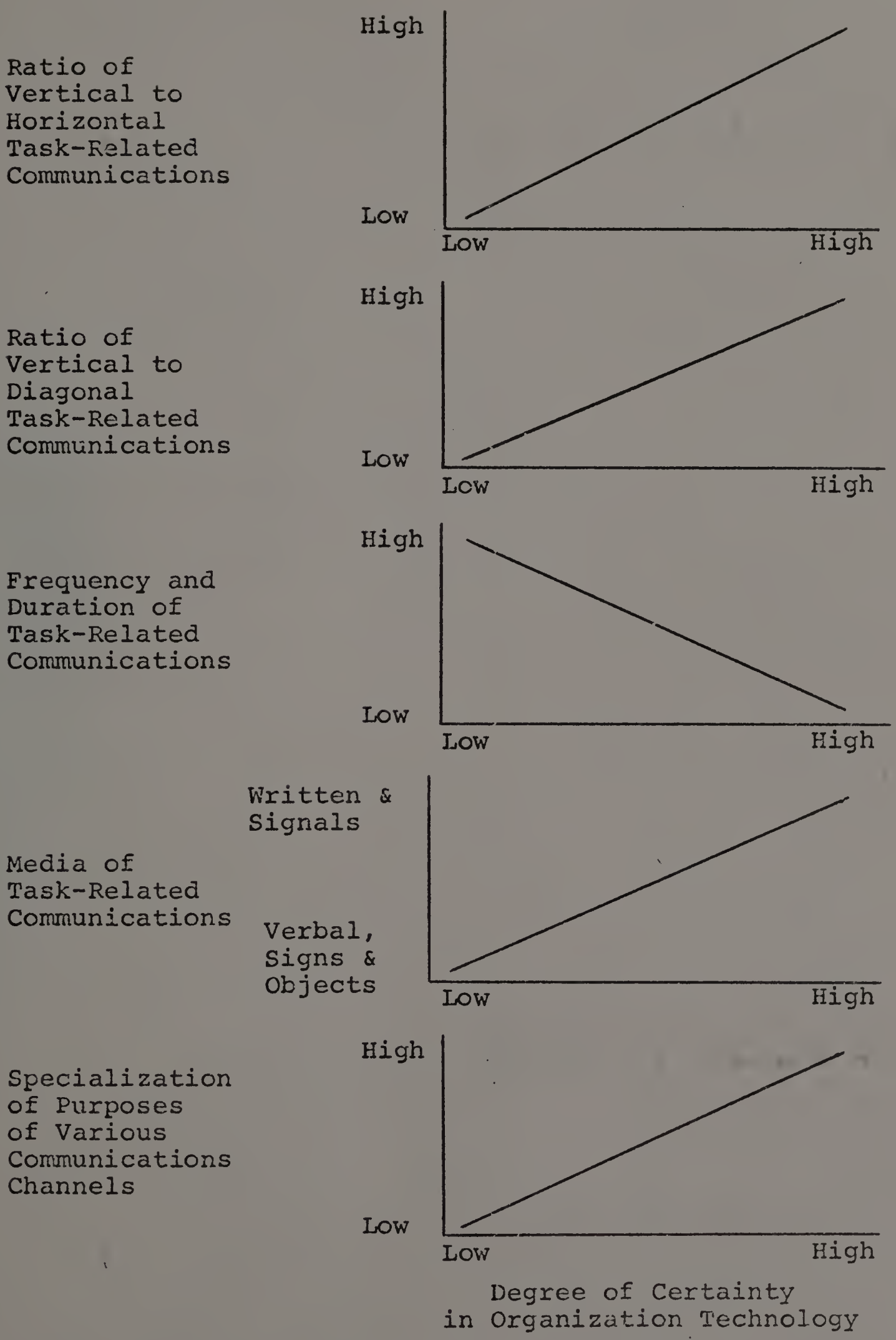


Figure 3-1. Pictorial Summary of the Five Specific Working Hypotheses of this Research

C H A P T E R IV

METHODOLOGY

This chapter will present the methodology which was developed to collect the data for testing the hypotheses stated in the previous chapter. It will cover the following areas: (1) choice of the type of research, (2) description of the subject organization, (3) choice of the specific methodology used, (4) description of the steps in the methodology, and (5) assessment of the strengths and weaknesses of the methodology.

Type of Research

The type of research which made the most sense for beginning to chart the relationship between organizational technology and communication patterns was field research. It would have been virtually impossible to simulate in the laboratory the stiuations created by the technology employed in ongoing organizations, especially since so little is known about the relationship under study. Also, since communication patterns imply a relatively fixed, continual and regular communication relationship, the time constraint of laboratory research would not have allowed the full development of communication patterns such as already exist in ongoing organizations (Thompson, 1956).

In order to gather the data necessary to test the five hypotheses stated in the previous chapter, an in-depth analysys was conducted in three departments of one ongoing organization--each department employing a different technology. One organization was chosen over three separate organizations so that the researcher could better control for other variables besides technology which might influence communication patterns. Such variables as organization structure, personal characteristics of the people, leadership style, and organization climate can also influence communication patterns, but these variables are more likely to be similar in the different technologies if the three technologies are contained within one organization. Nevertheless, data was collected on these variables so that similarities and differences could be reported. The author also recognizes that there may be some interdependence of technologies contained within the same organization such that the technology of one department may influence the communications of another separate department. It was felt that this influence from interdependence should, however, not be as great as the influence exerted by the unit's own technology, but this statement is difficult to support given the knowledge level of the relationship between technology and communication patterns. Therefore, the researcher employed a crude test based on the ratio of intra-departmental communications to inter-departmental communications being greater than one.

Another weakness of using one organization is, of course, the lack of generalizability of the findings. The author believes that this weakness is not serious when one recognizes that this research is of an exploratory nature and that this weakness is necessary in order to gain acceptable control over other possible influences on communication patterns, besides technology. In short, the advantages of studying three technologies in one organization seem to outweigh the disadvantages, and more will be said about assessing the methodology later in this chapter.

The Subject Organization

The organization studied in this research is a home for veterans of American wars. The home is a Massachusetts state agency and was built in 1952 with a new wing added in 1971. The home is a rather complete health facility; even dental services and facilities for minor surgery are provided. The staff consists of 300 people, 175 of whom are nursing personnel serving nine wards. The remainder of the staff is made up of resident physicians, laboratory technicians, physical therapists, maintenance personnel, kitchen personnel, housekeepers, laundry personnel, business office staff, and administrators (see organization chart in Appendix I, p. 194 The home has 300 beds of which 280 are routinely occupied by men and women averaging 70 years of age. The residents fall into one of several categories: dormitory residents who have

no other place to live (normally 60-70 people), extended care patients who choose not to live in nursing homes (normally 180-190 people), and hospital patients who are very sick or have had operations (normally 20-30 people). In addition, the home services approximately 17,000 people per year on an out-patient basis.

The three departments in the home studied in this research were:

(1) Kitchen--employing 28 people (19 on duty each day) in a technology characterized by few exceptions and relatively analyzable problems, i.e., a routine technology.

(2) Business Office--employing 11 people in a technology which serves to link people and services and is characterized by a moderate number of exceptions and moderately analyzable problems, i.e., a mediating technology.

(3) Cronic-Acute Patient Ward--employing 14 people (11 on duty each day) in a technology characterized by many exceptions and relatively unanalyzable problems, i.e., an intensive or a non-routine technology.

A pre-test of these classifications was conducted via a four-item questionnaire devised by Lynch (1974) and based on Perrow's two-dimensional technology construct (see Appendix II, p. 197-198). An F-ratio of 1.3 (p=.29) was recorded, and the scores of the three departments ranked in the predicted order (i.e., Kitchen 14.58, Business Office 13.10, Patient Ward 12.75--the higher score meaning fewer exceptions and more analyzable problems).

Choice of the Specific Methodology

Before deciding on the particular methodology, a number of alternatives for gathering the behavioral data needed in this research were explored: (1) only questionnaires and interviews, (2) critical incident, (3) diary, (4) activity sampling, (5) unstructured observation, and (6) structured observation.

Paper and pencil questionnaires and interviews using pre-established questions certainly offered the most convenient method of collecting vast amounts of data; however, one must always question the validity and reliability of this methodology since it depends entirely on respondent perceptions. Therefore, this methodology is most appropriate when one wishes to study perceptions of people or when one is reasonably certain that people's perceptions correspond well with the reality of their behaviors. It was unlikely that this statement would apply to the behaviors which were the subject of this research, as was pointed out in a pilot test of the data collection instruments. During the pilot test the researcher, using an observer coding scheme (see Appendix III, p. 199), observed 222 communication interactions involving the observee, but the observee in responding to page 1 of the questionnaire (see Appendix IV, p. 200) could recall only 10 of those interactions. The respondent did, however, agree with the observer in the perceptions of those

10 interactions. Nevertheless, this page of the questionnaire was eliminated from the final questionnaire due to its low reliability. Finally, questionnaires and interviews alone were inappropriate for this research because so little is known about the relationship between technology and communication patterns that it was difficult to even decide the questions to ask a respondent.

The critical incident methodology which allows for intense probing of certain aspects of a work situation was eliminated for much the same reasons as the questionnaire and interview methodology, because it depends heavily on both of these mechanisms. In relation to this study, another disadvantage of this method was that it focuses on special activities and can consistently ignore important parts of a work situation (Mintzberg, 1973). In beginning the charting of an unknown relationship, this handicap seemed especially dangerous.

Another method, the diary method, has as its major advantage the offering of an efficient way to collect data about the time distributed among known job factors, but it was eliminated because it is not extremely helpful in defining new dimensions of a problem and because it offers problems with interpretation, consistency and reliability (Stewart, 1967). Also, for those working in certain technologies (e.g., the Kitchen in this study), the diary method is highly impractical due to the nature of the work.

Activity sampling which is a highly efficient method of studying observational aspects of a work situation is also weak in helping to develop new dimensions of a problem. In this method the researcher, who records the data, is not continuously exposed to the activities, and this makes interpretation of complex relationships difficult (Kelly, 1964). The relationship under study not only appeared complex, but it was also little understood. These two facts suggest that activity sampling may be more appropriate for followup studies when the dimensions of the relationship between technology and communication patterns are better understood.

Finally, both unstructured and structured observation allow the researcher to develop understandings of new dimensions of a relationship and to probe the relationship. The major advantage of unstructured observation is that it allows the purely inductive development of theory, but it suffers severely in that the research cannot be replicated and that the researcher is subject to extreme bias in recording the myriad of activities which occur. Structured observation appears to maintain to a high degree the major advantage of unstructured observation while also eliminating its major disadvantage of non-replicability. The major problems of structured observation are the inefficient use of the researcher's time in terms of the attainable sample size and the difficulty in understanding some of the events which occur before the

researcher's eyes (Mintzberg, 1973).

If, however, structured observation is combined with questionnaire and interview probing of the observed phenomena, the difficulty in understanding some of the events observed can be overcome while also overcoming some of the shortcomings of questionnaire and interview data and validating the questionnaire. The researcher felt the the inefficiency in terms of sample size of this combined methodology was simply part of the price one had to pay to study systematically and comprehensively an uncharted relationship, such as the one between technology and communication patterns. Therefore, this combination of structured observation and questionnaire/interview was the methodology chosen for this research. The details of the methodology are explained in the next section.

Description of the Methodology

The methodology used in this study is outlined in Table 4-1, p. 70, and is explained in the following pages. The initial phase of the research consisted of three days of interviews, one day in each technology. The purpose of the interviews was to gain a better understanding of the three technologies and associated organization members, as well as to explain the research procedure to the people who would be involved in the research. The author believed that an understanding of the research by those involved would not alter the

Table 4-1. Schedule of Data Collection

Phase	Day	Description of Activity
1	1	Initial interviews/tour/explanation of research in Technology #1 (Kitchen).
	2	Initial interviews/tour/explanation of research in Technology #2 (Business Office).
	3	Initial interviews/tour/explanation of research in Technology #3 (Ward).
2	4	Structured observation of one worker in Technology #2 followed by worker completing the questionnaire and feedback of observations.
	5	Same as day #4 except in Technology #3.
	6	Same as day #4 except in Technology #1.
	7	Structured observation of two workers in Technology #3 followed by the workers completing the questionnaire and feedback of observations.
	8	Same as day #7 except in Technology #1.
	9	Same as day #7 except in Technology #2.
3	10	Administration of questionnaire to additional workers in Technology #1 or repeat of day #7 with two additional workers in Technology #1.
	11	Same as day #10 except in Technology #2.
	12	Same as day #10 except in Technology #3.
4	13-17	Re-observation of initial three workers in Technology #1 and structured observation of the people they communicate with most frequently followed by administration of the questionnaire and feedback of observations.
	18-22	Same as days #13-17 except in Technology #2.
	23-27	Same as days #13-17 except in Technology #3.
5	28	Administration of the questionnaire to people encountered in the communication pattern in Technology #1 who have not already completed the questionnaire.
	29	Same as day #28 except in Technology #2.
	30	Same as day #28 except in Technology #3.

existing communication patterns but, on the contrary, believed it would make people more aware of their own communication patterns and less likely to alter those patterns. Thus the researcher believed this openness would assist in obtaining an accurate picture of the true communication patterns. These interviews also served to acquaint the researcher with the work flow and various tasks along the work flow. A tour of each department provided an opportunity to meet the people who were involved in the research and allowed those people to meet the researcher as well. Finally, demographic data on each department was collected, including its functions, its work flow, its organization structure, and its general environment.

The second phase of the research was conducted over days 4-9 and included structured observation of three workers in each technology (one observed three hours and two observed one and one-half hours each). As a check on the observation reliability, the researcher employed on a spot-check basis simultaneous co-observers throughout the data collection period. On four separate occasions co-observers observed the workers simultaneously with the researcher, and their observations were compared with those of the researcher as a check on observer reliability. The initial observees were chosen from workers who perform key jobs in the work flow, as identified by the department

supervisor. At the end of the observation period, each worker was asked to complete a questionnaire and was given feedback as to the interactions the researcher observed during the observation period. Appendices III and IV, pp. 199-212, include a copy of the observer coding scheme which was employed by observers and a copy of the questionnaire which was completed by the workers. Both were pilot tested in a local business office and found to be both workable and useful in collecting the desired data. The researcher used the observer sheet as a guide to recording factual data about the communication patterns, but he also made notes about why the pattern seemed to exist as it did and asked clarifying questions as necessary to help in this understanding. Care was taken by the observers to avoid influencing what the workers did. In line with Perrow's technology construct, data was collected as to the number of exceptions encountered and the analyzability of problems in each technology. Exceptions were counted from the observer coding scheme as the number of times the observees initiated communications before determining the next task to perform, and unanalyzability of problems was determined from the observer sheet by the number of times the observee communicated for the purpose of problem solving.

At the end of the observation period, the researcher asked the observee to complete a questionnaire which

probed the worker as to why the pattern exists as it does and asked descriptive questions about the pattern. Demographic and leadership climate data had already been collected from the people in the three units, and this data allowed the three technologies to be compared on the basis of other variables which may alone or in conjunction with the technology affect communication patterns. It was felt that similarities and differences in variables such as leadership climate and personnel characteristics across the technologies would allow the researcher to better understand the impact of technology on communication patterns. The questionnaire data served to check if the worker's perceptions of his/her contacts during the day corresponded with the researcher's observations, i.e., a check on the validity of the questionnaire data. The feedback allowed the observee to help enlighten the researcher and served to maintain the observee's confidence in the researcher's purpose.

The third phase (days 10-12) allowed for either administering the questionnaire to the remaining people in each technology or observing two additional people in each technology. The choice was made on the basis of checking the correspondence between the questionnaire data and the observation data. If the correspondence was good, the researcher planned to simply administer the questionnaire to those remaining in each technology and thus be finished with

the data collection. While the correspondence was not that bad, the researcher decided the wealth of additional information gained from observation was too important to simply stop the observations after observing only three people in each technology. Thus the third phase consisted of observing two more workers in each technology, asking them to complete the questionnaire, and giving them feedback on their activities.

The fourth phase (days 13-27) included re-observation of the original three workers in each technology as well as structured observation and administration of questionnaires to key people in the communication patterns of the original three workers. That is, three people who the original workers seemed to communicate with most frequently were selected for observation. Each of these people was observed for one and one-half hours, asked to complete the questionnaire, and given feedback on what the researcher observed. This procedure allowed the communication pattern surrounding the original three workers to be extended so that a better understanding of the communication pattern in the unit could be developed.

The fifth and final phase was conducted over days 28-30 and included administering the questionnaire to any people already encountered in the communication patterns but who had not yet completed the questionnaire. In other words, the fifth phase was designed to allow for checking to be sure

that all the needed data had been collected.

To summarize, the number of people observed and given the questionnaire in each technology was as shown in Table 4-2.

Table 4-2. Number of People Observed in Each Technology

Phase	Days	Kitchen	Business Office	Ward
1	1-3	0	0	0
2	4-9	3	3	3
3	10-12	2	2	2
4	13-27	14	6	9
5	28-30	0	0	0
	Total	19	11	14

Assessment of the Methodology

As with any methodology which might be developed to study the relationship between technology and communication patterns and which has a limit on resources available, there were certain tradeoffs which had to be made. The primary tradeoffs considered in this methodology involved several factors: (1) observing a person long enough to begin to understand the communication pattern surrounding that person, (2) observing a person repeatedly in order to have confidence in the reliability of the observations, and (3) observing a sufficient number of people within the same technology to gain confidence that the aggregated patterns are truly representative of communication patterns in that technology. One might say that with the methodology described

above too few people are observed for too short a time, but the researcher believes enough data was generated to begin developing an understanding of the relationship between technology and communication patterns. In fact, some people might think that so much data was generated as to inundate the researcher, but the structured nature of the observations helped in categorizing and interpreting the meanings of the many activities observed.

Weaknesses of the Research. That is not to say that there were not weaknesses in the research design. The major weaknesses are that the study included only one unit of each type of technology and the researcher could not fully control for other variables which might affect communication patterns besides technology. Other weaknesses are that the departments studied represent only a limited range of technologies and that the possibility of bias existed because the researcher was also the primary observer.

These weaknesses are primarily a result of the study being exploratory. The structured observation methodology is not the most efficient use of the researcher's time in terms of sample size, but the author believes it was the most efficient in terms of the detailed information which was gathered about an uncharted relationship. Gathering data in one organization and in one unit of each technology does not allow the researcher to generalize the findings, which is always desirable in theory building. One cannot be certain

if the three departments studied are representative of other departments using similar technologies. With only one unit of each type of technology, it is always possible that these units are somehow unique from other units with similar technologies.

The weakness associated with the researcher's inability to control other variables besides technology which might affect communication patterns is related to the small sample issue of exploratory research, but it is also related to the difficulties encountered in conducting organizational research since organizations are such complex entities. Had the research been conducted in several units of each type of technology, it would have been easier to attempt to control for differences in leadership style, organizational climate, and other variables which might affect communication patterns. It may be that an organization's technology sets some boundaries within which the organization's leadership style and climate may fluctuate, and these variables in turn affect the communication patterns which emerge. But this research only allows the researcher to speculate and propose this question for future research.

The problem of studying organizations is indeed difficult due to their complexity. There exist many variables which individually and interactively affect such emergent subsystems as communication patterns, and to date the research tools to study such entities are rather crude. Nevertheless,

because organizations are complex, one must initially go to the organizational setting to conduct realistic studies, and then the complexity and lack of control over variables make the research extremely difficult. In thoroughly studying organizational communication patterns, one needs to consider not only technology but also division of work, needs for boundary spanning, organization rules, stability of the situation, leadership style, people characteristics, the hierarchy, the climate, individual competencies, mobility of organization members, spatial distance of organization members, and perhaps other variables not as yet determined. Needless to say, the task quickly becomes complicated and demands many resources and sophisticated questions. This study lacked such resources and because of the state of knowledge of the relationship under study lacked the sophisticated questions.

Another weakness was that the three technologies studied represent only a limited range of technologies. This raises the question of whether one would find the same indication of linear relationships as indicated in the findings stated in the next chapter if the study included even more certain technologies than the Kitchen and even less certain technologies than the Ward. That is, might some of the relationships found in this research tend to take on a curvilinear nature if the technology variable were extended beyond the range included in this study. The findings of this research must

therefore be confined to the range of technologies studied, and even then there are some questions because of there having been only one unit of each type of technology.

Finally, there did exist the potential for bias in the data collected, since the researcher was also the primary observer. For this reason co-observers who did not know the specific working hypotheses were used on four occasions, and their observations were compared with those of the researcher as a check on objectivity. The comparisons were quite good thus indicating negligible bias. More will be said about this issue in the next chapter.

Strengths of the research. Several strengths are found in the design for this study. The major ones are that this methodology provides for a systematic beginning to the study of a complex subject and that it allows for the inductive building of theory. Another strength is that the in-depth analysis of a small sample of technologies provides the opportunity to gather information which is rich in detail and hence useful in the embryonic stage of theory building.

The primary advantage to the methodology described above was that it allowed a systematic approach to a complex phenomenon. It was an initial probing of a complex subject which should lead to research questions and hypotheses as well as diagnostic techniques and a questionnaire useful for further research. Another advantage was that the researcher recorded much of the data, thereby allowing a chance to check observee

perceptions against a researcher's observations. In other words, the methodology did not depend solely on perceptions of the subjects as the source of the behavioral data needed.

Another major advantage to the methodology was that it allowed the inductive development of theory. Some categories of data were determined prior to the data collection based on literature of the field, but some of the categories were also determined by what happened before the researcher's eyes. In fact, some of the methodology itself was determined by the data which was collected as the research progressed and knowledge increased. As Mintzberg (1973, p. 277) says, "Early use of the highly structured forms of research that presuppose much knowledge of the subject and that do not enable the researcher to create new structure as he goes along is likely to perpetuate the naive views we now have of managerial work." The same can be said for the role that technology plays in influencing the dynamics of organizational life.

The richness of the information which was gathered by following the structured observation and questionnaire/interview methodology yielded exciting insights. In the process of searching out the links between technology and communication patterns, the researcher discovered potential explanatory interactions among these and other variables, such as leadership style, organization climate, mobility of organization members, and spatial distance among organization members. Certainly such information and methodology is in accord with

the systems nature of organizations. The findings resulted in the development of hypotheses, methodologies and the presentation of actual facts regarding how people communicate in various technologies. These results, which are presented in the next two chapters, help to define the importance of the technology variable in theories of organizations and of organization development, and they suggest ways of incorporating it into those theories. Thus this research was a factually oriented study based on the theory that is available, but more than that it was an attempt to link two components of the organization model (i.e., the theory related to organization technology and the theory related to communication patterns). An understanding of this linkage will be valuable in understanding organizations and hence valuable to organization development practitioners.

Summary

This chapter has explained the structured observation and questionnaire/interview methodology employed in this research. The use of exploratory field research has been justified, and the subject organization has been described. Finally, the specific methodology chosen has been justified, described and assessed as to strengths and weaknesses. The next chapter will report the results of testing the five hypotheses stated in Chapter III.

C H A P T E R V

RESULTS

The methodology explained in the previous chapter was used to collect the data for testing the five working hypotheses. This chapter will first review the general working hypothesis and the five operational hypotheses. Then several questions related to the validity of the data collected will be addressed, and finally, the results of testing each of the five hypotheses will be presented.

The Hypotheses

The general working hypothesis for this research was that an organization's technology influences the communication patterns which emerge within the organization. The objective of the research was to test this general hypothesis by testing several specific operational hypotheses. The testing of these hypotheses had the additional objective of beginning to refine the relationship between organizational technology and communication patterns by exploring the influence of technology on several of the dimensions of communication patterns.

In order to refresh the reader's memory regarding the five specific hypotheses, they are summarized below. The first two hypotheses, if supported, would indicate a relationship between an organization's technology and the directional-

ity dimension of communication patterns for task-related communications. Support for these two hypotheses would indicate an increasing importance of vertical communications and declining importance of horizontal and diagonal communications as the organization's technology increases in certainty (i.e., as the number of exceptions encountered decreases and the problems encountered become more analyzable). Support for the third hypothesis would indicate a relationship between organization technology and the volume of communications (i.e., frequency and duration). In particular, support for the third hypothesis would indicate a declining need for task-related communications as the technology increases in certainty.

The fourth and fifth hypotheses are related to some important dimensions of communication patterns, which to date have not been researched. Support for the fourth hypothesis would indicate a relationship between an organization's technology and the media utilized for task-related communications; the prediction was that as the technology increases in certainty the media used shifts from verbal, signs and objects to signals and written. The fifth hypothesis, if supported, would indicate a relationship between an organization's technology and the purposes for which the various communication channels are used. In addition, support for the fifth hypothesis would lend support to the prediction that as the certainty of the technology increases the various communications channels become more specialized in terms of the pur-

poses for which they are used. After answering some questions regarding the reliability of the data collected, each hypothesis will be restated and then tested.

Questions About the Data

As reported earlier the data to test these hypotheses was collected in three departments (Kitchen, Business Office, and Cronic-Acute Patient Ward) in a Massachusetts State Home for Veterans of American Wars. The primary sources of data collection were observations of people working in the three departments using an observer coding scheme (see Appendix III, p. 199) and a questionnaire completed by each observee (see Appendix IV, pp. 200-220). Several questions must be addressed as regards the validity of the data which is used to test the hypotheses: (1) What significance level should be set for the statistical tests of the hypotheses? (2) Are the three departments utilizing different technologies? (3) Will the interdependence of technologies contained within the same organization confound the influence exerted by each unit's own technology on communication patterns? (4) How do the three departments compare on other variables which might in addition to technology affect communication patterns, e.g., leadership style, climate, demographics of the people? (5) Are the data collected from observations reliable? (6) What statistics can be utilized to test the hypotheses since the study includes only one of each of the three technologies? Each of these

questions will be addressed in the following pages.

First question. What significance level should be set for the statistical tests of the hypotheses? In analyzing the data of this research, no attempt has been made to establish a level of significance. The reason for this is that the study should be considered exploratory in nature. Therefore, the probability values stated throughout the analysis measure the probability of the test statistic as associated with the null hypotheses. Acceptance or rejection of the findings at the level of significance stated is left to the reader.

Second question. Are the three technologies different? A pre-test of the hypothesis that the three departments do represent different technologies was conducted via a four-item questionnaire based on Perrow's technology construct and employing a five-point scale ranging from "to a very little extent" to "to a very great extent" (Lynch, 1974). The questions are as follows (see also Appendix II, pp. 197-198):

1. Think of all the kinds of events that cause your work. To what extent would you say that you are usually able to anticipate and predict the nature of these events?

2. To what extent do you usually encounter the same kinds of problems in your work day after day?

3. Many jobs require the use of searching procedures of one kind or another to solve the problems encountered. To what extent are

the searching procedures you use similar from one day to the next?

4. To what extent are the work decisions you make similar from one day to the next?

An F-ratio of 1.3 (p=.29) was recorded for these questions, and the scores of the three departments ranked in the predicted order (i.e., Kitchen 14.58, Business Office 13.10, and Ward 12.75--the higher score meaning fewer exceptions and more analyzable problems--complete data in Appendix II, p. 198). A t-test of the three pairs showed the Kitchen and Ward to be different at p=.05, the Kitchen and Business Office to be different at p=.13, and the Business Office and Ward to be different at p=.30. Obviously, one would hope for differences at higher levels of significance than this last level or the overall level, but given that the Lynch questionnaire is in the developmental stages and may therefore not discriminate among different technologies as well as desired, the researcher decided to proceed with the study, armed with observational judgments that the three technologies are different in terms of Perrow's typology.

Observations of the three departments by the researcher, as well as co-observers, supported the decision that the three departments represent different technologies. The Kitchen performs a very routine task of preparing set menus for approximately the same number of people each day. The recipes are well-known by the cooks, and few unexpected events seem to occur. On the other hand, the Ward never knows when

a new patient might be admitted or what may be the problem of the next patient. The patients in the Ward may have serious setbacks at any time and often without notice. The Business Office performs a semi-routine task of ordering supplies, handling the payroll and collecting payments due the Home. They mediate between the Home and its suppliers and creditors and are therefore open to unexpected events as announced via the mail each day or the telephone which may ring at any time.

The researcher did, however, include in the questionnaire administered to each observee two questions which have high face validity in relation to the two dimensions of Perrow's technology construct, and also observational data was collected on the number of exceptions and the analyzability of problems in each technology. The two questions on technology utilized the same five-point scale mentioned above and were stated as follows (see also Appendix IV, pp. 212-213):

> 29. To what extent is your planned work frequently interrupted by unexpected problems?
>
> 30. To what extent do you often need help to solve the unexpected problems you encounter?

The first question discriminated among the three departments at p=0.0, and the second discriminated at p=.04, and the scores of the departments ranked in the predicted order on both questions (Kitchen most certainty - mean scores = 2.5 and 1.9 - followed by Business Office - mean scores = 2.8 and 1.9 - and then Ward - mean scores = 3.8 and 2.7).

The results of the observational data on the number of exceptions and the analyzability of problems is summarized in Table 5-1.

Table 5-1. Observational Data on Exceptions Encountered and Analyzability of Problems in the Three Departments

Technology Dimensions		Department: Kitchen	Business Office	Ward	Total	X^2 df=2	p
Number of Exceptions**	E*	70	38	58			
	O*	34	59	73	166	34.0	.001
Number of Problem Solving Communications	E	31	17	26			
	O	10	31	33	74	26.7	.001

* E = expected frequency, O = observed frequency

** Exception defined as observee initiating a communication and receiving information before the next task is performed.

Again there is strong support that the departments do represent different technologies. Therefore, the researcher is confident that the three departments do indeed have different technologies. The Kitchen is characterized as having the fewest number of exceptions and the most analyzable problems, i.e., the highest certainty. The Business Office is characterized as having a greater number of exceptions and more unanalyzable problems, i.e., medium certainty. The Ward is characterized as having the greatest number of exceptions and the most unanalyzable problems, i.e., the least certainty.

Third question. Will the interdependence of the three technologies substantially influence the communications in

each department? As a crude test of the interdependence influence, the researcher hypothesized that the ratio of intra-departmental to inter-departmental communications would be greater than one. The ratios as determined from the observational data were: Kitchen 7.5:1, Business Office 7.1:1, and Ward 8.3:1. Thus the intra-departmental communications far outweigh the inter-departmental communications, and while this is a crude measure of the effect of technologies of other departments on each of the three departments, the predominance of intra-departmental communications and the fact that the study deals with technology's effect on communications would seem to allow the assumption that the effect of interdependence of technologies does not significantly bias the outcome of the research.

Fourth question. What about other variables besides technology which might affect communication patterns? Data was collected on leadership style, job climate, and demographics of the people by way of a questionnaire administered prior to beginning this study (see Appendix V, pp. 221-225). The data from these questions were used to perform an analysis of variance using F-tests on each question.

The job climate of each department is addressed by questions 1-14 of this questionnaire (see Appendix V, pp. 222-223 and 225), and the responses to these questions do indicate some differences in the climate. Question 3 deals with overall satisfaction in the job and yielded an F-ratio of 1.8

(p=.17), with the Business Office having the most satisfactory climate (mean score = 3.3) and the Kitchen (mean score = 2.6) and Ward (mean score = 2.3) being quite similar. What effect on communications this difference would have is unclear. One might expect to find more social communications in the Business Office, but this study deals primarily with task-related communications.

The questions realted to leadership, questions 15-26 (see Appendix V, pp. 223-225), expose some differences in leadership styles in the three departments. The overall result is addressed by question 26, which yielded an F-ratio of 2.5 (p=.09), with the Business Office (mean score = 3.1) having the leadership style which corresponds with the greatest degree of satisfaction and the Kitchen (mean score = 2.1) and Ward (mean score = 2.3) being quite similar. As regards the leadership dimensions of initiating structure and consideration, the Business Office rates highest on consideration and lowest on initiating structure, while the Kitchen rates highest on initiating structure and lowest on consideration, although not that different from the Ward. These results might be associated with a greater vertical to horizontal communications ratio in the Business Office than in the Ward or Kitchen due to a greater degree of satisfaction with the leadership in the Business Office creating a better atmosphere for vertical communications. It is also possible that the leadership style differences might have an effect on

the purposes for which the various channels of communication are used. Thus, there is some support for the prediction that differences in leadership style may be affecting the communication patterns in the three departments. But are the leadership styles different because of differences in leaders or because of differences in the technologies? The researcher cannot help but wonder if leadership style is not to some extent determined by the organization's technology and believes this area needs to be further researched.

Turning to demographics of the people in the three departments, there was very little difference in the ages of the people ($F=1.3$, $p=.30$) or their length of service ($F=.4$, $p=.69$). In terms of the sex of the people, they were mostly female in the Business Office and Ward and mostly male in the Kitchen, and in terms of education, the Business Office and Ward were quite similar (on average completed professional or technical school) with the Kitchen being quite different (on average completed high school). The overall difference in schooling yielded an $F=6.2$ ($p=.004$), but as other research has shown, technology and education level seem to be highly correlated; Hrebiniak (1974) reported a correlation between technology and education of .78. It appears that different technologies require people with different educational levels, the lower certainty technologies requiring people with more education. Therefore, these differences in educational level are actually part of the technology differences.

In summary then, there do appear to be some differences in the other variables besides technology, and this research cannot effectively control for these variables. This weakness of the study was addressed more fully in the chapter on methodology. More sophisticated research than the present study needs to be performed, research which can take into account the major variables which may affect communication patterns. Needless to say, such research will require the study of many organizations and the use of many resources.

Fifth question. How reliable is the observational data? As mentioned in the previous chapter, there was a potential for bias since the researcher was also the primary observer, and co-observers who did not know the specific working hypotheses were employed as a check on this possibility. On four different occasions the researcher employed simultaneous co-observers in such a way that both the researcher and the co-observer were using the observer coding scheme (see Appendix III, p. 199) to simultaneously and independently observe the same person. This spot-check of the reliability of the observation data was conducted once in both the Kitchen and Ward and twice in the Business Office.

The method for testing the reliability of the observations is identical to that used by Bales (1950) in his early study of small group communications. In essence the test assesses the null hypothesis that observers categorized their observations in like manner, i.e., the null hypotheses being

that the observers were sampling from the same population. The hope is that the null hypothesis can be accepted. Thus, the Chi-Square statistic is used to test the hypothesis, and Bales suggests an acceptable significance level of .50 given the great difficulties associated with comparing people's observations of the same phenomenon. Table 5-2 shows seven of the eight dimensions from the observer coding scheme and the probabilities associated with the null hypothesis for each of the four co-observers on each of the seven dimensions.

Table 5-2. Chi-Square Test of Observer Reliability

Dimensions on Coding Scheme	Probability with null Co-observer #: 1	2	3	4
Direction	.99	.98	.95	.90
Initiation	.95	.90	.65	.83
Media	.95	.85	.90	.99
Purpose	.99	.78	.95	.90
Giver/Receiver	.60	.87	.85	.80
Location	.65	.95	.60	.90
Attention	.85	.75	.65	.06

The duration dimension has been omitted due to the difficulties encountered in recording this dimension. The observers were so busy recording for each interaction the information for all eight categories on the coding scheme that the estimates of duration became mere guesses. In retrospect, it would probably have been easier to have used discrete categories of duration, but the frequency of communications can still be used to test Hypothesis H_3 related to volume of com-

munications. Based on the results shown in Table 5-2, the researcher is willing to accept the reliability of the observation data and proceed to test the specific hypotheses.

Sixth question. What statistical tests are appropriate? If one attempts to utilize aggregates of data to yield unit scores on the dimensions of communications, the resultant N of 3 allows only the use of non-parametric statistics, and even then the probabilities associated with the test statistics are suspect. However, since the research did include observation of everyone who works in the Ward and the Business Office, as well as a sampling in the Kitchen which yields an aggregate representation of a typical day's staffing, the author believes aggregate scores can be utilized. Also, the scores of the individuals (N=44) can be utilized as individual scores to test the hypotheses on the basis that the people in the three departments are in different settings and should yield different mean scores on the various dimensions of communications. Lastly, the communications observed (N=891) can be used as a sample of observations on communications in different settings. Nevertheless, the researcher believes that use of parametric statistical tests is inappropriate and will employ nonparametric tests. If differences related to the specific hypotheses are supported by the observation data, the researcher will conclude that the relationship between an organization's technology and the emergent communication patterns is worthy of further research.

Results of Testing Hypothesis H_1

The first hypothesis was stated as follows:

> As the degree of certainty in the organization's technology increases (i.e., as the number of exceptions encountered decreases and the problems encountered become more analyzable), the ratio of vertical to horizontal task-related communications increases under normal conditions (i.e., non-crisis conditions).

The null hypothesis associated with Hypothesis H_1 is that the ratio of vertical to horizontal task-related communications is not significantly different for the different technologies. Thus, the basic question being asked is if an organization's technology affects the utilization of vertical and horizontal directions of communication flow. A note applying to all of the hypotheses is that no crises were observed during the data collection, and this conclusion was verified several times with people in each department. Therefore, all of the data applies to "normal conditions".

Since the directionality of communication flow is obviously related to the organization's structure (i.e., the categorization of a communication as vertical or horizontal depends on the observee's position in the organization chart), the observed ratio of vertical to horizontal task-related communications must be adjusted for organization structure. If one assumes that an observee has equal opportunity to communicate with all people in the department and calculates a structural vertical to horizontal ratio based on the number

of people vertical and horizontal to the observee, one can then calculate the difference between the observed vertical to horizontal ratio (v/h_a) and the structural vertical to horizontal ratio (v/h_s) (see organization charts for the three departments in Appendix I, pp. 195-196). Then an average difference measure for the three departments ($v/h_a - v/h_s$) can be rank-ordered and correlated with the rank-order of the average technology scores on the Lynch instrument for the three departments. The Spearman-Rank Correlation Coefficient determines the degree of correlation (see Table 5-3).

Table 5-3. Spearman-Rank Correlation Coefficient between Technology and Vertical/Horizontal Communications Ratio

Department	Average ($v/h_a - v/h_s$)	Rank	Average Tech. score	Rank
Kitchen	.88	1	14.6	3
Business Office	2.31	2	13.1	2
Ward	3.77	3	12.8	1
	$r_s=-1$, $p=.17$			

Thus the test of the hypothesis does not agree with the predicted relationship, but indicates that the ratio of vertical to horizontal task-related communications is inversely related to the organization's technological certainty. In other words, the data seem to indicate a relationship opposite to the one hypothesized.

Of course, the question arises as to whether there is a significant difference between vertical to horizontal ratios observed in these three technologies. In order to test the hypothesis that the ratios of vertical to horizontal task-related communications are different for the three technologies (the null hypothesis being that there is no difference across the three technologies), the Kruskal-Wallis one-way analysis of variance by ranks was applied to both the unadjusted v/h_a and the difference measure $(v/h_a - v/h_s)$ for the 44 people observed. The results are as shown in Table 5-4.

Table 5-4. Kruskal-Wallis ANOVA Test of Vertical/Horizontal Communications Ratio in the Three Departments

Kruskal-Wallis H statistic	Degrees of Freedom	Probability under null hypothesis
6.57 for v/h_a	2	.04
3.09 for $v/h_a - v/h_s$	2	.22

Thus the adjustment for structure seems to explain a large portion of the variance, and the observation data does not lend support for the relationship predicted in the first hypothesis and lends only mild support that the ratio of vertical to horizontal task-related communications is different in the different technologies.

Results of Testing Hypothesis H_2

The second hypothesis was stated as follows:

> As the degree of certainty in the organization's technology increases (i.e., as the number of exceptions encountered decreases and the problems encountered become more analyzable), the ratio of vertical to diagonal task related communications increases under normal conditions (i.e., non-crisis conditions).

The null hypothesis associated with Hypothesis H_2 is that the ratio of vertical to diagonal task-related communications is not significantly different for the different technologies. Thus, the basic question being asked is if an organization's technology affects the vertical and diagonal directions of communication flow.

Again the directionality of communication flow is obviously related to the organization's structure, but the adjustment for a vertical to diagonal ratio according to the organization structure approaches zero because the number of potential diagonal people in the Home would include all people outside the subject department (approximately 275 people). Therefore, an average observed vertical to diagonal ratio (v/d_a) for the three departments can be rank-ordered and correlated with the rank-order of the average technology scores on the Lynch instrument for the three departments. The Spearman-Rank Correlation Coefficient determines the degree of correlation (see Table 5-5).

Table 5-5. Spearman-Rank Correlation Coefficient between Technology and Vertical/Diagonal Communications Ratio

Department	Average v/d_a	Rank	Average Tech. score	Rank
Kitchen	7.42	1	14.6	3
Business Office	8.58	2	13.1	2
Ward	9.66	3	12.8	1

r_s=-1, p=.17

Thus the test of the hypothesis does not lend support for the predicted relationship, but indicates that the ratio of vertical to diagonal task-related communications is inversely related to the organization's technological certainty. In other words, the data seem to indicate a relationship opposite to the one hypothesized.

As with Hypothesis H_1, the question arises as to whether there is a significant difference between the vertical to diagonal ratios observed in these three technologies. In order to test the hypothesis that the ratios of vertical to diagonal task-related communications are different for the three technologies (the null hypothesis being that there is no difference across the three technologies), the Kruskal-Wallis one-way analysis of variance by ranks was applied to v/d_a for the 44 people observed. The results are in Table 5-6.

Table 5-6. Kruskal-Wallis ANOVA Test of Vertical/ Diagonal Communications Ratio in the Three Departments

Kruskal-Wallis H statistic	Degrees of Freedom	Probability under null hypothesis
2.04	2	.37

Thus the observation data lend little support for the second hypothesis or for the hypothesis that the ratio of vertical to diagonal task-related communications varies with technology.

In summarizing the first two hypotheses, a close comparison shows that the two may be predicting the same thing, namely that the vertical communications channel becomes more predominant in use as the technology increases in certainty. However, the data collected in this research seem to contradict the prediction and would lead one to predict the opposite relationship, namely that vertical communications become less predominant as the technology increases in certainty. Finally, such hypotheses become difficult to test when one considers the variation of organization structures--an obvious factor affecting whether a communication is classified as vertical, horizontal or diagonal. More will be said in the next chapter regarding these hypotheses about directionality, as well as the relationship between an organization's technology and its structure.

Results of Testing Hypothesis H_3

The third hypothesis was stated as follows:

> As the degree of certainty in the organization's technology increases (i.e., as the number of exceptions encountered decreases and the problems encountered become more analyzable), the volume (i.e., frequency and duration) of required interpersonal task-related communications decreases under normal conditions (i.e., the work tends to be controlled by machines rather than people).

The null hypothesis associated with Hypothesis H_3 is that the volume of task-related communications is not significantly different for the different technologies. Thus, the basic question being asked is if an organization's technology affects the volume of communications required to complete the tasks.

Because of the difficulty in the reliability between observers in estimating the duration of communications, as explained earlier in this chapter, this hypothesis was tested on the basis of the frequency of task-related communications (i.e., the number of communications recorded for each of the 44 people observed). An immediate difficulty encountered is the different sizes of the three departments (Kitchen--19 people usually on duty, Business Office--11 people, and Ward--11 people usually on duty); one cannot simply compare the total numbers of communications observed in the three departments and size presents a two-sided problem. As the number of people in a unit increases, there are more opportunities for each member of the unit to communicate, but in small groups increasing size makes it more difficult to communicate

with all members due to the fixed amount of air time (Cartwright and Zander, 1968). The author believes that this small group influence may not be too applicable for organizational research due to the mobility of organization members. Nevertheless, two tests of the third hypothesis were conducted.

First, the number of task-related communications by each observee was divided by the number of other people on duty in the unit (i.e., the number of potential communication partners). Such a calculation takes into account the greater number of potential communication partners, which might tend to increase the number of communications, especially when people are mobile and moving throughout the department in completing their tasks. The data were used to calculate an average number of task-related communications per colleague for the three departments. These averages were rank-ordered and correlated with the rank-order of the average technology scores on the Lynch instrument for the three departments. The Spearman-Rank Correlation Coefficient determines the degree of correlation (see Table 5-7). Thus the test of the hypothesis does lend support for the predicted relationship, but are the differences shown in the table meaningful?

Table 5-7. Spearman-Rank Correlation Coefficient between Technology and Number of Communications per Colleague by Observees

Department	Average number communications per colleague by observees	Rank	Average Tech. score	Rank
Kitchen	.98	1	14.6	3
Business Office	1.64	2	13.1	2
Ward	2.37	3	12.8	1
	r_s=-1, p=.17			

In order to test the hypothesis that the number of task-related communications per colleague by the observees is different for the three technologies (the null being that there is no difference across the three technologies), the Kruskal-Wallis one-way analysis of variance by ranks was applied to the number of task-related communications per colleague for the 44 people observed. The results are in Table 5-8.

Table 5-8. Kruskal-Wallis ANOVA Test of Number of Communications per Colleague by Observees in the Three Departments

Kruskal-Wallis H statistic	Degrees of Freedom	Probability under null hypothesis
17.99	2	.001

Thus the observation data lend strong support for the third hypothesis if the frequency is measured as the number of task-

related communications per colleague; in other words, as the organization's technology increases in certainty, the number of task-related communications per colleague by the organization members decreases.

The second test of Hypothesis H_3 simply looked at the number of task-related communications by each observee during the observation period. Such an analysis essentially assumes that the mobility influence of increasing size and the limited-air-time influence of increasing size offset one another. The third hypothesis predicts that the number of task-related communications by observees should decline as the technology increases in certainty due to a declining need to communicate to complete tasks. An average number of task-related communications by observees was calculated for each of the three departments, and these averages were rank-ordered and correlated with the rank-order of the average technology scores on the Lynch instrument for the three departments. The Spearman-Rank Correlation Coefficient determines the degree of correlation (see Table 5-9).

Table 5-9. Spearman-Rank Correlation Coefficient between Technology and Number of Communications by Observees

Department	Average number communications by observees	Rank	Average Tech. score	Rank
Kitchen	17.6	2	14.6	3
Business Office	16.4	1	13.1	2
Ward	24.3	3	12.8	1
	r_s=-.5, p=.33			

Thus this test of the hypothesis lends only mild support for the predicted relationship, but the question of whether the differences shown above are meaningful should be addressed.

In order to test the hypothesis that the number of task-related communications by observees is different for the three technologies (the null being that there is no difference across the three technologies), the Kruskal-Wallis one-way analysis of variance by ranks was applied to the number of task-related communications for the 44 people observed. The results are in Table 5-10.

Table 5-10. Kruskal-Wallis ANOVA Test of Number of Communications by Observees in the Three Departments

Kruskal-Wallis H statistic	Degrees of Freedom	Probability under null hypothesis
5.75	2	.06

Thus the observation data lend strong support for the hypothesis that the number of task-related communications varies with technology, but if the frequency is measured as the number of task-related communications by each observee, the predicted direction of the relationship between an organization's technology and the frequency of task-related communications is only mildly supported. More will be said in the next chapter regarding this hypothesis and the complicating variable of organization size. Also, the variable of mobility of an organization's members will be further utilized to help explain

the complication encountered above.

Results of Testing Hypothesis H_4

The fourth hypothesis was stated as follows:

> As the degree of certainty in the organization's technology increases (i.e., as the number of exceptions encountered decreases and the problems encountered become more analyzable), the task-related communications media shift from verbal, signs, and objects to written and signals under normal conditions.

The null hypothesis associated with Hypothesis H_4 is that the media employed are not significantly different for the different technologies. Thus, the basic question being asked is if the organization's technology affects the media used for task-related communications.

This hypothesis will be addressed first by testing the hypothesis that the proportions of task-related communications employing the six observed media differ for the three departments (the null being that there is no difference across technologies). The Chi-Square statistic was used to test this as shown in Table 5-11 (p. 107). Thus the Chi-Square test lends strong support for the hypothesis that different media are employed more frequently in different technologies (X^2=53.6, p=.001).

The next question to answer is which media are most frequently used in each technology; i.e., does the media shift from verbal, signs, and objects to written and signals as one compares the Ward to the Business Office to the Kitchen?

Table 5-11. Chi-Square Test of Frequency of Task-Related Communications Using the Six Media in the Three Departments

Media		Department: Kitchen	Business Office	Ward	Total	X^2 df=2	p
Verbal 1:1	E*	247	159	247			
	O*	235	143	275	653	5.4	.08
Verbal small group	E	14	9	14			
	O	8	13	16	37	4.6	.10
Sign	E	13	9	13			
	O	24	6	5	35	14.7	.001
Object	E	57	37	58			
	O	72	39	41	152	12.9	.01
Telephone	E	12	8	12			
	O	2	16	14	32	17.3	.001
Written	E	26	17	26			
	O	29	21	19	69	3.4	.19
Total		370	238	370	978		

Overall X^2 = 53.6 with 10 degrees of freedom, p = .001

* E = expected frequency, O = observed frequency

Considering first verbal communications, the combination of Verbal 1:1 and Verbal small group categories yields a $X^2=5.53$ with 2 degrees of freedom, p=.07 under the null hypothesis that there is no difference in the use of the verbal medium (see Table 5-11, p. 107). Utilizing the Spearman-Rank Correlation Coefficient to test the directionality of the relationship yields the results shown in Table 5-12. The test lends mild support for the predicted relationship ($r_s= -.5$, p=.33), and the Chi-Square test lends strong support for the hypothesis that there are differences in the proportions of task-related communications employing verbal media in the different technologies.

Table 5-12. Spearman-Rank Correlation Coefficient between Technology and Percentage of Task-Related Communications Which Are Verbal

Department	% Task-related communications that are verbal	Rank	Average Tech. score	Rank
Kitchen	66.5%	2	14.6	3
Business Office	65.0%	1	13.1	2
Ward	79.0%	3	12.8	1
	$r_s=-.5$, p=.33			

Following the same procedure for other media, Table 5-13 (p. 109) can be constructed to show the direction of the relationship between technology and the various media, using the

Table 5-13. Results of Testing Hypothesis H_4 Using Spearman-Rank Correlation Coefficient between Technology and Percentage of Task-Related Communications Using Six Media

Media	% of communications in Kitchen, Business Office and Ward	Spearman-Rank Correlation Coefficient (r_s)	Supports Hypothesis H_4?
Verbal	K 66% BO 65% W 79%	-.5, p=.33	Yes, but only mild support for predicted direction
Sign	K 6% BO 3% W 1%	1.0, p=.17	Yes, but opposite to predicted direction
Object	K 19% BO 16% W 11%	1.0, p=.17	Yes, but opposite to predicted direction
Written	K 8% BO 9% W 5%	.5, p=.33	Yes, but only mild support for predicted direction
Telephone	K 1% BO 7% W 4%	-.5, p=.33	Yes, but only mild support for predicted direction
Verbal and Telephone	K 67% BO 72% W 83%	-1.0, p=.17	Yes, and support for predicted direction

Spearman-Rank Correlation Coefficient. The Chi-Square statistics shown in Table 5-12 for each medium are useful in determining if the differences in usages are significant. To summarize, the tests of Hypothesis H_4 related to sign and object media lend little support for the relationship predicted; in fact, the exact opposite relationship would seem to find strong support in these data (r_s=1, p=.17 for both media, with

X^2 = 14.7, p=.001 for sign and X^2 = 12.9, p=.01 for object). Namely, as the technology increases in certainty, the use of sign and object media also increases. The tests of Hypothesis H_4 related to verbal and telephone media lend only mild support for the predicted relationship when these media are tested separately (r_s= -.5, p=.33 for verbal, with X^2 = 5.5, p=.07, and r_s= -.5, p=.33 for telephone, with X^2 = 17.3, p=.001), but when these two media are combined, there is strong support for the predicted relationship between technology and verbal media (r_s= -1, p=.17, with X^2 = 6.7, p=.04). In other words, as the technology increases in certainty, the use of verbal communications of all forms combined declines. The tests of Hypothesis H_4 related to written media lend only mild support for the predicted relationship (r_s=.5, p=.33, with X^2 = 3.4, p=.19). As the technology increases in certainty, the use of written communications also increases, but there is not that much difference between proportions in the Kitchen and Business Office (8% for the Kitchen versus 9% for the Business Office). It is possible that the usage of written communications is overstated in the Business Office, since written materials constitute the work of the people in the Business Office, and more will be said in the next chapter about this issue and the possible new dimensior of communications which it raises.

Results of Testing Hypothesis H_5

The fifth hypothesis was stated as follows:

> As the degree of certainty in the organization's technology increases (i.e., as the number of exceptions encountered decreases and the problems encountered become more analyzable), the purposes of various communication channels under normal conditions become increasingly specialized; e.g., downward vertical communications tend to be for giving orders and instructions, upward vertical communications tend to be for supplying information for decisions, and horizontal communications tend to be for satisfying social and non-task-related needs.

The null hypothesis associated with Hypothesis H_5 is that there is no difference in specialization of purpose for the various communications channels in the different technologies. The specific sub-hypotheses listed as part of the hypothesis will be tested as a test of Hypothesis H_5.

The first sub-hypothesis stated above was that as the technology increases in certainty, downward vertical communications tend to be used more exclusively for giving orders and instructions (the null being that there is no difference in the specialization of downward vertical communications across the three technologies). The Chi-Square statistic was used to test this hypothesis as shown in Table 5-14 (p. 112). The Chi-Square test lends support to the sub-hypothesis regarding downward vertical communications (overall $X^2 = 26.06$, $p=.01$). The observed frequency for the stimulus purpose exceeds the expected frequency in the Kitchen, is less than the expected frequency in the Business Office and almost equal to

Table 5-14. Chi-Square Test of Frequency of Downward Vertical Communications for the Five Purposes in the Three Departments

Purpose		Department: Kitchen	Business Office	Ward	Total	X^2 df=2	p
Social	E*	31	13	29			
	O*	27	21	25	73	6.0	.05
Information exchange	E	71	29	67			
	O	74	25	68	167	.7	.70
Stimulus	E	61	25	58			
	O	69	16	59	144	4.3	.12
Questions and Problem Solving	E	25	10	24			
	O	14	18	27	59	11.6	.01
Other (Advice, Learn Task, Feedback, Complaint)	E	8	3	9			Expected frequency too small for calculation
	O	12	1	7	20		
Total		196	81	186	463		
X^2 (df=4)		8.5	16.45	1.08			
p		.10	.01	.90			

Overall X^2 = 26.06 with 8 degrees of freedom, p=.01

*E = expected frequency, O = observed frequency

the expected frequency in the Ward, and the $X^2 = 4.30$, p=.12, for the stimulus purpose for downward vertical communications. Referring to Table 5-14, the observed frequency is almost identical to the expected frequency for all purposes in the Ward ($X^2 = 1.08$, p=.90), thus indicating no specialization. The Kitchen shows a greater observed than expected frequency for the stimulus purpose and a lesser observed than expected frequency for the social and questions and problem solving purposes ($X^2 = 8.53$, p=.10), thus supporting the hypothesis that downward vertical communications are used more for giving orders and instructions in technologies of higher certainty. The Business Office also exhibits some specialization in that the observed frequency is less than the expected frequency for the stimulus purpose and greater than the expected frequency for the social and questions and probjem solving purposes ($X^2 = 16.45$, p=.01). This specialization in the Business Office does tend to indicate that there may be specialization of purpose for the various communications channels at all levels of technological certainty; the specialization may just be for different purposes in different technologies. However, before drawing this conclusion, the upward vertical, horizontal and diagonal channels should be considered.

The second sub-hypothesis stated under Hypothesis H_5 was that as the technology increases in certainty, upward vertical communications tend to be used more exclusively for supplying

information for decisions (the null being that there is no difference in the specialization of upward vertical communications across the three technologies). The Chi-Square statistic was used to test this hypothesis as shown in Table 5-15 (p. 115). The Chi-Square test lends support to the sub-hypothesis regarding upward vertical communications ($X^2 = 18.24$, $p=.01$), but the direction of the relationship is not as predicted. The data in Table 5-15 lend weak support to the opposite of the relationship predicted in this sub-hypothesis in that upward vertical communications tend to be used more for information exchange in the lower certainty technology of the Ward than in the higher certainty technology of the Kitchen. The observed frequency of upward vertical communications for the purpose of information exchange exceeds the expected frequency in the Ward and is less than the expected frequency in the Kitchen and equal to the expected frequency in the Business Office, though the difference has a high probability even under the null hypothesis ($X^2 = 1.06$, $p=.70$).

On the other hand, there is only weak support for the hypothesis that upward vertical communications are used in a more specialized manner as the technology increases in certainty, and the specialization is for different purposes than predicted. Referring to Table 5-15, there is a low observed frequency as compared to the expected frequency for the purpose of social in the Ward and for the purpose of stimulus in the Business Office, but this despecialization in both depart-

Table 5-15. Chi-Square Test of Frequency of Upward Vertical Communications for the Four Purposes in the Three Departments

Purpose		Department: Kitchen	Business Office	Ward	Total	X^2 df=2	p
Social	E*	25	21	33			
	O*	31	26	22	79	6.3	.05
Information exchange**	E	41	34	55			
	O	36	34	60	130	1.1	.70
Stimulus	E	15	12	19			
	O	19	3	24	46	9.1	.01
Questions and Problem Solving	E	26	21	35			
	O	21	25	36	82	1.8	.50
Total		107	88	142	337		
X^2 (df=3)		4.07	8.70	5.46			
p		.30	.05	.15			

Overall X^2 = 18.24 with 6 degrees of freedom, p=.01

*E = expected frequency, O = observed frequency

** The 7 communications for the advice and complaint purposes were included in the information exchange category because their small frequency would have made the Chi-Square statistic meaningless in a separate "other" category.

ments seems to be equally spread among the other three purposes in both cases. Thus, in both the Ward and the Business Office there is specialization of upward vertical communications only in that this channel is not used for certain purposes (X^2 = 5.46, p=.15 in the Ward; X^2 = 8.70, p=.05 in the Business Office). The Kitchen does exhibit some specialization in that the observed frequency exceeds the expected frequency for the purposes of social and stimulus, but the differences are not substantially greater than the differences for the other purposes in the Kitchen (X^2 = 4.07, p=.30). So as with the downward vertical communications, the data seem to indicate a necessary revision to the Hypothesis H_5.

The third sub-hypothesis stated under Hypothesis H_5 was that as the technology increases in certainty, horizontal communications tend to be used more exclusively for satisfying social and non-task-related needs (the null being that there is no difference in the specialization of horizontal communications across the three technologies). As with the first two sub-hypotheses, the Chi-Square statistic was used to test this hypothesis as shown in Table 5-16 (p. 117). The Chi-Square test lends support to the sub-hypothesis regarding horizontal communications (X^2 = 43.46, p=.001). The observed frequency of horizontal communications for the purpose of social exceeds the expected frequency by a greater difference in the Kitchen than the Business Office, and the observed frequency is less than the expected frequency in the

Table 5-16. Chi-Square Test of the Frequency of Horizontal Communications for the Four Purposes in the Three Departments

Purpose		Department: Kitchen	Business Office	Ward	Total	X^2 df=2	p
Social	E*	41	21	18			
	O*	46	24	10	80	4.60	.10
Information exchange**	E	58	30	27			
	O	54	21	40	115	9.23	.01
Stimulus	E	29	15	13			
	O	37	7	13	57	6.47	.04
Questions and Problem Solving	E	19	10	8			
	O	10	23	4	37	29.63	.001
Total		147	75	67	289		
X^2 (df=3)		7.35	24.29	11.81			
p		.10	.001	.01			

Overall X^2 = 43.46 with 6 degrees of freedom, p=.001

*E = expected frequency, O = observed frequency

** The 3 communications for the complaint and learn task purposes were included in the information exchange category because their small frequency would have made the Chi-Square statistic meaningless in a separate "other" category.

Ward (X^2 = 4.60, p=.10).

However, the specialization in the Kitchen seems to be greatest in terms of the stimulus purpose while there is obviously low observed frequency of communications for the purpose of questions and problem solving (X^2 = 7.35, p=.10). There also appears to be specialization in both the Business Office (X^2 = 24.29, p=.001) and the Ward (X^2 = 11.81, p=.01), but for different purposes. In the Business Office, the observed frequency of communications for questions and problem solving exceeds the expected frequency and is less than the expected frequencies for stimulus and information exchange. In the Ward, the observed frequency of communications for information exchange exceeds the expected frequency and is less than the expected frequency for social. Thus, there appears to be specialization in all three technologies. In the Kitchen horizontal communications are used more than expected for stimulus and social; in the Business Office they are used more than expected for social and questions and problem solving; and in the Ward they are used more than expected for information exchange. This result does not lend support to Hypothesis H_5, but again it may lend support to a re-statement of the hypothesis.

The final test of Hypothesis H_5 relates to diagonal communications; no specific sub-hypothesis was made, so the question of increasing specialization with increasing technological certainty will be tested for the diagonal communi-

cations channel (the null being that there is no difference in the specialization of diagonal communications across the three technologies). Again the Chi-Square statistic was used to test this hypothesis as shown in Table 5-17 (p. 120). The Chi-Square test lends support to the fifth hypothesis as regards diagonal communications (X^2=42.48, p=.001). However, the data seem to indicate some specialization in all three departments but for different purposes, and the Kitchen shows only a slightly greater degree of specialization, utilizing the stimulus purpose to a greater extent than in the Business Office or Ward (X^2=22.76, p=.001), while utilizing the information exchange purpose less (X^2=15.58, p=.001) and the social purpose less (X^2=6.98, p=.05). In the Kitchen the specialization seems to be for the stimulus purpose; the observed frequency of diagonal communications for the stimulus purpose exceeds the expected frequency but is less than the expected frequency for the other three purposes (X^2=19.83, p=.001). In the Business Office the specialization seems to be for the information exchange purpose; the observed frequency of diagonal communications for the information exchange purpose exceeds the expected frequency, is almost identical to the expected frequency for the social purpose, and is less than the expected frequency for the stimulus purpose (X^2=8.25, p=.05). In the Ward the specialization is less pronounced as it seems to be for both the information exchange and social purposes; the observed frequencies of diagonal communications for information exchange and social purposes exceed the expected

Table 5-17. Chi-Square Test of Frequency of Diagonal Communications for the Four Purposes in the Three Departments

Purpose		Department: Kitchen	Business Office	Ward	Total	X^2 df=2	p
Social	E*	17	10	9			
	O*	10	11	15	36	6.98	.05
Information exchange**	E	18	10	10			
	O	9	14	15	38	15.58	.001
Stimulus	E	31	18	16			
	O	50	10	5	65	22.76	.001
Questions and Problem Solving	E	5	3	3		Too small expected frequency to calculate	
	O	3	6	2	11		
Total		72	41	37	150		
X^2 (df=3)		19.83	8.25	14.39			
p		.001	.05	.01			

Overall X^2 = 42.48, with 6 degrees of freedom, p=.001

*E = expected frequency, O = observed frequency

** The 1 communication for the complaint purpose was included with the information exchange category because its small frequency would have made the Chi-Square statistic meaningless in a separate "other" category.

frequencies, and the observed frequency is less than the expected frequency for the stimulus purpose ($X^2 = 14.39$, $p=.01$).

In summarizing the results of testing Hypothesis H_5, there does seem to be some support for the hypothesis that the various communications channels are used for more specialized purposes as the organization's technology increases in certainty. However, the sub-hypotheses receive only mixed support, and the results of testing the sub-hypotheses suggest the need for a restatement of Hypothesis H_5. Such a restatement will be discussed in the next chapter. Referring to the hypothesis as stated, the stimulus purpose does seem to be a more common purpose associated with downward vertical communications in the Kitchen than is the case for the Business Office and the Ward. Rather than the information exchange purpose being a more common purpose associated with upward vertical communications in the Kitchen, it seems to be a more common purpose of upward vertical communications in the Ward than in either the Business Office or the Kitchen (though there is a 70% chance under the null hypothesis for the calculated Chi-Square statistic). The social purpose does not seem to be a more common purpose for horizontal communications in the Kitchen than in the Business Office, although both employ horizontal communications for social purpose more often than is the case in the Ward. Also, there are certain purposes for which horizontal communications are more common in each department than is the case for the other

two departments. The purpose more common for horizontal communications in the Kitchen than in the other departments is the stimulus purpose; in the Business Office it is the question and problem solving purpose; and in the Ward it is the information exchange purpose. As for diagonal communications the specialization seems to be greatest in the Kitchen with the stimulus purpose being more common in the Kitchen than in the other departments.

Needless to say, this fifth hypothesis is difficult to summarize, and it was difficult to test, though it does seem to be mildly supported by the data. The data do, however, raise the possibility that a more interesting hypothesis is that there may be specialization of purpose for the various communications channels in all technologies, but the specialization may be for different purposes in the different technologies. More will be said about this alternative hypothesis in the next chapter.

Summary

This chapter has presented the results of testing the hypotheses of this study. Prior to presentation of the actual results, several questions regarding the data collection and its validity and reliability were addressed. Then for each of the five hypotheses, the statistical tests used in testing each hypothesis were presented along with an analysis of the meaning of those tests. The results of the tests

do lend support to the general working hypothesis that an organization's technology influences the nature of the communication patterns in the organization, although the exact nature of the influence was not always as predicted. But this failure to a priori predict the correct direction of influence is not disconcerting, since this study was exploratory in nature. The findings suggest important differences in the various dimensions of communication patterns in the different technologies.

The results of testing the first two hypotheses lend some support to the prediction that the extent to which vertical and horizontal communications are employed varies with different technologies, but the issue is confounded by the differences in organization structure encountered in this research. The results of testing the third hypothesis lend support to the prediction that the frequency of task-related communications declines as the organization's technology increases in certainty, but again there are confounding issues--differences in organization size and differences in the mobility of the organization members. The results of testing the fourth hypothesis lend support to the prediction that the media employed for task-related communications varies with different technologies. The data seem to indicate that verbal communications are most important in a low certainty technology, such as the Ward; written and telephone communications are most important in a moderate certainty technology, such as the Business Office; and sign, object and

written communications are most important in a high certainty technology, such as the Kitchen. Finally, the results of testing the fifth hypothesis lend mild support to the prediction that there is a greater degree of specialization of purpose of the various communications channels (downward vertical, upward vertical, horizontal, and diagonal) as the technology increases in certainty. But the data suggest that a more appropriate hypothesis may be that all channels tend to have specialized purposes in each of the different technologies; the specialized purpose of each channel just varies as the technology varies.

The author is sufficiently encouraged by these test results to conclude that the relationship between an organization's technology and its emergent communication patterns is worthy of further research. Needless to say, there are other variables which may also affect the emergent communication patterns; some have already been mentioned--organization structure, organization size, mobility of organization members, leadership climate, and demographics of the organization members. All of these variables must also be addressed before the model is complete. So while it is not correct to say that an organization's technology is the only variable affecting the emergent communication patterns, the data collected in this research indicate that it may be one of the important variables. The next chapter will discuss some of these other variables as related to this research sample, as

well as some alternative and additional hypotheses which grow out of the data collected in this research and which deserve further research. Also, the next chapter will compare the observational data collected to the questionnaire data collected.

C H A P T E R VI

ADDITIONAL ANALYSIS AND INTERPRETATION OF FINDINGS

The results reported in the previous chapter did lend support to the hypothesis that an organization's technology does have an impact on the communication patterns which emerge in the organization. The meanings of the resultant findings of this research will be explored in this chapter. Since the research was exploratory in nature, some tentative explanations for the findings will be proposed, and some unanticipated findings from the research will be presented along with new hypotheses to be tested in further research.

As stated in the previous chapter, the results of the first two hypotheses were not in total agreement with the expectations regarding the directionality of communications in the different technologies. An alternative way of stating these two hypotheses will be explored to see if more light can be shed on this dimension of communication patterns. Also, the organization structure variable will be addressed as these hypotheses are reconsidered, since it is obviously related to the directionality assigned to observed communications and since Woodward (1965) has reported research related to the relationship between technology and organization structure.

Next, some additional variables related to the third hypothesis, which regards the frequency of task-related commun-

ications, will be introduced to offer tentative explanations for the results of the test of this hypothesis. These additional variables will be spatial distance between the organization members, mobility of the organization members and interdependence of the tasks of the organization's members. Some of the questionnaire data collected in this research will be introduced to help explain the findings related to this hypothesis.

Regarding the fourth hypothesis, a new dimension of communication patterns will be introduced. This new dimension is related to the lag which exists between the transmission of information and the use of the information. Some tentative explanations for the findings related to the differences in media employed in the different technologies will also be offered.

Then regarding the fifth hypothesis, an alternative statement of this hypothesis will be offered. This hypothesis regarding the specialization of purposes of the various communications channels, is indeed a complicated hypothesis, and the dimensions of this hypothesis have not been fully addressed by this research. Also, the present research has led to the proposal of several new purposes of communications, thus further refining the understanding associated with this dimension of communication patterns. These new purposes will be presented in this chapter.

The final part of the chapter will explore the compari-

son of the observational data and the questionnaire data. The reader will recall that a second objective of this research, in addition to increasing the understanding of the relationship between technology and communication patterns, was the development of more refined methodologies which lend themselves to more sophisticated probing of the relationship between technology and communication patterns. The results of the comparison of the two sets of data as related to the specific working hypotheses will indicate that much of the necessary data for testing such hypotheses as stated in this research can be collected by way of questionnaire data as well as observational data.

Another Look at the First Two Hypotheses

As noted in the previous discussion of the two hypotheses related to the directionality of communications, both are predicting essentially the same thing. Regardless of whether one considers the ratio of vertical to horizontal communications or the ratio of vertical to diagonal communications, one is essentially considering the importance of the vertical communications channel. Consequently, the first two hypotheses of this research could have been stated as follows:

> As the degree of certainty in the organization's technology increases (i.e., as the number of exceptions encountered decreases and the problems encountered become more analyzable), the proportion of communications which are vertical, horizontal and diagonal will decrease, increase and remain the same, respectively.

The null hypothesis associated would be that the proportions of communications which are vertical, horizontal and diagonal are not significantly different for the different technologies.

Then if the data collected in this research were used to test this hypothesis, the results would be as shown in Table 6-1 (p. 130), using the Chi-Square test. The Chi-Square test lends strong support for the hypothesis that the proportion of communications which are vertical, horizontal and diagonal are different in the three different technologies. Then if one notes the Chi-Squares and the observed and expected frequencies for each of the three directions, there is support for the prediction that the proportion of vertical communications decreases as the certainty of the technology increases (i.e., as one compares the Ward to the Business Office to the Kitchen). Also, there is support for the prediction that the proportion of horizontal communications increases as the certainty of the technology increases and for the prediction that the proportion of diagonal communications is unaffected by the change in technological certainty. These results can also be depicted as shown in Figure 6-1 (p. 130), and this new hypothesis dealing with directionality should be tested in further research.

However, as mentioned in the previous chapter the categorization of communications as vertical, horizontal and diagonal is directly related to the organization's structure.

Table 6-1. Chi-Square Test of Frequency of Usage of the Three Communication Directions in the Three Departments

Communication Direction		Department: Kitchen	Business Office	Ward	Total	X^2 df=2	p
Vertical	E*	235	119	231			
	O*	217	112	256	585	4.50	.15
Horizontal	E	84	42	82			
	O	99	49	60	208	9.74	.01
Diagonal	E	39	20	39			
	O	42	20	36	98	.46	.50
Total		358	181	352	891		

Overall X^2 = 14.7 with 4 degrees of freedom, p=.01

*E = expected frequency, O = observed frequency

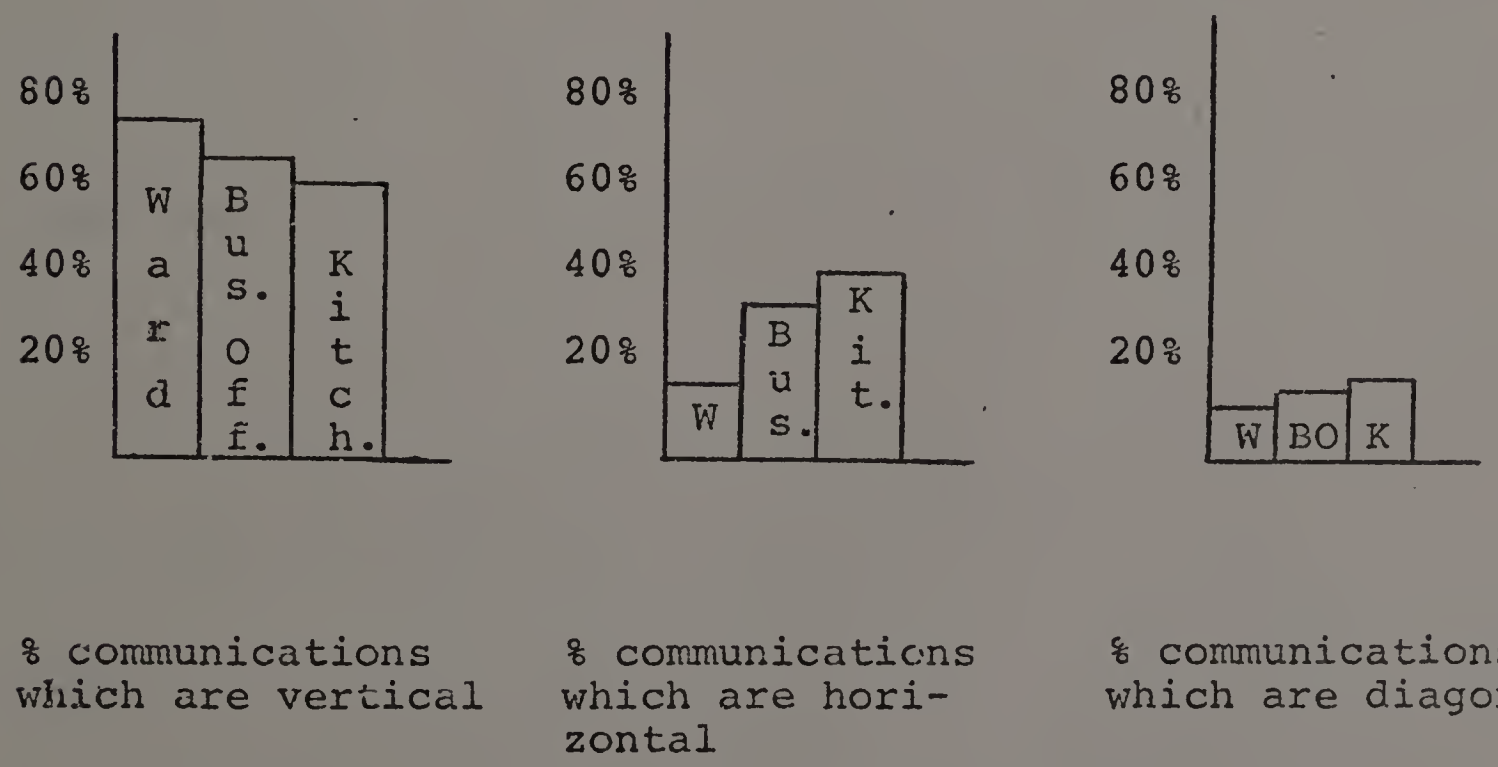


Figure 6-1. Percentage of Communications Which Are Vertical, Horizontal, and Diagonal in the Three Departments

What happens if one considers the fact that the average ratio of the number of vertical positions to the number of horizontal positions surrounding each organization member is different for the three departments? The average ratios are as follows: Kitchen 4.0:1, Business Office 2.3:1, Ward 3.7:1. In other words, on the basis of structure, a communication is about 1.7 times as likely to be vertical in the Ward and the Kitchen as it is in the Business Office. The Kitchen and Ward are both taller structures (5 levels) than the Business Office (3 levels) so that these ratios make sense from a visual inspection of the organization charts (see Appendix I, pp. 195-196).

Therefore, this researcher adjusted the frequencies in the above chart to account for these differences in structure by dividing the observed frequencies of vertical communications in the Kitchen and the Ward by 1.7 and then recalculated the expected frequencies with this correction. Other corrections might be possible, but this one seemed a reasonable way to attempt to adjust for organization structure differences. After this correction the Chi-Square statistics were recalculated as shown in Table 6-2 (p. 132). Even with this correction for organization structure, the new statement of the hypothesis regarding directionality of communications receives strong support from the data. The data collected in this research does not refute the prediction that as an organization's technology increases in certainty the proportion of

Table 6-2. Chi-Square Test of Frequency of Usage of the Three Communication Directions in the Three Departments after Adjusted for Structural Differences

Communication Direction		Department: Kitchen	Business Office	Ward	Total	X^2 df=2	p
Vertical	E*	150	101	138			
	O*	127	112	150	389	5.96	.05
Horizontal	E	80	54	74			
	O	99	49	60	208	7.62	.03
Diagonal	E	38	25	35			
	O	42	20	36	98	1.45	.50
Total		268	181	246	695		

Overall X^2 = 15.0 with 4 degrees of freedom, p=.01

*E = expected frequency, O = observed frequency

communications which are vertical declines, while the proportion which are horizontal increases and the proportion which are diagonal remains constant.

It appears that this finding may have been obscurred in the original statement of the first two hypotheses of this research, which considered the data in ratio form. By considering the ratio of vertical to horizontal communications actually observed and as predicted on the basis of the organization structure, the actual differences between departments were not as apparent in the statistical tests performed as they seem to be when the more simplified Chi-Square test is performed on the basis of proportions of communications which are vertical, horizontal and diagonal. Since the proportion of communications which are vertical decreases and the proportion which are horizontal increases as the technology increases in certainty, the ratio of vertical to horizontal communications should likewise decrease as the data on p. 96 of the previous chapter indicate is the case. Therefore, the Chi-Square tests on the proportions of communications which are vertical, horizontal and diagonal do not yield different results from the original two hypotheses, but this use of proportions makes it easier for one to see the differences in direction of communications as the technology varies.

On the basis of this researcher's experience in the three departments which were the subject of this research, these findings relating to the directionality of communications do

seem compatible with the situations in the three dpeartments. As the technology increases in certainty, there is less of a need for an organization member to communicate with his/her superiors and subordinates. Once the member understands the tasks to be performed in a high certainty technology, the problems encountered in performing the tasks are so infrequent and analyzable that the organization member can receive the help necessary to solve the problems from other organization members at the same organizational level. This certainly appeared to be the case in the Kitchen where the tasks were so routine in nature that there was little need for the organization members to communicate with anyone, and when a need did arise, they were able to resolve the issue with their peers. On the other hand, there appeared to be many exceptions to the routine in the Ward, and the problems were often so difficult to resolve that not only were a large number of communications necessary to perform the tasks, but also it was often necessary to go to one's superior to resolve the problems. In other words, the problems encountered were so unanalyzable that they required help from many levels in the organization in order to be solved.

Revisiting the Third Hypothesis

The reader will recall that the third hypothesis was related to the frequency of task-related communications in the three departments.

> Hypothesis H_3. As the degree of certainty in the organization's technology increases (i.e., as the number of exceptions encountered decrease and the problems encountered become more analyzable), the volume (i.e., frequency and duration) of required interpersonal task-related communications decreases under normal conditions.

The data collected in this research supported the prediction that the frequency of task-related communications decreases as the organization's technology increases, but the variable of organization size did tend to confound the findings, yielding different results for the two different ways of accounting for the size variable (i.e., number of communications per colleague by observees and number of communications by observees). Size is not an easy variable for which to adjust, but the researcher believes that the introduction of several other variables, which should probably be part of the technology construct, can help to explain the confusion introduced by the size variable. These variables are: the mobility of the organization members, the interdependence of the tasks in an organization and the spatial distance between organization members.

First, consider a comparison of the Business Office and the Ward. Both of these departments have 11 people on duty during the work day. Therefore, size cannot have a different effect on the two departments, and yet, the average number of communications by the observees was far different in the two departments (Business Office 16.4 and Ward 24.3). Unfortunately, the Lynch technology questionnaire discriminated between the two with only a $p=.30$. The two questions on

technology introduced by the researcher in the questionnaire (questions 29 and 30, Appendix IV, pp. 212-213) discriminated between the two departments at p=.001, as did the observational data on the number of exceptions and the analyzability of problems encountered. However, the ranking of the three departments was different with the observational data than with the researcher's questions. That is, the observational data showed the Business Office to have the least certain technology, while the researcher's questions and the Lynch questionnaire showed the Ward to have the least certain technology. The conclusion to draw from these facts is that one cannot be sure that the technology differences in the two departments explains the differences in frequencies of task-related communications at least not with the technology construct as operationally defined in this study.

Other variables which probably should be part of the technology construct can be considered to help in the explanation of observed difference. Attention is directed to the variable of spatial distance between organization members; the researcher utilized a crude measure of spatial distance as the average number of square feet in the organization per member. The people are closer together in the Business Office (132 sq. ft./person) than in the Ward (542 sq. ft./person). This difference should tend to create a greater

frequency of communications in the Business Office than in the Ward. The data indicate the opposite, however. An explanation can be offered in terms of the mobility of the organization members even though no quantitative measure was made of their mobility. In the Business Office the organization members are almost immobile since they can do the majority of their work at a desk. On the other hand, the people in the Ward are constantly moving about the Ward in order to perform their tasks. This difference in mobility should tend to create more frequent communications in the Ward due to more frequent physical contact between organization members than in the Business Office, a prediction supported by the data. Also, in the Business Office people depend very little on others in the department in order to do their work. This lack of dependence is indicated by the answers to questions 26 and 27 of the researcher's questionnaire, as shown below (see also Appendix IV, p. 211-213):

> 26. If others in your department do not do their jobs well, to what extent does this hinder your doing your job well?
>
> 27. To what extent must you communicate with others in your department in order to do your job well?

A t-test of the two departments on these two questions was significant at p=.05 and p=.02 respectively, with both indicating the Business Office to have the least degree of independence of tasks and thus the least need to communicate (Business Office mean scores = 2.4 and 2.5, Ward mean scores

= 3.4 and 3.8). Thus, the variables of mobility and task interdependence are helpful in explaining the differences in frequencies of task-related communications in the Business Office and the Ward, and this author believes these variables belong in a definition of a meaningful technology construct.

Considering next a comparison of the Kitchen and the Business Office, the average number of communications by the subjects was almost identical (Kitchen 17.6 and Business Office 16.4). At the same time, the Kitchen has nearly twice as many organization members as does the Business Office (19 and 11 respectively), and according to small group theory this should produce a lower average number of communications by people in the Kitchen than in the Business Office. Also, the Kitchen has a technology with a higher certainty than does the Business Office (t-test results in a p=.13), and according to Hypothesis H_3 this should tend to produce a lower average number of communications by people in the Kitchen.

To explain this discrepancy, attention can be directed to the variables of spatial distance, mobility and interdependence. First consider the variable of spatial distance between organization members; the people are closer together in the Business Office (132 sq. ft./person) than in the Kitchen (334 sq. ft./person), and this difference should tend to create a greater frequency of communications in the

Business Office than in the Kitchen. The data indicate an equal frequency, however. Turning to the interdependence of organization members, the Business Office shows a lower degree of interdependence than does the Kitchen. The answers to questions 26 and 27 (see p. 138, or Appendix IV, pp. 211-213) of the researcher's questionnaire indicated, using a t-test, that the two departments were different on these two questions at p=.05 and p=.20 respectively, thus indicating less of a need to communicate in the Business Office than in the Kitchen (Business Office mean scores = 2.4 and 2.5, Kitchen mean scores = 3.2 and 2.9). Also, there is a vast difference between the two departments in the mobility of organization members. In the Business Office the organization members are almost immobile since they can do most of their work at a desk, whereas in the Kitchen the people are quite mobile in the performance of their tasks. Thus, the differences in the two departments' size, technology and spatial distance of members should tend to produce a lower frequency of communications in the Kitchen, but these differences seem to be offset by differences in mobility and interdependence of tasks, which should tend to produce a greater frequency of communications in the Kitchen. The result is that the frequencies are almost identical. One can again conclude that the variables of mobility of organization members and interdependence of members' tasks are important variables which

should perhaps be incorporated into a technology construct.

Finally, a comparison of the Kitchen and Ward does not offer a great deal of new information since the mobility of members is essentially equal in the two departments and since the variables of technology, size, and the interdependence of members' tasks all tend to indicate a lower frequency of communications by people in the Kitchen than in the Ward, which is what the data show (Kitchen 17.6 and Ward 24.3). The technologies are different with a p=.05 on the Lynch questionnaire, and the Kitchen has the technology of greater certainty. The Kitchen is nearly twice the size of the Ward (19 and 11 people respectively), and the Kitchen has a smaller spatial distance between members (334 sq. ft./person in Kitchen and 542 sq. ft./person in Ward). Again the spatial distance variable would lead one to predict the opposite result to the one found in the data. The answers to questions 26 and 27 (see p. 138, or Appendix IV, p. 211-213) of the researcher's questionnaire indicated, using a t-test, that the two departments were different on these two questions at p=.30 and p=.03 respectively, with the Kitchen having a lower degree of interdependence of tasks (Kitchen mean scores = 3.2 and 2.9, Ward mean scores = 3.4 and 3.8). The measures of the two departments on all the variables except spatial distance would lead one to predict the observed comparison of task-related communications, i.e., the Kitchen should have the lower frequency.

In summary, the author believes that the introduction of the variables of mobility of organization members and the interdependence of tasks of the members can offer interesting new insights into the question of relating an organization's technology and its emergent communication patterns, and these variables should be included in a definition of the technology construct. The variable of spatial distance of members, while logically an important variable, did not offer much help in explaining the observations of this study, but perhaps the reason lies with the crude measure of spatial distance employed. It would seem that more research needs to be performed on this variable as well as on the incorporation of the variables of mobility and interdependence into a technology construct.

Hypothesis H_4 and A New Dimension of Communications

In the previous chapter the research data indicated strong support for the prediction that the media employed for task-related communications varies among different technologies, but the predicted changes in media from one technology to another were often not supported. First, there was mild support for the prediction that verbal communications become less predominant as the technology increases in certainty, even though verbal communications did account for a slightly greater percentage of total communications in the Kitchen than in the Business Office (66.5% and 65% respec-

tively). If one considers the mobility of organization members as introduced in the last section, the greater mobility of the members of the Kitchen can help explain these unexpected results regarding verbal communications. An interesting finding was that if telephone communications were added together with verbal communications, the percentage of communications accounted for by these two media did increase as the technological certainty decreases (i.e., Kitchen 67%, Business Office 72% and Ward 83%). The reason for this result was that the highest percentage of communications which employed the telephone was found in the Business Office (7%), followed by the Ward (4%) and then the Kitchen (1%). This higher percentage in the Business Office, is, of course, reasonable given that almost everyone in the Business Office has easy access to a telephone (6 phones divided among 11 people), whereas there are only two phones for 11 people in the Ward and two for 19 people in the Kitchen.

Turning to sign and object communications, the result of the observational data indicated a strong relationship between the use of these media and the organization's technology, but the relationship was opposite to the one predicted. Sign and object media seem to become more important as the technology increases in certainty; the percentages of communications which were sign were: Ward 1%, Business Office 3% and Kitchen 6%; the percentage which were object were: Ward 11%, Business Office 16% and Kitchen 19%. This increase in the usage of

these non-verbal communications media as the organization's technology increases in certainty can be explained on the basis of observations made by the researcher during the study. In the Kitchen the problems encountered are few in number and easy to solve, and the tasks performed are rather routine. Consequently, the information which needs to be transmitted from person to person is simple and thus lends itself to the simple forms of communication, such as sign (e.g., body movements) and object (i.e., the work piece itself). In the Ward, however, the problems encountered are frequent and difficult to solve, and the tasks performed are rather complex. Consequently, the information which needs to be transmitted from person to person is complex and does not lend itself to the simple forms of communication by sign and object. It is more necessary in the Ward to employ verbal communications, perhaps in conjunction with sign and object media, but the verbal media is more essential for the complex information which must be transmitted in the Ward.

Finally, written media was most predominant in the Business Office (9% of task-related communications) but closely followed by the Kitchen (8% of task-realted communications). The Ward utilized written media in only 5% of the task-related communications. The conclusion reached in the previous chapter was that the hypothesis that written media becomes more predominant as the technology increases in certainty

was only mildly supported because the Business Office employed the written media to a greater extent than did the Kitchen, which was not predicted by the hypothesis. However, as stated in the last chapter, the researcher believes that the usage of written communications could have been overstated in the Business Office, and this leads to the possible need for a new dimension of written communications --that being the urgency of the information communicated.

In the Business Office the job of the people is handling written documents and reports, and it is sometimes difficult for an observer to determine whether the written document is actually a communication or merely the object of the person's work. The fact is, all of these written documents are communications, but some are to be used immediately (e.g., memos, letters are often sent to someone for immediate use) while others may go into the files to be available for use at a later date, or perhaps not at all. This same distinction could be made in the Ward; some written documents are employed almost immediately (e.g., memos and some of the information on a patient's chart) while others go into the files for possible future use (e.g., narcotics manual and a patient's permanent file). The author presents this "urgency" dimension of communications as potentially useful in future research. No recording was made of the frequencies with which the communications observed in this study went into the two categories of "for

immediate use" and "for later use", but based on subjective observations made by the researcher, it seems that communications "for later use" were rather frequent in the Business Office, less frequent in the Ward and rather infrequent in the Kitchen. This subjective assessment coupled with the mobility of the members in the Kitchen (which should decrease the use of written media) would seem to lend additional support to the hypothesis that written communications increase in usage as the organization's technology increases in certainty, at least when considering written communications "for immediate use". Needless to say, additional research needs to be performed which incorporates this new dimension of written communications before one can begin to have confidence about the relationship predicted by this tentative explanation.

Re-addressing the Complex Fifth Hypothesis

The fifth hypothesis was related to the specialization of purposes of the various communications channels, with a prediction that specialization of the channels increases as technology increases in certainty. As mentioned in the previous chapter, this hypothesis was difficult to test as stated:

> Hypothesis H_5. As the degree of certainty in the organization's technology increases (i.e., as the number of exceptions encountered decreases and the problems encountered become more analyzable), the purposes of various communication channels under

> normal conditions become increasingly specialized; e.g., downward vertical communications tend to be for giving orders and instructions, upward vertical communications tend to be for supplying information for decisions, and horizontal communications tend to be for satisfying social and non-task-related needs.

The difficulty lies in the fact that there are two questions being asked: (1) Are the purposes for which a channel is used different in different technologies?, and (2) Is there more specialization of the purpose for which a channel is used as the technology increases in certainty?

The data collected in this research strongly support a "yes" answer to the first question. The Chi-Square tests for each of the four channels resulted in a p=.01 or less under the null hypothesis that there is no difference in the purposes for which each of the channels are used in the three technologies (see pp. 112-120 for the Chi-Square tests).

But in relation to the second question, the data seem to indicate that a restatement of the hypothesis might be in order since there appeared to be specialization of purpose at all three levels of technology for most of the four communications channels explored, and the specialized purposes of the channels were different in the different technologies. A restatement of the fifth hypothesis based on the data collected in this study could be as follows:

> As the degree of certainty in the organization's technology increases (i.e., as the number of exceptions encountered decreases and the problems encountered become more analyzable), the purposes

of various communications channels under normal conditions will vary according to the following table:

Channel		Department		
		Kitchen	Business Office	Ward
Downward vertical	More than expected	Stimulus	Social Question & Problem Solving	None
	Less than expected	Social Question & Problem Solving	Stimulus	None
Upward vertical	More than expected	None	Social	Stimulus
	Less than expected	None	Stimulus	Social
Horizontal	More than expected	Social Stimulus	Social Question & Problem Solving	Information Exchange
	Less than expected	Information exchange Question & Problem Solving	Information exchange Stimulus	Social Question & Problem Solving
Diagonal	More than expected	Stimulus	Information exchange	Information exchange Social
	Less than expected	Information exchange Social	Stimulus	Stimulus

The data related to Hypothesis H_5 (see pp. 112-120) are summarized in the following paragraphs, and these data were used to construct the table in the restatement of Hypothesis H_5. Regarding downward vertical communications, the stimulus purpose was more predominant in the Kitchen than in either the Business Office or the Ward, whereas the social and question and problem solving purposes were more predominant in

the Business Office than in either of the other two departments. In the Ward no purpose was any more predominant than it was in the other two departments, thus suggesting a lack of specialization in the Ward for downward vertical communications and different purposes of specialization in the Business Office and Kitchen. There was a noticeable lack of downward vertical communications for the social and questions and problem solving purposes in the Kitchen, and a lack of downward vertical communications for the stimulus purpose in the Business Office, whereas there was no noticeable lack of downward vertical communications for any purpose in the Ward, again suggesting a lack of specialization of purpose for downward vertical communications in the Ward.

Turning to upward vertical communications, the social purpose was more predominant in the Business Office than in the other two departments, and the stimulus purpose was more predominant in the Ward than in the other two departments. There was a noticeable lack of upward vertical communications for the stimulus purpose in the Business Office and a noticeable lack of upward vertical communications for the social purpose in the Ward. The Kitchen indicated no degree of specialization of purpose for upward vertical communications.

As for horizontal communications, the stimulus and social purposes were more predominant in the Kitchen than in the other two departments; the question and problem solving and social purposes were more predominant in the Business Office

than in the other two departments; and the information exchange purpose was more predominant in the Ward than in the other two departments. There was a noticeable lack of horizontal communications for the stimulus purpose in the Business Office and a noticeable lack of horizontal communications for the social purpose in the Ward. The Kitchen and Business Office showed a greater lack of horizontal communications for the information exchange purpose than did the Ward, and the Kitchen and Ward showed a greater lack of horizontal communications for the question and problem solving purpose than did the Business Office.

Finally, diagonal communications were used for the stimulus purpose more frequently in the Kitchen than in the other two departments, and the problem solving and question purpose was more predominant in the Business Office than in the other departments (although no Chi-Square test could be performed due to the small frequencies for this purpose category). Diagonal communications for the social purpose were more predominant in the Ward than in the other departments, and diagonal communications for the information exchange purpose were more predominant in the Business Office and Ward than in the Kitchen. There was a noticeable lack of diagonal communications for the stimulus purpose in the Business Office and Ward, and there was a noticeable lack of diagonal communications for the information exchange purpose and social purpose in the Kitchen.

As one can see, the issue of which purpose becomes predominant for each technology and communication channel is not adequately addressed in this research and will have to be further determined by data collected in subsequent research. It might be that the predominant purpose for each channel and technology would have to be determined on an organization by organization basis. However, the prediction that different purposes will predominate for different technologies and different channels is worthy of note by any organization development consultant and worthy of further research by organization theorists.

Another problem related to testing the fifth hypothesis can be seen by referring to the observer coding scheme (see Appendix III, p. 199). There were a number of purpose categories which were a priori determined: exchange of information, advice exchange, stimulus to do certain tasks, problem solving, learning new tasks, alerting of a crisis, evaluative feedback on job, and social. During the observations two new purposes seemed to be necessary to describe the communications observed, and they were: question and complaint. Neither of these seems to be covered by the other categories determined prior to the research, with the possible exception of the exchange of information category. But then, the exchange of information category is the general category for all others because every communication has the underlining purpose of information exchange; otherwise there is no need

for communication. All of the other categories which are developed are refinements of the information exchange category.

It remains a necessary job for researchers of organization communication patterns to continue to refine the purpose categories into which an observer can place observed communications. In spite of the efforts of the researcher to do this, even to the point of adding new categories as the research progressed, the large majority of communications were still categorized as for the purpose of information exchange. In fact, if one considers the twelve possible combinations of technologies and communications channels, in nine of the twelve the information exchange purpose was the predominant purpose of the communications. The data related to this statement are summarized in Table 6-3 (p. 153). The job which is ahead for researchers of organization communication patterns is large. It will be necessary to continue to refine the categories into which communications can be placed, and the dimension of urgency introduced earlier will be of use if it can be operationalized in a meaningful way.

Comparing the Observational Data and the Questionnaire Data

The last section of this chapter will direct attention to the comparison of the observational data and the questionnaire data collected in this research. One of the objectives of this research was to develop methodologies which lend them-

Table 6-3. Percentage of Communications for the Ten Purposes Using the Four Communications Channels in the Three Departments

Department	Communication Channel	Purpose Categories: Info. Exchange	Advice Exchange	Stimulus	Prob. Solve	Learn Task	Alert Crisis	Feedback	Social	Question	Complaint
Kitchen	Vertical downward	38%	1%	35%	.5%	3%	0%	.5%	14%	7%	1%
	Vertical upward	31	1	16	4	0	0	0	29	16	3
	Horizontal	35	0	25	2	0	0	0	31	5	2
	Diagonal	14	0	69	2	0	0	0	14	1	0
Business Office	Vertical downward	31	0	20	11	0	0	0	26	11	1
	Vertical upward	38	0	3	17	0	0	0	30	11	1
	Horizontal	28	0	9	15	0	0	0	32	16	0
	Diagonal	34	0	24	5	0	0	0	27	10	0
Ward	Vertical downward	37	1	32	4	1	0	0	13	10	2
	Vertical upward	39	1	23	6	0	0	0	15	14	2
	Horizontal	59	0	19	0	1	0	0	15	6	0
	Diagonal	38	0	13	3	0	0	0	40	3	3

selves to more sophisticated probing of the relationship between an organization's technology and the emergent communication patterns. Exploratory research must always attempt to advance both theory and methodology in order to allow the attainment of the ultimate goal of building a meaningful theoretical model. The structured observation methodology is useful for collecting vast amounts of data but the findings usually lack generalizability due to the small sample size. One must develop methodologies, such as questionnaires, which are efficient mechanisms for collecting data from large samples in order to have more confidence in the findings as applied to other sites. To this end, the questionnaire and observational data are compared in the following pages.

In relation to the measure of certainty of the organization's technology, the author has already mentioned the difficulties encountered but they will be summarized again below. Both the Lynch questionnaire (see Appendix II, p.197-198) and the researcher's questions on Perrow's technology construct (see Appendix IV, p. 212-213, questions 29 and 30) result in the same ranking of the three departments as to the certainty of their technologies (i.e., Kitchen--most certainty, Business Office--next most certainty, and Ward--least certainty). The difference in the results of the two questionnaires was the difference in the probability associated with the null hypothesis that there is no difference in the three technologies, with the Lynch questionnaire p=.30

and with the researcher's questions p=.001. The problem encountered when this data was compared with the observational data on the number of problems encountered and the analyzability of the problems was in the ranking of the three departments. The Business Office encountered the most exceptions and had the most unanalyzable problems, followed by the Ward and then by the Kitchen; therefore, this ranking is different from that arising from the questionnaire data. In other words, the Business Office and the Ward have switched positions in the ranking. This discrepancy obviously raises the question as to the reliability of the two sources of data. Lynch has tested her questionnaire and reports that it is reliable, and the observational data was tested for its reliability and found to be highly reliable in terms of the purpose of the communications, the direction of the communication and its initiation. Therefore, both methods seem to yield reliable data which is inconsistent. The only conclusion to be drawn is that more research and theory building needs to be performed in search of a meaningful technology construct. The author believes such work will need to include the variables of organization member mobility, spatial distance of organization members, and the interdependence of tasks before a meaningful technology typology can be developed.

Considering questions 8, 9 and 10 of the researcher's questionnaire, the data from these questions was used to test the new statement of the first two hypotheses. These ques-

tions are as follows (see also Appendix IV, pp.204 and 213):

8. What percentage of your work-related communications would you say are with your immediate superior and/or his/her superior? What percentage would you say you initiate?

9. What percentage of your work-related communications would you say are with your peers in the organization? What percentage would you say you initiate?

10. What percentage of your work-related communications would you say are with higher-ups in other departments? What percentage would you say you initiate?

The observational data supported the hypothesis that the proportion of communications which are vertical decreases as the organization's technology increases in certainty ($p=.05$ after adjusting for differences in organizational structure, and the data from question 8 also supports this hypothesis with $p=.057$. Furthermore, the percentages from the observational data compare favorably with the questionnaire (see Table 6-4).

Table 6-4. Comparison of Observational and Questionnaire Data Regarding Percentage of Communications Which Are Vertical

Department	Observational Data	Questionnaire Data
Kitchen	60%	41-60% mean response choice
Business Office	63%	41-60% mean response choice
Ward	73%	61-80% mean response choice

As for the hypothesis that the percentage of communications which are horizontal increases as the organization's technology increases, the observational data supported the

hypothesis (p=.03) after adjusting for differences in organizational structure. The questionnaire data results in a p=.002, but the ranking of the three departments is not consistent with the hypothesis or the observational data. With the questionnaire data the Ward has the highest percentage of communications which are horizontal, followed by the Kitchen and then the Business Office. These results are summarized in Table 6-5.

Table 6-5. Comparison of Observational and Questionnaire Data Regarding Percentage of Communications Which are Horizontal

Department	Observational Data	Questionnaire Data
Kitchen	27%	41-60% mean response choice
Business Office	25%	21-40% mean response choice
Ward	14%	41-60% mean response choice

An obvious problem is noticeable in Tables 6-3 and 6-4; the results of the questionnaire data for the Ward amount to at least 102% of the communications being vertical and horizontal which is impossible, especially when one considers that this percentage total does not include the diagonal communications referred to in question 10. So while the data from question 8 and question 10 (as will be shown below) do agree very favorably with the observational data, the data from question 9 does not agree. Also, it opens the possibility that the data from questions 8 and 10 are invalid, in spite

of their comparability with the observational data. Perhaps people are responding to the three questions on directionality of communications in terms of the volume of communications in their department rather than accurately discriminating who the communications involve. It is also possible that the respondents interpreted question 9 to include people outside their department but still a "peer in the organization" (i.e., interpreting the words "the organization" in question 9 to be the entire organization and not just their department).

Turning to the question regarding diagonal communications, the observational data support the hypothesis that the percentage of communications which are diagonal is the same in the three departments, p=.50. The questionnaire data also support this hypothesis with a p=.28, and the percentages reported with the two methods are comparable (see Table 6-6).

Table 6-6. Comparison of Observational and Questionnaire Data Regarding Percentage of Communications Which Are Diagonal

Department	Observational Data	Questionnaire Data
Kitchen	13%	0-20% mean response choice
Business Office	12%	0-20% mean response choice
Ward	12%	21-40% mean response choice

The author believes that the overall comparability of the observational data and the questionnaire data on the proportions of communications which are vertical, horizontal and diagonal is good and would allow the questionnaire method to

to be used in further research. The author is inclined to think that the difficulty with the question on horizontal communications was due to the wording of the question. Of course, this notion can be tested in another setting with a re-worded question 9 before further research is undertaken in the overall research program.

Turning to question 27 of the researcher's questionnaire, the data from this question can be used to test the hypothesis regarding volume of communications in the three departments. The question is stated below (see also Appendix IV, pp. 212-213):

> 27. To what extent must you communicate with others in your department in order to do your job well?

The hypothesis was that the volume of task-related communications would decrease as the organization's technology increased. As discussed in the previous chapter, this hypothesis was only mildly supported due to the similarity in frequencies of communications in the Kitchen and in the Business Office, although there was strong support that there is a difference in the frequency of communications across technologies ($p=.06$). Some possible explanations for these findings were given earlier in this chapter. However, the question here is the comparability of the questionnaire data to the observational data. The results of the data from question 27 yield the same ranking of the three departments as the observational data (mean scores: Kitchen 2.9, Business Office 2.5,

Ward 3.8); the Kitchen and Business Office report similar results to question 27; and the data yielded a p=.03 for the null hypothesis that there is no difference in the technologies. Thus, the data from the questionnaires compares quite well to the observational data.

If one considers how the questionnaire data might be used to test the fourth hypothesis which is related to the changes in the use of media employed for task-related communications as the technology changes, one would turn to questions 17, 18 and 19 of the researcher's questionnaire, shown below (see also Appendix IV, pp. 208-209 and 217-218):

17. When you communicate with other people on the job for the purpose of giving or receiving information (regardless of who the people are or who initiates the communication), there are a number of possible media which can be used. Place check marks beside 2 or 3 of the media which are most frequently used.

18. When you communicate with other people on the job for the purpose of starting one of the tasks in your job (regardless of who the people are or who initiates the communication), there are a number of possible media which can be used. Place check marks beside 2 or 3 of the media which are most frequently used.

19. When you communicate with other people on the job for the purpose of solving a work-related problem (regardless of who the people are or who initiates the communication), there are a number of possible media which can be used. Place check marks beside 2 or 3 of the media which are most frequently used.

The choices for each of the three questions included: letter or memorandum; report or procedure manual; telephone; verbal face to face (one to one); group meeting or discussion with

several people; signs (e.g., body movements, whistling); signals (e.g., dials, lights, horns); objects (that is, the work piece or person); and other (please explain). The purposes of "giving or receiving information," "starting one of the tasks in your job," and "solving a work-related problem" account for the vast majority of the communications in the three departments, and therefore one can utilize the data from these three questions to test the hypothesis related to media. As with the observational data, the Chi-Square statistic can be used to test the hypothesis using the questionnaire data from these three questions as shown in Table 6-7 (p. 162). The result in this table is quite comparable with the result obtained from the observational data, where X^2 = 53.62 with 10 degrees of freedom, p=.001 under the null (see p. 107 of Chapter V). But what about the comparison of the results for the individual media using the Chi-Square test and the Spearman-Rank Correlation Coefficient to test the directionality of the relationship between media and technology?

The results of the questionnaire data from these three questions are shown in Table 6-8 (p. 163). By refering to the similar table using observational data and presented on p. 109 of Chapter V (Table 5-13), one can see that the results are almost identical. All of the Spearman-Rank Correlation Coefficients are the same for the different media, with the one exception of the sign and object media. The ob-

Table 6-7. Chi-Square Test of Frequency of Task-Related Communications Using the Five Media in the Three Departments

Media		Department: Kitchen	Business Office	Ward	Total
Verbal 1:1	E*	49	35	38	
	O*	53	31	38	122
Verbal small group	E	20	14	16	
	O	21	5	24	50
Sign and Object**	E	8	6	6	
	O	10	8	2	20
Telephone	E	18	12	14	
	O	8	27	9	44
Written	E	17	12	14	
	O	21	7	15	43
Total		113	78	88	279

Overall X^2 = 43.66 with 8 degrees of freedom, p=.001

*E = expected frequency, O = observed frequency
** Sign and Object categories were combined due to their small frequency prohibiting the calculation of the Chi-Square statistic if they remained separate categories and because of their similarity.

Table 6-8. Chi-Square Statistic and Spearman-Rank Correlation Coefficient for the Relationship between Technology and Percentage of Communications Using Four Media

Media	X^2 and p under null	% Responses to questions 17-19 in Kitchen, Bus. Office and Ward	Spearman-Rank Correlation Coefficient and p under null
Verbal	4.42, p=.12	K 65% BO 46% W 70%	-.5, p=.33
Sign and Object*	3.84, p=.16	K 9% BO 10% W 2%	.5, p=.33
Written	3.08, p=.21	K 19% BO 9% W 17%	.5, p=.33
Telephone	26.10, p = .001	K 7% BO 35% W 10%	-.5, p=.33

* Sign and Object categories were combined due to their small frequency prohibiting the calculation of the Chi-Square statistic if they remained separate categories and because of their similarity.

servational data yielded a correlation coefficient of 1.0 for both sign and object media and X^2's with probabilities under the null of .001 and .01 respectively. As shown in Table 6-8, the questionnaire data yielded a correlation coefficient of .5 and a X^2 with probability of .16 under the null.

Thus it would seem that the questionnaire data can be used equally as well as the observational data in testing the fourth hypothesis related to the media employed in different technologies. The final comparison of the questionnaire data and the observational data is to be made in relation to the fifth hypothesis.

As the reader will recall, the fifth hypothesis regarding the specialization of the purposes of various communication channels presented some problems, and an attempt to restate the hypothesis was proposed earlier in this chapter. Still, the hypothesis remains a difficult one to test. Questions 11, 13 and 15 of the researcher's questionnaire deal with the purposes for which one communicates with superiors, peers and people in other departments (see also Appendix IV, pp. 205-207 and 214-216):

> 11. Think about the times you communicate with your superiors, regardless of who initiates the communications. There are a number of possible purposes for these communications, as shown below. Place check marks beside the 2 or 3 purposes which occur most frequently.
>
> 13. Think about the times you communicate with your peers, regardless of who initiates the communications. There are a number of possible purposes for these communications, as shown below. Place check marks beside the 2 or 3 purposes which occur most frequently.

15. Think about the times you communicate with higher ups in other departments, regardless of who initiates the communications. There are a number of possible purposes for these communications, as shown below. Place check marks beside the 2 or 3 purposes which occur most frequently.

The choices for each of the three questions included: give or receive information; starting one of the tasks in your job; solving a work-related problem; learning a new task; dealing with a crisis (please give an example); receiving evaluations on your performance; social (non-work-related); other (please indicate). A Chi-Square test can be performed on the questionnaire data from these questions to test if there is a difference in the purposes for which one communicates with superiors, peers and people in other departments. The results of these tests can then be compared with the results of the observational data shown on pages 112 to 120 of the previous chapter. Tables 6-9, 6-10, and 6-11 show the results of the Chi-Square tests of questions 11, 13, and 15 (see tables on pp. 166-168).

It is apparent that the questionnaire data do not yield as significant results as did the observational data presented in the previous chapter. The observational data for downward vertical, upward vertical, horizontal and diagonal communications all yielded X^2's with a probability of no more than .01 under the null hypothesis. The .17, .80 and .15 probabilities under the null yielded by the questionnaire data do leave something to be desired; however, two of the

Table 6-9. Chi-Square Test of Question 11--Frequency of Responses that One Communicates with Superiors for the Four Purposes

Purpose		Department: Kitchen	Business Office	Ward	Total
Give/Receive Information	E*	16	11	13	
	O*	17	11	12	40
Start task	E	6	5	6	
	O	7	2	8	17
Solve Problem	E	13	9	10	
	O	12	10	10	32
Other	E	12	8	10	
	O	11	15	9	30
Total		47	33	39	119

Overall $X^2 = 9.28$ with 6 degrees of freedom, p=.17

*E = expected frequency, O = observed frequency

Table 6-10. Chi-Square Test of Question 13--Frequency of Responses that One Communicates with Peers for the Four Purposes

Purpose		Department: Kitchen	Business Office	Ward	Total
Give/Receive Information	E*	15	10	14	
	O*	16	11	12	39
Start task	E	8	5	7	
	O	10	5	5	20
Solve Problem	E	9	6	8	
	O	8	7	8	23
Other	E	13	8	11	
	O	11	7	14	32
Total		45	30	39	114

Overall X^2 = 3.07 with 6 degrees of freedom, p=.80

*E = expected frequency, O = observed frequency

Table 6-11. Chi-Square Test of Question 15--Frequency of Responses that One Communicates with Higher Ups in Other Departments for the Four Purposes

Purpose		Department: Kitchen	Business Office	Ward	Total
Give/Receive Information	E*	14	10	11	
	O*	13	10	12	35
Start task	E	6	4	6	
	O	9	4	3	16
Solve Problem	E	9	6	8	
	O	4	9	10	23
Other	E	10	7	7	
	O	13	4	7	24
Total		39	27	32	98

Overall $X^2 = 9.63$ with 6 degrees of freedom, $p=.15$

*E = expected frequency, O = observed frequency

three tests do approach respectable levels of significance for exploratory research.

The researcher believes that the comparisons between the observational data and the questionnaire data presented on the previous pages do indicate that much of the data necessary for testing such hypotheses as stated in this research can be gathered by way of questionnaires as well as observations. Of course, the observational data, which was tested for reliability, was necessary to test the reliability of the questionnaire data. Such comparisons are useful in the development of methodologies which are needed to build theory, and careful building of methodologies is necessary if one wishes to avoid erroneous conclusions in the theory-building process.

Overview

In this chapter the results of the current research have been further explored, and some tentative explanations for the findings have been offered. First, an alternative statement of the first two hypotheses related to directionality of communications was proposed and tested using the data collected in the research. This restatement of these two hypotheses appears to make the subject relationship more readily discernible than is true for the original statement of the hypotheses. Also, since the data seem to indicate the opposite relationship between directionality of communications and tech-

nology, several explanations based on the observations were offered. No doubt more research needs to be done in this area by considering even more diverse technologies. Next, the hypothesis related to the volume of communications was revisited. The variables of mobility of organization members, interdependence of tasks, and spatial distance between organization members were introduced to help explain the confusion created by the size variable. The author believes these variables should be incorporated into new definitions of technology which can then be used in further research.

The next focus was on the relationship between communications media and technology. Several explanations were explored in an attempt to better understand the findings of this research, and a new dimension of communications was introduced in this attempt--i.e., the urgency of the information which is transmitted in the communication. Then a restatement of the fifth hypothesis, which is related to specialization of purpose of various communications channels, was offered in an attempt to make this hypothesis more understandable. Reference was also made to the necessary job of further refining the categories of the purpose dimension of communications; too many communications must still be categorized as "information exchange", which is the basic purpose of any communication.

The final section of the chapter was devoted to a comparison between the observational data and the questionnaire

data because one objective of this research was to refine the methodology for further study of the relationship between technology and communication patterns. Exploratory research must always have in mind the dual objectives of furthering the understanding of a theoretical relationship and furthering the sophistication of the methodology for studying that relationship. But one must proceed cautiously by continuing to verify the reliability of the methodological tools being used. Otherwise, one runs the risk of perpetuating a naive and possibly erroneous understanding of theoretical relationships.

The next chapter will summarize the findings of this research as well as its weaknesses and strengths. Then, some recommendations for future research will be offered, and finally, some of the practical applications of the findings will be explored.

C H A P T E R VII

SUMMARY AND RECOMMENDATIONS

This chapter summarizes what the research described in this report has done; what the major findings of the research are; and what some of the weaknesses and strengths of the research are. Implications for future research are explored as well as implications which are useful for the organization development practitioner.

The research focused on the relationship between an organization's technology and emergent communication patterns. The objectives of the research were: (1) to begin charting the relationship between these two variables, and (2) to develop methodologies which could be used in future research. For purposes of this research, technology was defined according to Perrow's two-dimensional construct, i.e., the number of exceptions encountered in completing the task and the analyzability of problems encountered in completing the task. Communication patterns were defined according to four dimensions of communications: (1) purpose, (2) media, (3) directionality, and (4) timing of communications.

Hypotheses were formulated regarding the relationship between an organization's technology and: (1) the directionality of communications, (2) the volume of communications, (3) the media used in communicating, and (4) the purposes for communicating. Because this was exploratory research, the testing of these hypotheses was complimented by the defining

of new categories for communications dimensions, and the defining of new communications dimensions. Also, a questionnaire related to communication patterns was validated by comparison to observational data on communication patterns.

The research design called for the use of structured observation accompanied by questionnaires to be administered in conjunction with the observations. Three departments of a Massachusetts State Home for Veterans of American Wars were employed in the data collection. The subject organization utilizes a number of different technologies in its various departments and therefore offered a variance in the independent variable of technology while offering some control over environmental variables which might also affect communication patterns. The schedule of activities called for observation of people in each department one at a time, and the questionnaire was administered at the end of the observation of each subject. The design also included periodic co-observers as a check on the reliability of the researcher's observations. Prior to the beginning of the schedule of observation-questionnaire activities, the observation coding scheme was pilot tested; a test was made of the assumption that the three departments represented different technologies; and data was collected on the leadership style, job climate, and the demographics of the people in each department.

In summary the purpose of this research was to begin linking two important components of the organization model--

technology and communications patterns. Understanding this linkage will be important to the understanding of organizations and hence valuable to organization theorists and organization development practitioners alike.

Summary of Findings

A number of findings were important and tend to support the basic hypothesis of this research that an organization's technology is related to the communication patterns which emerge in the organization. First of all, the data supported the prediction that the directionality of task-related communications is related to the organization technology. The initial statement of the two hypotheses relating technology and directionality of communications in terms of the ratios of vertical to horizontal and vertical to diagonal communication tended to obscure the relationship which existed in the data. In an attempt to clarify this relationship between directionality and technology, these hypotheses were restated in terms of the proportions of communications which are vertical, horizontal and diagonal. This restatement allowed the relationship to become more obvious. The data tend to support the following hypothesis:

> As an organization's technology increases in certainty the porportion of communications which are vertical decreases, while the proportion which are horizontal increases and the proportion which are diagonal remains the same.

This relationship held even after adjusting the data for dif-

ferences in organization structure in the three departments (i.e., the different numbers of vertical and horizontal positions surrounding each person in the department). This finding is of interest because it seems to refute the hypothesis suggested in current literature.

The second finding of importance was that the frequency of task-related communications tends to decrease as the organization's technology increases in certainty. This relationship is slightly confounded by adjustments for differences in organization size. This confusion is related to the question of whether the findings of small group research can be applied to organizational research. Small group research supports the prediction that as a group increases in size the frequency of communications by its members decreases, but this research may not be applicable to organizational research due to the greater mobility of organizational members as compared to the mobility of small group research subjects. Small group research deals with people working in a common space on a common task, and therefore increasing the group size should tend to decrease the frequency of communications by group members due to a fixed amount of air space for communications. On the other hand, organization members tend to move about a department while working on a number of simultaneous tasks, and this mobility enhances the chance of coming into contact with other members of the organization. This mobility should tend to increase the frequency of communica-

tions as organizations increase in size. It was reported in the previous chapter that introducing this variable of mobility of organization members, as well as the interdependence of tasks in the departments, was useful in explaining observed differences in frequencies of communications in the three departments. The author believes that the adjustment for size differences does not refute the finding that the frequency of communications decreases as the technology increases in certainty.

With respect to the question of which media are employed in communications, several findings come from this research. First, the data supported the hypothesis that the media employed varies as one considers different technologies. It was found that the verbal medium becomes less predominant as the technology increases in certainty, especially if telephone communications are included with other verbal communications. Secondly and contrary to the original prediction, the data revealed that the use of sign and object media increases as the technology increases in certainty. Also of note was the finding that few signal communications were observed in this research; it is possible that signal communications become important only in technologies of greater certainty than the most certain technology in this research. Finally, the research data supported the prediction that written communications become more predominant as the technology increases in certainty, but because the Business Office

had a slightly greater percentage of communications which were written than did the Kitchen the researcher was prompted to offer a potentially helpful new dimension of communications.

This new dimension was labeled "the urgency of the communications", and the author proposed that communications might be categorized as to being "for immediate use" or being "for later use". For example, it appeared that many of the written communications in the Business Office were "for later use". The author believes that this distinction might be useful for understanding written communications in technologies like the Business Office, where the task of people is to deal with written documents, thus making it difficult to distinguish between communicating via the written medium and performance of the task.

Another finding of this research was that the fifth hypothesis was stated in such a way as to make it difficult to test. While there was some support for the prediction that the various communications channels are used for more specialized purposes as the organization's technology increases in certainty, there was support for another prediction: the various communications channels all have specialized purposes which are different in the different technologies. In other words, the data seem to indicate that there is specialization of purpose for each communication channel at all three levels of technology, and the specialized purpose is differ-

ent for each of the technologies.

Even an attempt to restate this fifth hypothesis leaves one feeling that this question of specialization of purpose of the various communications channels is not adequately addressed in this research. The reason for the failure of this research as regards this question is that the question is complicated, especially given the difficulty of refining the purpose categories beyond the overall purpose of information exchange. Indeed, in spite of the researcher's attempt to further refine the purpose categories, most of the communications in all three of the subject technologies were categorized as information exchange. This result indicates the work which remains for students of organizational communication patterns in developing an understanding of the purposes of various communications. This research has resulted in two additional categories for the purpose of a communication: questions and complaints. Still the task looms large before an adequate understanding of the purpose dimension of organizational communication patterns is achieved.

The fifth finding of this research is related to the methodology which can be employed in the future for study of the relationship between technology and communication patterns. Data collected from the structured observations was found to be quite comparable with the data collected from questionnaires administered to the observees. In other words, the five hypotheses tested in this research could have been

tested by the questionnaire data, and the results would have been essentially the same as with the observational data. This finding is extremely important for future research into the relationship studied in this research because questionnaires allcw a researcher to gather data from large samples and thus be better equipped to control for certain variables and to generalize the research findings. However, this exploratory research was necessary to determine the reliability of the questionnaire data, and further exploratory research will likely be necessary in order to take the initial steps on the road to further and deeper understanding of the impact of technology on organizational communication patterns.

Weaknesses and Strengths of the Research

The major weaknesses of this study are primarily the result of its being exploratory. The small sample size necessitated by the use of structured observation and a limited amount of resources make the findings less generalizable than one would like. Also, the small sample size limited the researcher's ability to control for other variables which might in addition to technology affect communication patterns in the organization. But these weaknesses are also brought on by the difficulties encountered in studying the complex entities called organizations. To study organizations in a realistic manner, one must go to the organizational setting, especially when beginning to study an uncharted relationship

such as was the subject of this study, and then the complexity of organizations and lack of control over variables makes the research difficult indeed.

Still the task must proceed in this manner if one hopes to alter the naive views which now exist about the functioning of organizations. The primary strength of this research was that it systematically and cautiously approached the study of a complex phenomenon. It was an initial probing of a complex subject using admittedly crude tools and a small sample size, but the research has led to some tentative answers to the questions posed at its inception, some new questions and hypotheses to be answered and tested in future research, and a methodological tool which should be useful in further research into the relationship between technology and communication patterns. The research has found support for the basic hypothesis that an organization's technology is related to the communication patterns which emerge in the organization, and the richness of the information gained through this in-depth analysis leads the author to conclude that the strengths of the study outweigh the weaknesses.

Recommendations for Future Research

A number of recommendations for future research can be made. The first recommendation would be to conduct similar research using the restated hypotheses in several Kitchens, Business Offices and Wards to see if the units studied in this

research seem to be representative of other departments employing similar technologies. The fact that the questionnaire data compares well with the observational data should allow questionnaires to be utilized in this research, as well as other research suggested below, and this advance in methodology would facilitate the collection of data from larger samples.

Another similar study should be conducted in technologies which extend the range of technologies under consideration. That is, technologies of greater certainty than the Kitchen in this study and of lesser certainty than the Ward in this study would be considered. The new research would be directed at the nature of the relationships suggested in this report; namely, are they linear or curvilinear?

In the case of both of the above studies, the use of questionnaires and large samples would allow data to be simultaneously collected on other variables affecting communication patterns. Certainly this type of multivariate research needs to be conducted, because the interrelationships of organization variables may be as important, if not more important, than the effect of the variables themselves.

Additional interest should be directed at the influence of the variables of organization size, mobility of organization members and spatial distance of members. As encountered in this study, one must wonder if the size variable affects organization communications as it affects communications in

small groups. Additional research needs to be conducted into the effect of organizational size, and this research should include consideration of the mobility and spatial distance of organization members. As suggested in this report, these variables seem to hold promise in helping to explain the communication patterns observed in different technologies, and they might even be helpful in defining a meaningful technology construct.

The research herein reported resulted in the proposing of a new dimension of communication patterns (i.e., the urgency of the communication) and two new purpose categories for communications (i.e., question and complaint). Research needs to be conducted which tests the usefulness of this new dimension and these new purpose categories. Also, research into the new purpose categories should attempt to delineate other new categories so that one is not forced to categorize communications in the most general category of "information exchange". The author believes that an inability to delineate the purposes of various communications will only tend to perpetuate the naive understanding which currently exists regarding the relationship between organization technology and communication patterns.

This study has only scratched the surface of understanding which can be developed regarding the relationship between technology and other organization variables, but the researcher believes a good beginning has been made. Some good questions were asked, because their tentative answers have

led to the asking of some new questions which will hopefully lead researchers closer to an understanding of organizations. Still, practitioners cannot wait for behavioral scientists to perfect their answers before dealing with problems confronting them, so what does this research offer organization development practitioners?

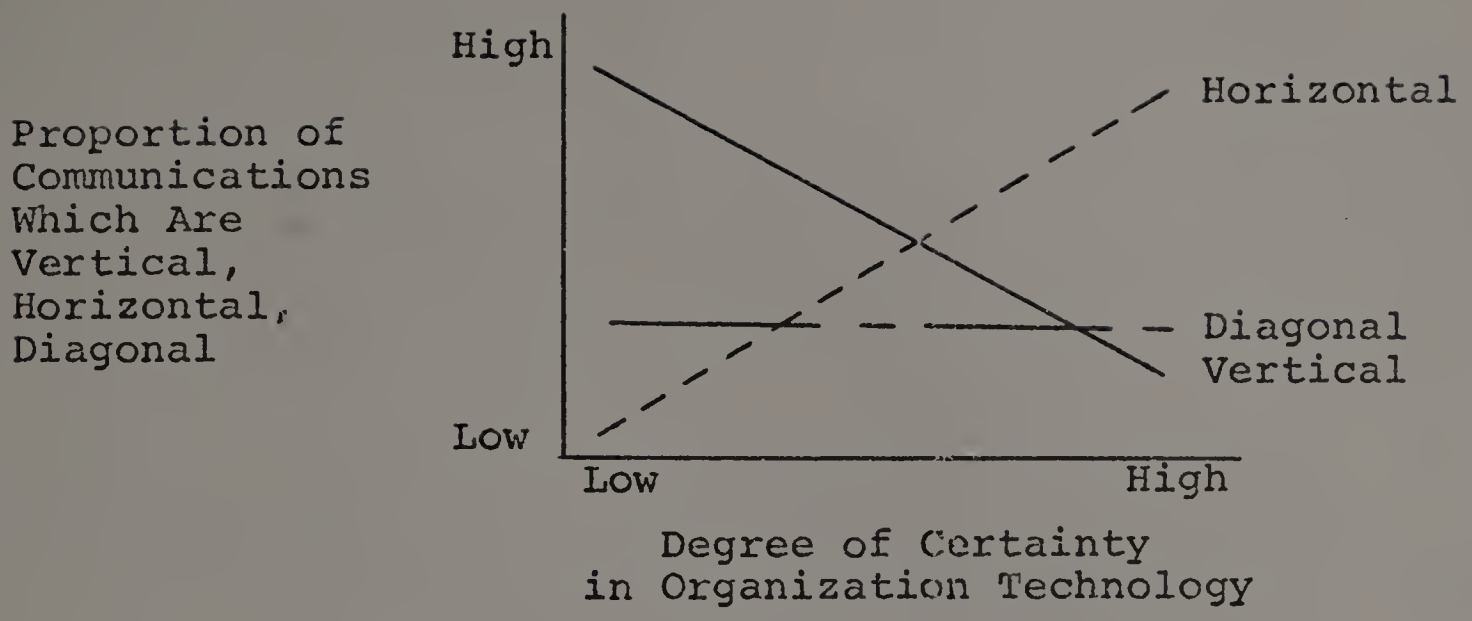
Recommendations for Organization Development Practitioners

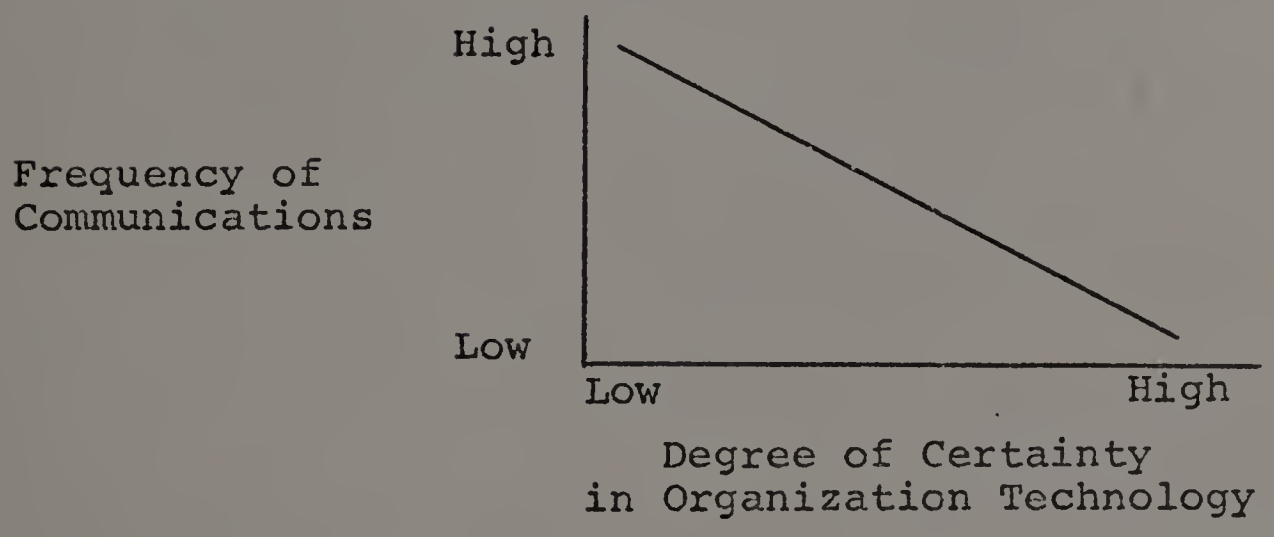
Organization development practitioners need to develop an appreciation for the impact of all of the variables in organizations. Only then can they hope to successfully intervene in organizations and make them more efficient as well as better places for the people in them. This research has pointed out the importance of one often-overlooked variable affecting communication patterns in organizations, i.e., the organization's technology. For the organization development practitioner to ignore this variable is to conduct an incomplete diagnosis and to set up the practitioner and the organization for an unsuccessful intervention. A thorough understanding of the client organization is essential to successful interventions because understanding the situation surrounding an organization can allow the organization development practitioner to help the organization structure itself in the "best way" for the particular situation.

This research has indicated that when one intervenes in different technologies, there are likely to exist different usages of the various communications channels, both in terms of the frequency of their usage and the purposes for which they are used. Also, the overall volume of communications is likely to be different in different technologies, as are the media employed for communications. The tentative findings of this study which might be useful to organization development practitioners can be summarized in Figure 7-1 and Table 7-1 (pp. 185 and 186).

While these relationships are as yet tentative, they should prove helpful in the diagnostic phase of an intervention. For example, if one were intervening into an organization like the Kitchen in this study (high certainty technology), this research indicates that one would find a small frequency of communications with the predominant direction being horizontal. The technology leaves little need for vertical communications, and an attempt by the consultant to increase the frequency of vertical communications would meet resistance from the nature of the organization's technology. The technology's rigidity might easily spell an early defeat for the consultant's suggestion.

If the organization development practitioner enters an organization with an understanding of what types of communication patterns are most satisfying for people and most efficient for information exchange and decision making, but lacks





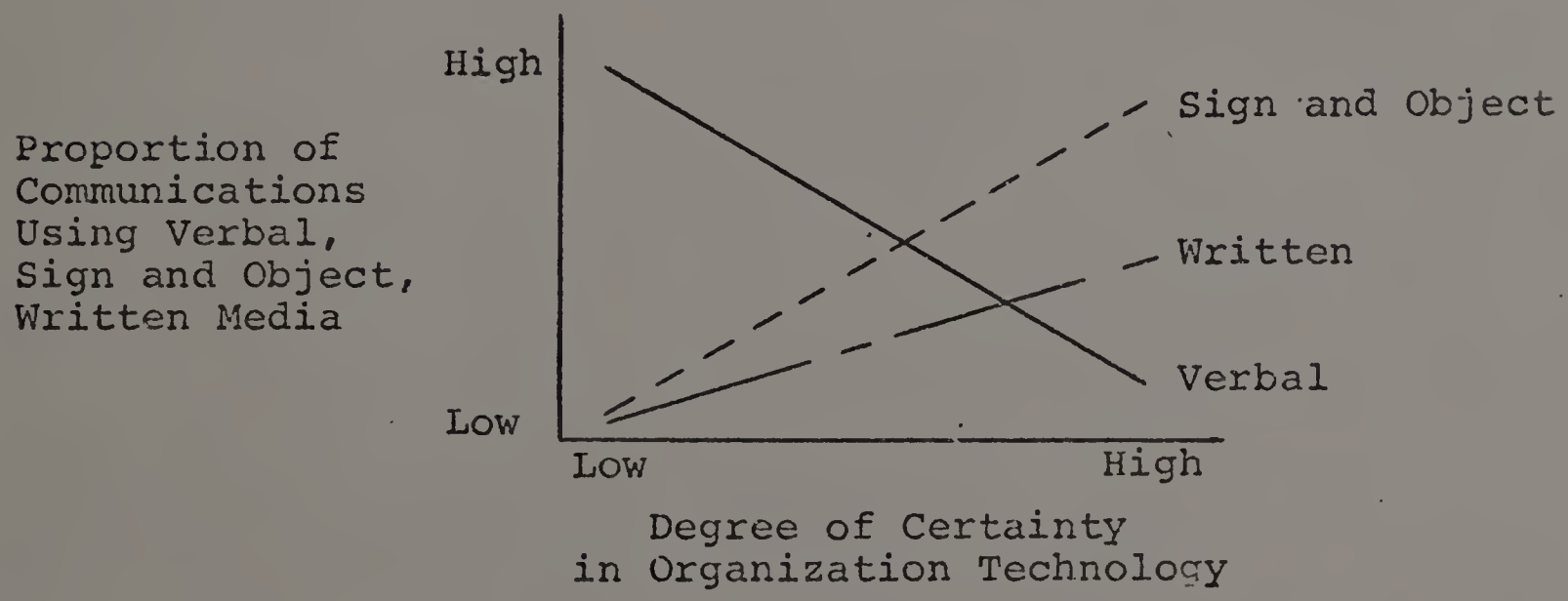


Figure 7-1. Tentative Relationships between Organization Technology and Several Dimensions of Task-Related Communication Patterns

Table 7-1. Purpose for Which Four Communication Channels Are Most Used in Three Technologies*

	Degree of Certainty in Organization Technology		
	Low	Medium	High
	Department		
Channel	Ward	Business Office	Kitchen
Vertical downward	Stimulus	Social	Stimulus
Vertical upward	Stimulus	Social	Social
Horizontal	Information exchange	Social	Social
Diagonal	Social	Social	Stimulus

* Excludes information exchange (except in Ward where it far exceeded any other purpose) which is the most general purpose category and was most used in all channels and technologies except horizontal in Business Office, and diagonal in Kitchen and Ward.

an understanding of the impact the organization's technology has on communication patterns, the practitioner enters with only half of the picture. The result is likely to be frustration for the organization members and inefficiency for the organization. If on the other hand, the practitioner enters with both an understanding of effective communications and an understanding of technology's influence on communications, the practitioner is utilizing more of the organization theory which is now available. Additionally, such utilization of theory in practice can advance the theoretical framework by continuously validating and re-defining its propositions in the field.

In summary, an organization's technology is an important variable affecting communication patterns in organizations. Organization development practitioners simply cannot afford to ignore its impact if they are to successfully assist organization in striving for effective operation, including satisfying needs of the human system of the organization.

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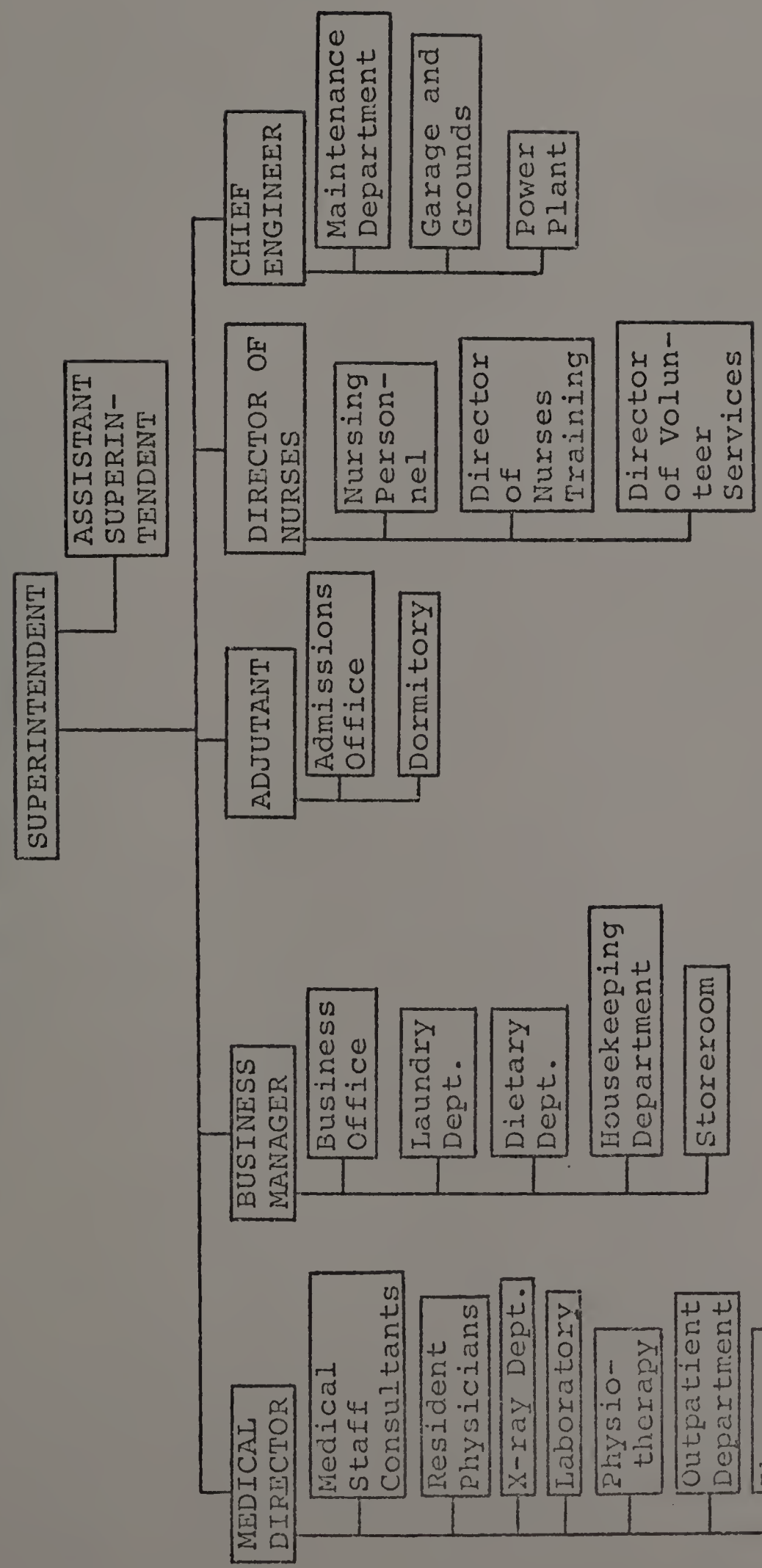
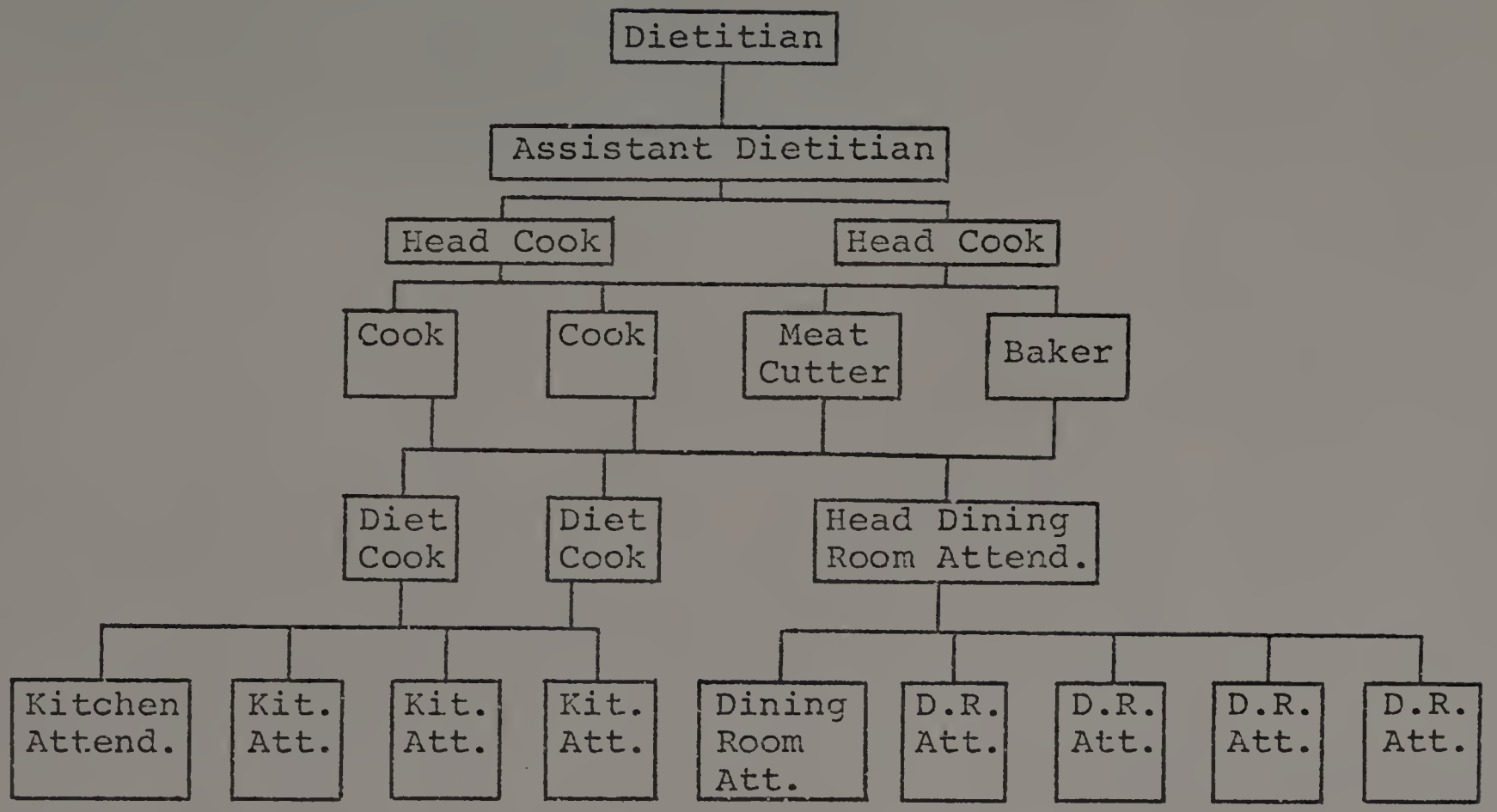
APPENDIX I

APPENDIX I

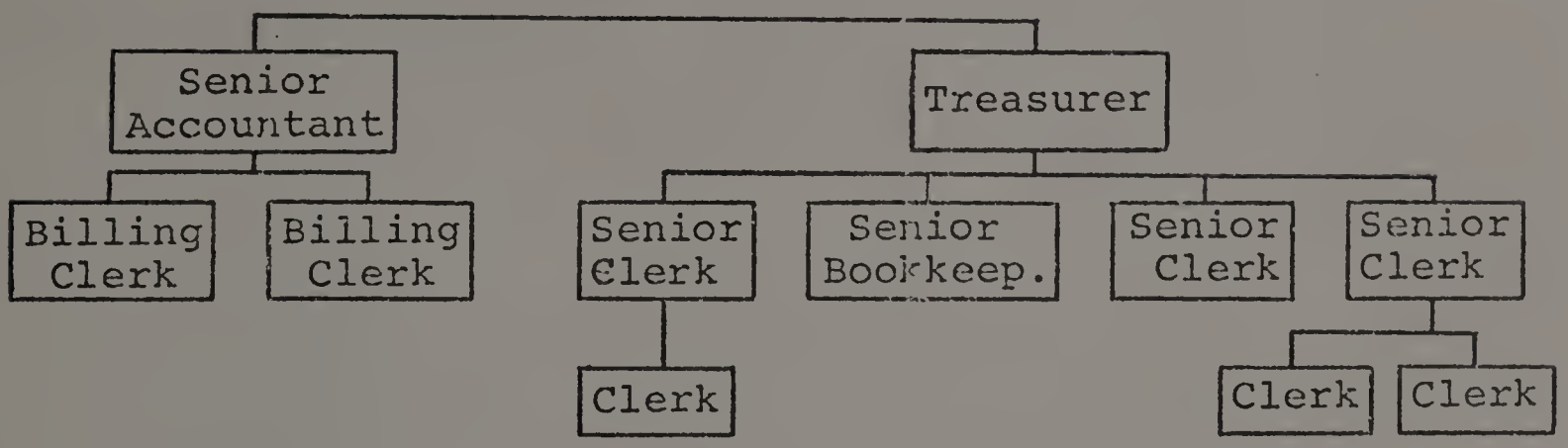

Home Organization Chart
SUPERINTENDENT
ASSISTANT SUPERIN-TENDENT
MEDICAL DIRECTOR
Medical Staff Consultants
Resident Physicians
X-ray Dept.
Laboratory
Physio-therapy
Outpatient Department
Pharmacy
Medical Records Section
BUSINESS MANAGER
Business Office
Laundry Dept.
Dietary Dept.
Housekeeping Department
Storeroom
ADJUTANT
Admission Office
Dormitory
DIRECTOR OF NURSES
Nursing Person-nel
Director of Nurses Training
Director of Volun-teer Services
CHIEF ENGINEER
Maintenance Department
Garage and Grounds
Power Plant

Kitchen Organization Chart*

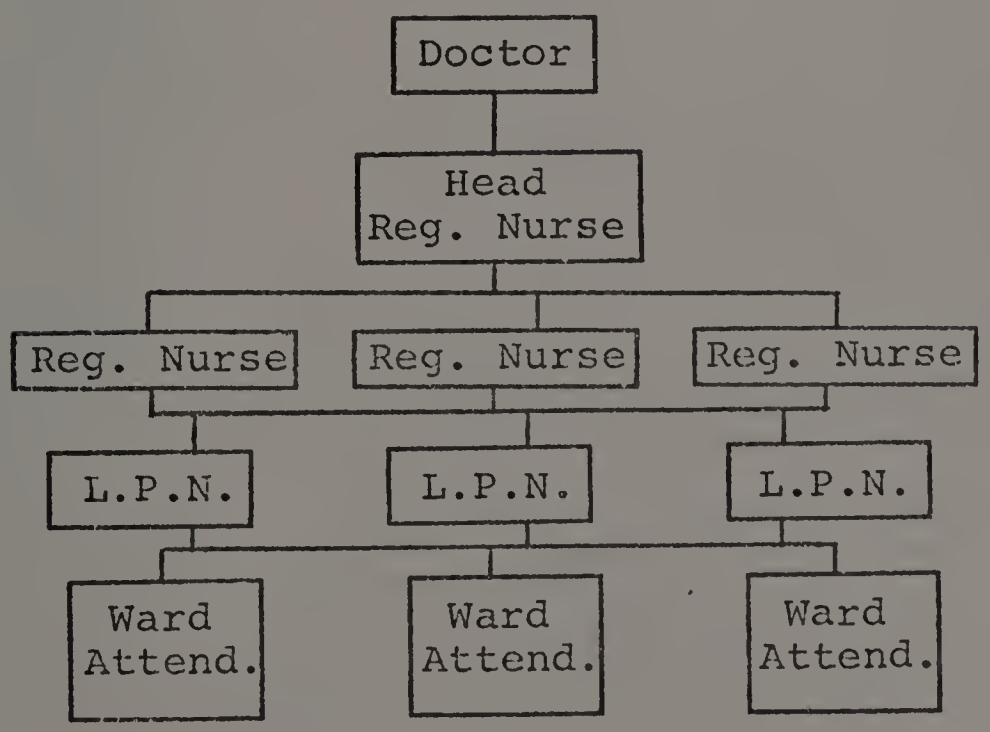


* This chart represents the staffing on a normal day.

Business Office Organization Chart



Ward Organization Chart*



* This chart represents the staffing on a normal day.

APPENDIX II

Perrow's Technology Construct
(Lynch, 1974)

Note: Read carefully the answer categories shown to the right. Then answer the following questions by circling the number which corresponds to the answer you wish to give.

	To a very little extent	To a little extent	To some extent	To a great extent	To a very great extent
1. Think of all the kinds of events that cause your work. To what extent would you say that you are usually able to anticipate and predict the nature of these events.	1	2	3	4	5
2. To what extent do you usually encounter the same kinds of problems in your work day after day?	1	2	3	4	5
3. Many jobs require the use of searching procedures of one kind or another to solve the problems encountered. To what extent are the searching procedures you use similar from one day to the next?	1	2	3	4	5
4. To what extent are the work decisions you make similar from one day to the next?	1	2	3	4	5

Responses to Lynch Questionnaire

by People in Kitchen, Business Office and Ward

	Kitchen		Business Office		Ward			
Question	Mean Score	Standard Deviation	Mean Score	Standard Deviation	Mean Score	Standard Deviation	F ratio	p
1	3.8	.99	3.6	.70	3.9	.64	.33	.72
2	3.8	1.28	3.2	.92	3.1	.99	1.43	.25
3	3.5	.97	3.1	.99	2.3	.71	4.88	.01
4	3.5	1.00	3.2	1.13	3.5	1.07	.27	.77
Total 1-4	14.6	3.45	13.1	2.80	12.8	.70	1.30	.29

APPENDIX III

OBSERVER SHEET

Name of observee_____ Date _____

Position and level of observee_____

Contact Record:

Other party involved, name and position (manuals, rules included)	Initiator	End Time -Begin Time Duration	Medium	Purpose	Observee is Giver or Receiver	Location	Attention Given (Hi-Med-Lo)
	Observee or other		See notes below	See notes below		Work station, superior office, other	

Notes: Medium may include: letter, memo, report, periodical, manual, rules, telephone, verbal one on one, discussion with several people, meeting (use sociograms for these last two), signs (e.g., body movements), signals (e.g., dials), objects, others to be added as necessary.
Purpose may include: exchange of information, advice exchange, stimulus to do certain tasks, problem solving, learning new tasks, alerting of a crisis (describe crisis), eavluative feedback on job, social, multiple if cannot list separately, others to be added as necessary.
Extra blank sheets will be used for sociograms and notes about what happens and why it seems to happen as related to technology demands.

APPENDIX IV

QUESTIONNAIRE

Date_____

Your name and position_____

1. Please complete the following record of the contacts you had today with other people and with manuals and rules books while doing your job. Please try to list and number all the contacts for today:

Other person(s) and position, manuals, rules you had contact with today	Initiator (self or other)	Duration of contact in minutes (estimate)	Medium (see note below)	Purpose (see note below)	Were you giver or receiver of information?	Location	Attention Given (Hi-Med-Lo)
1.							

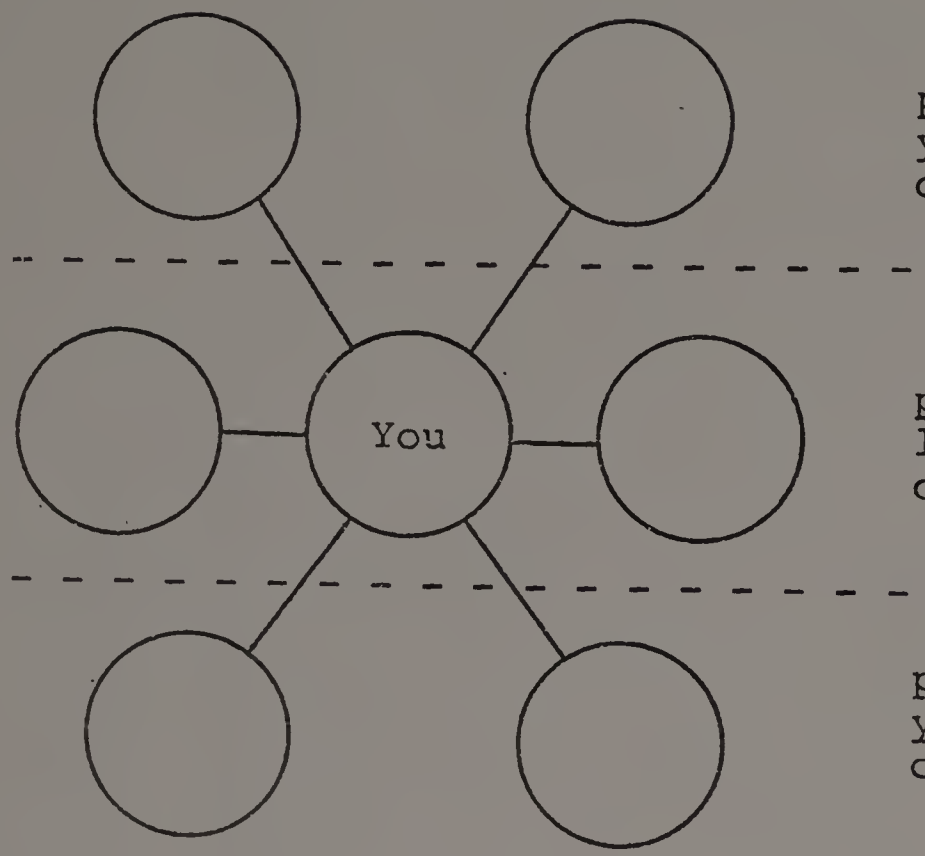
Note on Medium: Medium may include letter, memo, report, periodical, manual, rules, telephone, verbal one to one, discussion with several people, meeting, signs (e.g., body movements), signals (e.g., dials, lights, horns), object (i.e., the work piece or person), other (please indicate).

Note on purpose: Purpose may include exchange of information, advice exchange, stimulus to do certain tasks that are part of your job, problem solving, learning new tasks for your job, alerting of a crisis (please describe the crisis), feedback and appraisal of your work, social, multiple if too many to list separately, other (please indicate).

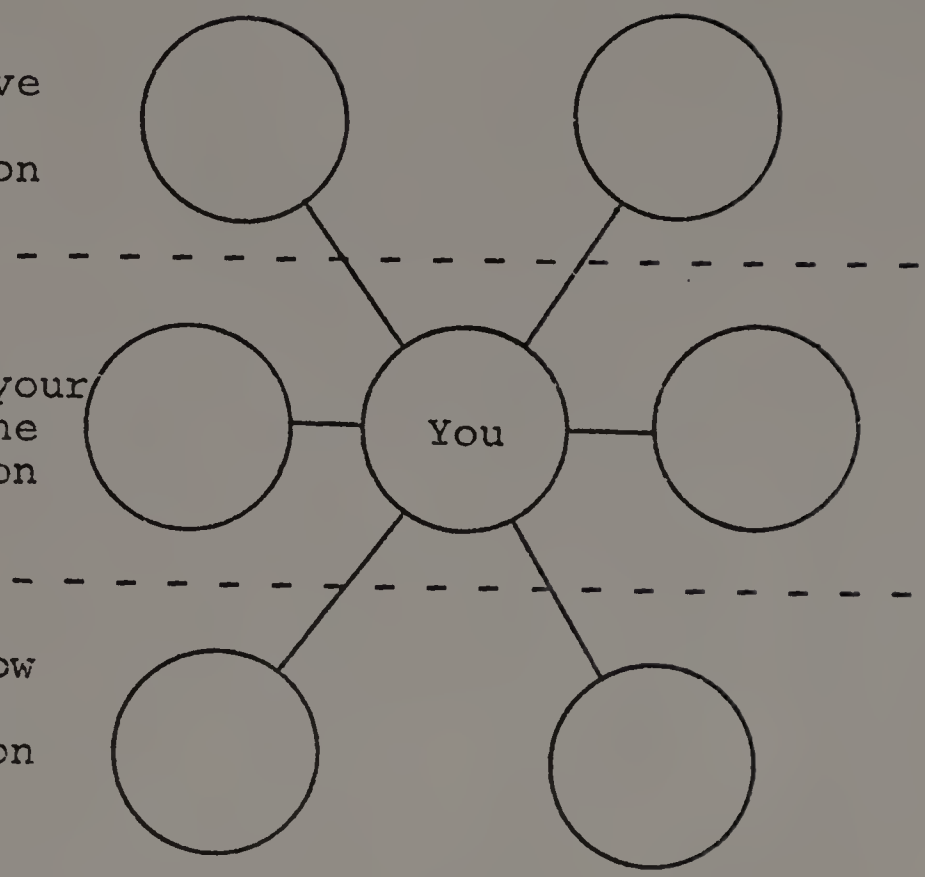
2. Would you say today was a typical day for you? Yes__ No __ Not sure __

For questions 3 to 7 please place the information requested in the circles below each question (draw other circles as necessary) and indicate by an arrowhead the usual direction of initiation of the communication:

3. Give the names and positions of 3 or 4 people you normally get information from to do your job.



4. Give the names and positions of 3 or 4 people you normally go to for help with work-related problems.

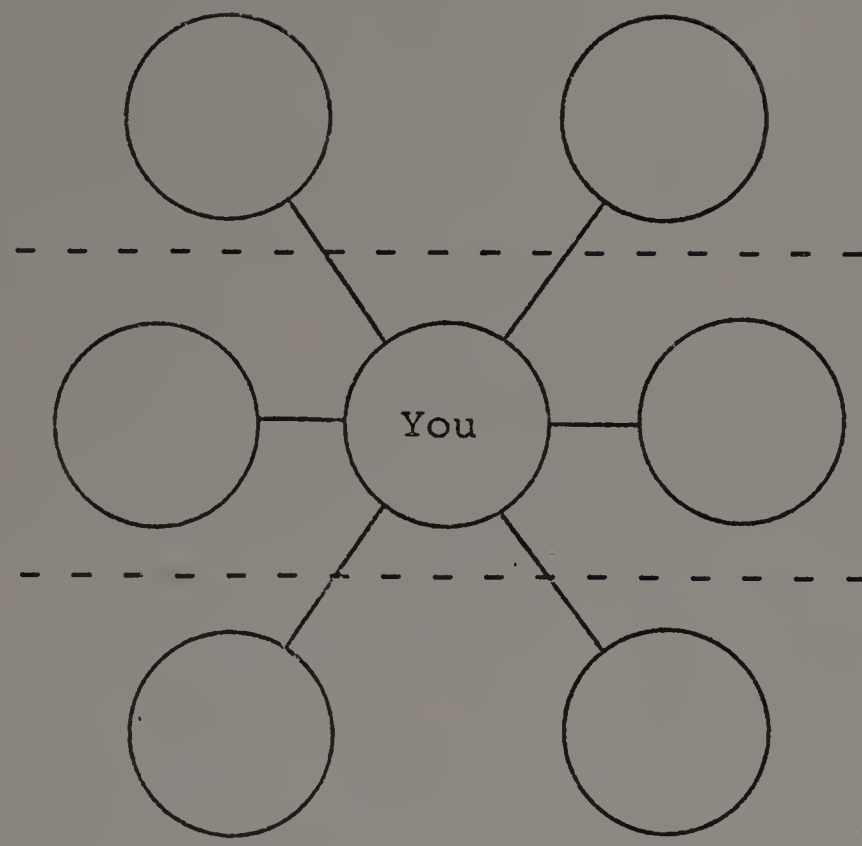


people above you in the organization

people on your level in the organization

people below you in the organization

5. Give the names and positions of 3 or 4 people who normally help you to learn new tasks on your job.

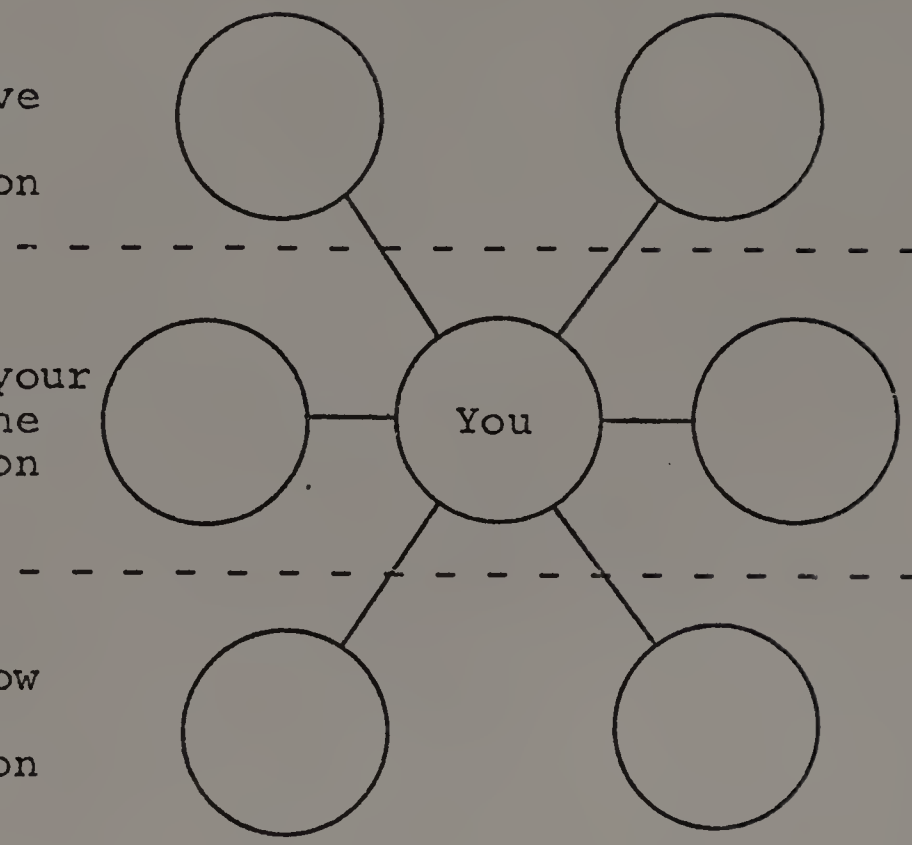


people above you in the organization

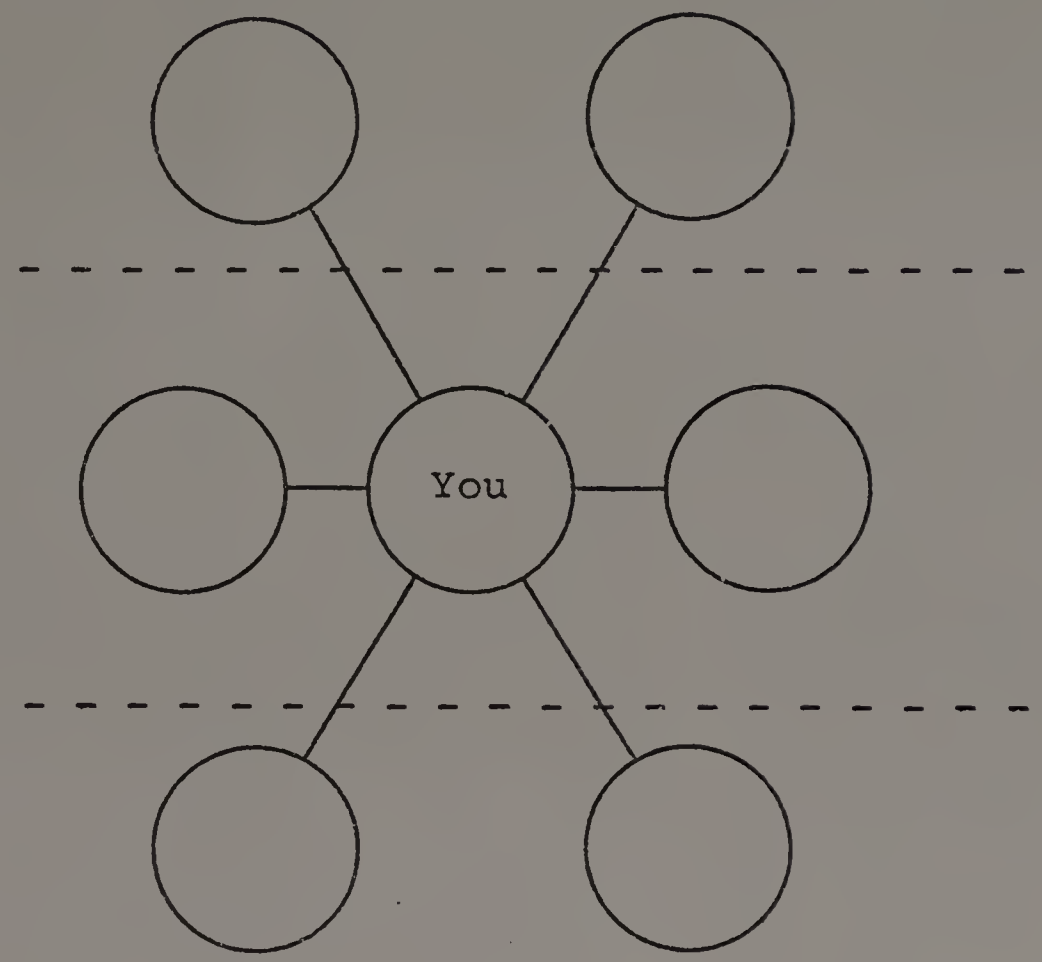
people on your level in the organization

people below you in the organization

6. Give the names and positions of 3 or 4 people who would most likely alert you of a crisis or severe problem in the organization



7. Give the names and positions of 3 or 4 people you normally socialize with while at work, say during lunch or coffee break.



people above you in the organization

people on your level in the organization

people below you in the organization

Note: Read carefully the answer categories shown to the right. Then answer questions 8 to 10 by circling the number which corresponds to the answer you wish to give.

	0-20%	21-40%	41-60%	61-80%	81-100%

8. What percentage of your work-related communications would you say are with your immediate superior and/or his/her superior?

1 2 3 4 5

What percentage would you say you initiate?

1 2 3 4 5

9. What percentage of your work-related communications would you say are with your peers in the organization?

1 2 3 4 5

What percentage would you say you initiate?

1 2 3 4 5

10. What percentage of your work-related communications would you say are with higher-ups in other departments?

1 2 3 4 5

What percentage would you say you initiate?

1 2 3 4 5

11. Think about the times you communicate with your superiors, regardless of who initiates the communications. There are a number of possible purposes for these communications, as shown below. Place check marks beside the 2 or 3 purposes which occur most frequently.

____ give or receive information
____ starting one of the tasks in your job
____ solving a work-related problem
____ learning a new task
____ dealing with a crisis (please give an example_____)
____ receiving evaluations on your performance
____ social (non-work-related)
____ other (please indicate)_____

12. Think of the times you communicate with your superiors, regardless of who initiates the communications. There are a number of possible media which can be used. Place check marks beside 2 or 3 of the media which are most frequently used.

____ letter or memorandum
____ report or procedure manual
____ telephone
____ verbal face to face (one to one)
____ group meeting or discussion with several people
____ signs (e.g., body movements, whistling)
____ signals (e.g., dials, lights, horns)
____ objects (that is, the work piece or person)
____ other (please indicate)_____

13. Think about the times you communicate with your peers, regardless of who initiates the communications. There are a number of possible purposes for these communications, as shown below. Place check marks beside the 2 or 3 purposes which occur most frequently.

____ give or receive information
____ starting one of the tasks in your job
____ solving a work-related problem
____ learning a new task
____ dealing with a crisis (please give an example_____)
____ receiving evaluations on your performance
____ social (non-work-related)
____ other (please indicate)_____

14. Think of the times you communicate with your peers, regardless of who initiates the communications. There are a number of possible media which can be used. Place check marks beside 2 or 3 of the media which are most frequently used.

____ letter or memorandum
____ report or procedure manual
____ telephone
____ verbal face to face (one to one)
____ group meeting or discussion with several people
____ signs (e.g., body movements, whistling)
____ signals (e.g., dials, lights, horns)
____ objects (that is, the work piece or person)
____ other (please indicate)_____

15. Think about the times you communicate with higher ups in other departments, regardless of who initiates the communications. There are a number of possible purposes for these communications, as shown below. Place check marks beside the 2 or 3 purposes which occur most frequently.

____ give or receive information
____ starting one of the tasks in your job
____ solving a work-related problem
____ learning a new task
____ dealing with a crisis (please give an example_____)
____ receiving evaluations on your performance
____ social (non-work-related)
____ other (please indicate)_____

16. Think about the times you communicate with higher ups in other departments, regardless of who initiates the communications. There are a number of possible media which can be used. Place check marks beside 2 or 3 of the media which are most frequently used.

____ letter of memorandum
____ report or procedure manual
____ telephone
____ verbal face to face (one to one)
____ group meeting or discussion with several people
____ signs (e.g., body movements, whistling)
____ signals (e.g., dials, lights, horns)
____ objects (that is, the work piece or person)
____ other (please indicate)_____

17. When you communicate with other people on the job <u>for the purpose of giving or receiving information</u> (regardless of who the people are or who initiates the communication), there are a number of possible media which can be used. Place check marks beside 2 or 3 of the media which are most frequently used.

____ letter or memorandum
____ report or procedure manual
____ telephone
____ verbal face to face (one to one)
____ group meeting or discussion with several people
____ signs (e.g., body movements, whistling)
____ signals (e.g., dials, lights, horns)
____ objects (that is, the work piece or person)
____ other (please indicate)_____

18. When you communicate with other people on the job <u>for the purpose of starting one of the tasks in your job</u> (regardless of who the people are or who initiaates the communication), there are a number of possible media which can be used. Place check marks beside 2 or 3 of the media which are most frequently used.

____ letter or memorandum
____ report or procedure manual
____ telephone
____ verbal face to face (one to one)
____ group meeting or discussion with several people
____ signs (e.g., body movements, whistling)
____ signals (e.g., dials, lights, horns)
____ objects (that is, the work piece or person)
____ other (please indicate)_____

19. When you communicate with other people on the job <u>for the purpose of solving a work-related problem</u> (regardless of who the people are or who initiates the communication), there are a number of possible media which can be used. Place check marks beside 2 or 3 of the media which are most frequently used.

____ letter or memorandum
____ report or procedure manual
____ telephone
____ verbal face to face (one to one)
____ group meeting or discussion with several people
____ signs (e.g., body movements, whistling)
____ signals (e.g., dials, lights, horns)
____ objects (that is, the work piece or person)
____ other (please indicate)_____

20. When you communicate with other people on the job <u>for the purpose of learning a new task</u> (regardless of who the people are or who initiates the communication), there are a number of possible media which can be used. Place check marks beside 2 or 3 of the media which are most frequently used.

____ letter or memorandum
____ report or procedure manual
____ telephone
____ verbal face to face (one to one)
____ group meeting or discussion with several people
____ signs (e.g., body movements, whistling)
____ signals (e.g., dials, lights, horns)
____ objects (that is, the work piece or person)
____ other (please indicate)_____

21. When you communicate with other people on the job <u>for the purpose of dealing with a crisis</u> (regardless of who the people are or who initiates the communication), there are a number of possible media which can be used. Place check marks beside 2 or 3 of the media which are most frequently used. Also, please give an example of what you mean by a crisis:

_____.

____ letter or memorandum
____ report or procedure manual
____ telephone
____ verbal face to face (one to one)
____ group meeting or discussion with several people
____ signs (e.g., body movements, whistling)
____ signals (e.g., dials, lights, horns)
____ objects (that is, the work piece or person)
____ other (please indicate)_____

22. When you communicate with other people on the job <u>for the purpose of receiving evaluations on your performance</u> (regardless of who the people are or who initiates the communication), there are a number of possible media which can be used. Place check marks beside 2 or 3 of the media which are most frequently used.

____ letter or memorandum
____ report or procedure manual
____ telephone
____ verbal face to face (one to one)
____ group meeting or discussion with several people
____ signs (e.g., body movements, whistling)
____ signals (e.g., dials, lights, horns)
____ objects (that is, the work piece or person)
____ other (please indicate)_____

23. When you communicate with other people on the job <u>for the purpose of social or non-work-related concerns</u> (regardless of who the people are or who initiates the communication), there are a number of possible media which can be used. Place check marks beside 2 or 3 of the media which are most frequently used.

____ letter or memorandum
____ report or procedure manual
____ telephone
____ verbal face to face (one to one)
____ group meeting or discussion with several people
____ signs (e.g., body movements, whistling)
____ signals (e.g., dials, lights, horns)
____ objects (that is, the work piece or person)
____ other (please indicate) _____

Note: Read carefully the answer categories shown to the right. Then answer questions 24 to 30 by circling the number which corresponds to the answer you wish to give.

	To a very little extent	To a little extent	To some extent	To a great extent	To a very great extent
24. To what extent does your job require that you have freedom to decide matters regarding your own work?	1	2	3	4	5
25. To what extent does the machinery and equipment you work with set the pace of your work?	1	2	3	4	5
26. If others in your department do not do their jobs well, to what extent does this hinder your doing your job well?	1	2	3	4	5

	To a very little extent	To a little extent	To some extent	To a great extent	To a very great extent
27. To what extent must you communicate with others in your department in order to do your job well?	1	2	3	4	5
28. To what extent do you have to work directly with people in other departments in order to do your job well?	1	2	3	4	5
29. To what extent is your planned work frequently interrupted by unexpected problems?	1	2	3	4	5
30. To what extent do you often need help to solve the unexpected problems you encounter?	1	2	3	4	5

Note: The majority of these questions have been adapted from questionnaires developed at the University of Michigan Survey Research Center and by Thomas J. Allen at MIT. A brief pilot test of the questionnaire was conducted to test its construct validity, and more information regarding its validity and reliability will become available as this research progresses.

Responses to Researcher's Questionnaire on Communications by People in Kitchen, Business Office and Ward (data from first seven questions could not be used because of interpretation problems)

	Kitchen		Business Office		Ward			
Question	Mean Score	Standard Deviation	Mean Score	Standard Deviation	Mean Score	Standard Deviation	F ratio	p
8	3.0	1.37	3.2	1.47	4.1	1.23	3.07	.057
8a	3.2	1.27	3.2	1.08	3.9	1.10	1.50	.24
9	3.2	1.21	2.3	1.19	3.9	.83	7.00	.002
9a	2.9	1.10	2.3	.90	4.0	.55	11.87	.000
10	1.9	1.39	1.9	1.04	2.6	1.50	1.32	.28
10a	2.2	1.54	2.2	1.17	2.9	1.49	1.34	.27
24	3.1	.97	3.0	1.26	3.2	1.05	.14	.87
25	3.5	.96	2.7	.77	3.2	1.31	1.76	.18
26	3.2	1.27	2.4	1.36	3.4	.85	2.75	.08
27	2.9	1.24	2.5	1.21	3.8	1.12	3.75	.03
28	2.5	1.17	2.7	1.35	3.1	1.29	1.15	.33
29	2.3	1.05	2.8	.87	3.8	.80	9.96	.000
30	1.9	1.04	1.9	.88	2.7	.83	3.55	.04

Question 11 - Frequencies of Responses

		Department			
Purpose		Kitchen	Business Office	Ward	Total
Give/Receive Information	E	16	11	13	
	O	17	11	12	40
Start task	E	6	5	6	
	O	7	2	8	17
Solve problem	E	13	9	10	
	O	12	10	10	32
Other	E	12	8	10	
	O	11	15	9	30
Total		47	33	39	119

Overall $X^2 = 9.28$, $p=.17$

Question 12 - Frequencies of Responses

		Department			
Media		Kitchen	Business Office	Ward	Total
Written	E	7	4	6	
	O	8	3	6	17
Telephone	E	6	4	4	
	O	5	5	4	14
Verbal	E	17	11	14	
	O	18	11	13	42
Other	E	2	1	2	
	O	2	2	1	5
Total		39	26	33	98

Overall $X^2 = 3.32$, $p=.80$ (if combine Telephone and Other categories)

Question 13 - Frequencies of Responses

Purpose		Department: Kitchen	Business Office	Ward	Total
Give/Receive Information	E	15	10	14	
	O	16	11	12	39
Start task	E	8	5	7	
	O	10	5	5	20
Solve Problem	E	9	6	8	
	O	8	7	8	23
Other	E	13	8	11	
	O	11	7	14	32
Total		45	30	39	114

Overall $X^2 = 3.07$, $p=.80$

Question 14 - Frequencies of Responses

Media		Department: Kitchen	Business Office	Ward	Total
Written	E	4	3	3	
	O	6	0	4	10
Telephone	E	5	3	4	
	O	1	8	3	12
Verbal	E	25	15	19	
	O	25	14	20	59
Other	E	3	2	3	
	O	5	1	2	8
Total		37	23	29	89

Frequencies too small to calculate Chi-Square statistic

Question 15 - Frequencies of Responses

Purpose		Department: Kitchen	Business Office	Ward	Total
Give/Receive Information	E	14	10	11	
	O	13	10	12	35
Start task	E	6	4	6	
	O	9	4	3	16
Solve Problem	E	9	6	8	
	O	4	9	10	23
Other	E	10	7	7	
	O	13	4	7	24
Total		39	27	32	98

Overall $X^2 = 9.63$, $p=.15$

Question 16 - Frequencies of Responses

Media		Department: Kitchen	Business Office	Ward	Total
Written	E	5	3	4	
	O	5	4	3	12
Telephone	E	11	9	10	
	O	11	11	8	30
Verbal	E	17	14	15	
	O	15	11	20	46
Other	E	3	2	2	
	O	5	2	0	7
Total		36	28	31	95

Overall $X^2 = 6.16$, $p=.20$ (if combine Written and Other categories)

Question 17 - Frequencies of Responses

		Department			
Media		Kitchen	Business Office	Ward	Total
Written	E	6	4	4	
	O	8	1	5	14
Telephone	E	7	5	5	
	O	3	10	4	17
Verbal	E	23	15	18	
	O	24	11	21	56
Other	E	3	2	2	
	O	4	3	0	7
Total		39	25	30	94

Overall X^2 = 13.18, p=.02 (if combine Written and Other categories

Question 18 - Frequencies of Responses

		Department			
Media		Kitchen	Business Office	Ward	Total
Written	E	8	5	6	
	O	7	5	7	19
Telephone	E	6	4	4	
	O	3	9	2	14
Verbal	E	20	15	16	
	O	22	11	18	51
Other	E	4	3	3	
	O	5	2	3	10
Total		37	27	30	94

Overall X^2 = 5.33, p=.25 (if combine Telephone and Other categories)

Question 19 - Frequencies of Responses

		Department			
Media		Kitchen	Business Office	Ward	Total
Written	E	4	3	3	
	O	6	1	3	10
Telephone	E	5	4	4	
	O	2	8	3	13
Verbal	E	27	18	20	
	O	28	14	23	65
Other	E	2	1	1	
	O	2	3	0	5
Total		38	26	29	93

Frequencies too small to calculate Chi-Square statistic

Question 20 - Frequencies of Responses

		Department			
Media		Kitchen	Business Office	Ward	Total
Written	E	7	4	5	
	O	7	3	6	16
Telephone	E	3	1	2	
	O	1	4	1	6
Verbal	E	25	14	19	
	O	25	12	21	58
Other	E	5	3	3	
	O	6	4	1	11
Total		39	21	29	89

Frequencies too small to calculate Chi-Square statistic

Question 21 - Frequency of Responses

		Department			
Media		Kitchen	Business Office	Ward	Total
Written	E	5	3	3	
	O	7	2	2	11
Telephone	E	8	4	5	
	O	6	6	5	17
Verbal	E	26	13	18	
	O	25	12	20	57
Other	E	3	1	2	
	O	3	1	2	6
Total		41	21	29	91

Frequencies too small to calculate Chi-Square statistic

Question 22 - Frequencies of Responses

		Department			
Media		Kitchen	Business Office	Ward	Total
Written	E	8	3	5	
	O	7	2	7	16
Telephone	E	1	0	1	
	O	1	1	0	2
Verbal	E	18	6	13	
	O	18	6	13	37
Other	E	2	1	1	
	O	2	1	1	4
Total		28	10	21	59

Frequencies too small to calculate Chi-Square statistic

Question 23 - Frequencies of Responses

		Department			
Media		Kitchen	Business Office	Ward	Total
Written	E	2	1	2	
	O	3	0	2	5
Telephone	E	7	3	6	
	O	6	3	7	16
Verbal	E	27	13	18	
	O	27	14	17	58
Other	E	1	1	1	
	O	2	1	0	3
Total		38	18	26	82

Frequencies too small to calculate Chi-Square statistic

APPENDIX V

APPENDIX V

The following pages contain a questionnaire related to job climate and leadership style. This questionnaire was administered to the employees of the Soldier's Home as part of a larger questionnaire, which was administered to the employees during the data collection phase of an earlier organization development project in which the author participated. Only those questions directly related to this study of the relationship between technology and communication patterns are contained in this Appendix. Many of the questions were adapted from a questionnaire from the Institute for Social Research at the University of Michigan.

When the questionnaire was administered, each respondent reported certain demographic data on the answer sheet: age, sex, years of service at the Home, and amount of schooling.

SOLDIERS' HOME QUESTIONNAIRE

General Instructions

You have in your hands a questionnaire composed of two sets of questions, dealing with different subjects (your job and your supervisor). The questions are multiple choice questions. You also have an answer sheet on which you are asked to indicate your answer to the questions.

Please read carefully the answer categories that go with the questions. Then read carefully the questions themselves.

When you have decided upon your answer for each question, blacken the box on the answer sheet which corresponds to the answer you wish to give (choices are 1,2,3,4, and 5). Please be sure the answer number on the answer sheet is the same as the question number you are answering.

THIS FIRST SET OF QUESTIONS IS RELATED TO YOUR JOB AT THE HOME:

	To a very little extent	To a little extent	To some extent	To a great extent	To a very great extent
1. To what extent is your department quick to use improved work methods?	1	2	3	4	5
2. To what extent do people in your department know what their jobs are?	1	2	3	4	5
3. All in all, how satisfied are you with your job?	1	2	3	4	5
4. All in all, how satisfied are you with the people in your department?	1	2	3	4	5

In general, to what extent does each of the following groups of people have influence about what goes on in your department?

5. Supervisors?	1	2	3	4	5
6. Top administrators?	1	2	3	4	5
7. Employees?	1	2	3	4	5

8. In general, to what extent do you have influence about what goes on in your department?

1 2 3 4 5

9. To what extent are people in your department willing to listen to your problems?

1 2 3 4 5

10. To what extent are people in your department friendly and easy to approach?

1 2 3 4 5

11. To what extent do people in your department encourage each other to give their best effort?

1 2 3 4 5

12. To what extent do people in your department help you find ways to do a better job?

1 2 3 4 5

13. To what extent do people in your department encourage each other to work as a team?

1 2 3 4 5

14. To what extent do you feel the people in your department work together as a team?

1 2 3 4 5

THIS NEXT SET OF QUESTIONS RELATES TO THE SUPERVISOR TO WHOM YOU REPORT DIRECTLY (YOUR IMMEDIATE SUPERVISOR).

15. How often does your supervisor hold group meetings where he/she and the people who work for him/her can really discuss things together?

1 2 3 4 5

16. How friendly and easy to approach is your supervisor?

1 2 3 4 5

17. When you talk with your supervisor, to what extent does he/she pay attention?

1 2 3 4 5

18. To what extent is your supervisor willing to listen to your problems?

1 2 3 4 5

19. To what extent does your supervisor encourage subordinates to take action without waiting for detailed review and approval from him/her?

1 2 3 4 5

20. To what extent does your supervisor encourage the people who work for him/her to work as a team?

1 2 3 4 5

21. To what extent does your supervisor encourage people who work for him/her to exchange opinions and ideas?

1 2 3 4 5

To be a better manager, to what extent does your immediate supervisor need:

22. More interest in and concern for the people who work for him/her?

1 2 3 4 5

23. More information about principles of good management?

1 2 3 4 5

24. To what extent do you feel your supervisor has confidence and trust in you?

1 2 3 4 5

25. To what extent do you have confidence and trust in your supervisor?

1 2 3 4 5

26. All in all, to what extent are you satisfied with your supervisor?

1 2 3 4 5

Responses to Climate and Leadership Questionnaire

by People in Kitchen, Business Office and Ward

	Kitchen		Business Office		Ward			
Question	Mean Score	Standard Deviation	Mean Score	Standard Deviation	Mean Score	Standard Deviation	F ratio	p
1	1.8	.98	2.4	1.16	2.5	1.00	2.21	.12
2	1.8	1.13	2.9	.79	2.5	.90	5.57	.007
3	2.6	1.32	3.3	.97	2.3	1.23	1.83	.17
4	2.3	1.14	3.4	.51	2.9	1.44	4.11	.02
5	2.3	1.43	2.6	1.08	3.3	1.14	2.00	.15
6	2.5	1.50	2.9	1.24	2.6	1.50	.32	.73
7	1.5	1.47	1.6	1.24	1.5	1.21	.007	.99
8	1.1	1.23	1.6	1.16	.7	1.10	1.50	.23
9	1.7	1.22	3.0	.95	1.9	1.62	3.81	.03
10	2.0	1.43	3.6	.51	2.1	1.62	5.89	.006
11	1.3	1.27	2.5	1.17	2.3	1.07	5.08	.01
12	1.8	1.33	2.3	1.37	2.5	1.09	1.50	.23
13	1.2	1.40	2.6	1.08	1.9	1.44	4.26	.02
14	1.2	1.12	2.5	.67	2.2	1.47	5.96	.005
15	.6	1.03	1.8	1.42	1.3	1.67	3.29	.05
16	1.9	1.30	3.5	.67	2.1	1.78	5.94	.005
17	1.7	1.31	3.4	.90	2.6	1.38	7.84	.001
18	2.0	1.09	3.3	.78	2.3	1.37	5.64	.007
19	1.6	1.20	2.3	1.14	1.3	1.42	1.99	.15
20	1.4	1.43	2.6	.99	2.3	1.54	3.11	.06
21	1.1	1.26	2.6	1.08	1.5	1.78	4.50	.02
22	2.5	1.08	1.4	1.73	2.3	1.71	2.26	.12
23	2.2	1.30	1.9	1.68	1.7	1.15	.69	.50
24	2.3	1.23	2.9	1.08	2.1	1.67	1.33	.28
25	2.2	1.18	3.1	1.16	2.7	1.23	2.39	.10
26	2.1	1.22	3.1	.99	2.3	1.44	2.51	.09
Age	41-50		31-40		31-40		1.3	.30
Years serv.	1-5 yrs.		1-5 yrs.		1-5 yrs.		.4	.69
Sex	Mostly male		Mostly female		Mostly female		-	-
Education	Completed high school		Comp. prof. or tech. sch.		Comp. prof. or tech. sch.		6.21	.004