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A SOCIOTECHNICAL APPROACH TO THE STUDY OF
SEMIAUTONOMOUS WORK GROUP COMMUNICATION
IN TECHNICAL ORGANIZATIONS

by

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B.S.E.E. June 1986, Clemson University

A Thesis Submitted to the Faculty of
Old Dominion University in Partial Fulfillment of the
Requirements for the Degree of

MASTER OF ENGINEERING MANAGEMENT

OLD DOMINION UNIVERSITY
May 1993

Approved by:

Frederick Steier (Director)

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ABSTRACT

A SOCIOTECHNICAL APPROACH TO THE STUDY OF SEMIAUTONOMOUS WORK GROUP COMMUNICATION IN TECHNICAL ORGANIZATIONS

Elizabeth B. Varnes
Old Dominion University, 1993
Director: Dr. Frederick Steier

The sociotechnical aspects of group communication in semiautonomous technical work teams were investigated to understand how team members define "effective" group communication and what impact technical tools have on the group communication process. A team of workers with various technical backgrounds was selected for study. The study involved videotaped group sessions, a group training educational briefing and individual group member questionnaires. The results indicate that group members believed sharing information among group members was critical to successful communication and that certain technical tools could be effective during group meetings. The findings are congruent with the general theory that group communication is multi-dimensional with social characteristics that must be considered as well as technical aspects.

DEDICATION

To Robert and Catherine

ACKNOWLEDGEMENTS

I would like to thank my advisor, Dr. Frederick Steier, for his guidance, support and teachings which helped me explore new ideas and concepts in this exciting area of sociotechnical systems. My appreciation also extends to my advisory committee members, Dr. Lawrence Richards and Dr. Billie Reed, who provided helpful insight and suggestions to complete this work.

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CHAPTER 1
INTRODUCTION

A growing area of research in engineering management is the sociotechnical study of group interaction. There have been numerous studies performed on the group communication process, but most have focused only on the social aspects of group communication. Sociotechnical theory involves not only concern for the social aspects of group communication but also the technical factors of the communication process as well. In his book, Autonomous Group Functioning, P. G. Herbst states that "a basic implication of the socio-technical approach is that the adequacy of a social system has to be looked at with reference to the task to be carried out and the technology employed" (p. 7). Therefore, in order to perform a more complete study of group interaction, one must investigate both the social and technical aspects of group communication.

This study involves investigation of technical work groups (groups in which members have scientific or engineering backgrounds and experience and are involved in working with technical issues and problems). Social aspects

of group communication were observed and investigated, and additional study considered some of the technical tools that may be used during group interaction.

Theoretical Formulation

Analysis of previous research of sociotechnical systems theory indicates that several areas need additional study, such as understanding aspects of effective communication and use of technical tools. This research attempts to understand the social issue of how group members interpret and define "effective" communication. Additionally, technical tools currently used in the group communication process are identified, and their effects on the communication process are investigated. By studying group communication using sociotechnical theories, it is believed that this research may aid in more completely understanding the group communication process.

Purpose of the Study

The purpose of this study is to investigate some of the sociotechnical aspects of group communication for a work group comprised of members with technical backgrounds in science and engineering and involved in working with technical problems and issues. This research will increase understanding of how group members define "effective" group

communication and how technical tools may affect the group communication process.

Problem

As earlier indicated, there has been a great deal of research done in studying the group communication process, much of which has been performed with strong emphasis on the social aspects of group interaction; technical characteristics of group study have been largely ignored. Sociotechnical researchers study group communication from both social and technical perspectives.

Many technical organizations are currently involved with quality initiatives involving improvement of technical teams. Communication-based qualities of work groups have been studied to determine the effectiveness of the group (Fisher, p. 198). This study seeks to determine some of the factors which group members associate with effective communication in the hope that by understanding how group members individually define "effective" communication, significant improvements can be made to enhance technical team quality.

Technical aspects of groups may include the makeup of the group (i.e., the range of technical backgrounds in science and engineering), the specific task of the group (i.e., a task involving technical design or problem solving) and technical tools that may be used by the group during the

group communication process (e.g., the spectrum of tools ranging from pen and paper to integrated workstations). This study focuses on determining the technical tools currently used during group communication and obtaining information about tools which group members may find helpful for future group interaction. Therefore, by understanding the impact of technical tools on the group communication process, this investigation may lead to quality initiative improvements through changes in tools or their use.

Methods and Procedure

The work group under study was comprised of individuals with engineering and technological backgrounds. The group was semi-autonomous in that one group member, Group Member C, served as a design leader although he did not supervise other group members or evaluate their performance. Tasks of the group were technical in nature with discussions and communication of the group focusing on technical design issues.

Physical tools (materials and facilities) used by the group during group meetings were considered "technical tools". A wide range of technical tools was available for use by the group during group meetings and included Computer Aided Design (CAD) equipment, simple pen and paper, a conference room with table, whiteboard (similar to a blackboard, but some whiteboards have the capability of

printing hard copies of what is written on them), flip chart, overhead projector, etc. Group meetings occurred in two different locations in order to investigate changes in the group interaction process possibly attributable to the use of different technical tools during group meetings. The group was studied as a system, and the interactions which occurred during discussions and the communication process were interpreted. By viewing the work group from a systems perspective, consideration was given as to how elements of the system (i.e., group members, their behavior and tools) impacted one another in the communication process.

Several methods of investigation (i.e., questionnaires, observations, and an educational briefing) were used for this study. First, each member of the group was given a questionnaire (see Appendix A) to fill out before the first observed group meeting. The responses to this questionnaire are summarized in Appendix C. The researcher was then allowed to "sit in" on a "typical" group meeting which was videotaped by the researcher. Several weeks after the initial group meeting, the researcher met with the group to present theoretical information about group communication. The purpose of the briefing was not only for group member education but to study the effect, if any, that education or discussion about communication may have on the second group meeting to follow. Next, a second group meeting was conducted and again, the researcher simply observed the

meeting, and the observation was videotaped for later review by the researcher. Shortly after the second meeting, group members were asked to fill out a second questionnaire (see Appendix B). Responses to this questionnaire are summarized in Appendix D.

CHAPTER 2
BACKGROUND OF THE STUDY

Review of Literature

Discussion of Sociotechnical Systems

The term "sociotechnical system" was originally used by Trist and Bamforth in 1951 at the Tavistock Institute of Human Relations in London where they were conducting studies of work groups in British deep-seam coal mines. As referenced in Emery and Trist (Emery, Trist, 1973), Trist and Bamforth (1951) felt that in studying these groups, the social and technical aspects were so closely linked that "the social and the psychological can be understood only in terms of the detailed engineering facts and of the way the technological system as a whole behaves in the environment of the underground situation" (p. 215). Thus, instead of simply *social* systems theory, Trist and Bamforth selected the term *sociotechnical* systems theory to more accurately describe the basis of their approach to studying work groups. Later research, conducted by Emery and Trist, continued in sociotechnical systems theory and introduced an additional facet which they entitled "enterprises" (Emery,

Trist, 1973, p. 215). Emery (Emery, Trist, 1973) described an enterprise as "an organization of men and materials about some human endeavor" (p. 215). Emery and Trist (De Greene, 1973) considered that the technological component served as one of the major boundary conditions of the social system by "mediating between the enterprise and the external environment" (p. 47). Pasmore referenced Emery (1959) and Emery's belief that "peak performance" (Pasmore, 1988, p. 2) could only be obtained when the needs of both social and technical systems, "dual optimization" (Pasmore, 1988, p. 2), were met.

The study of sociotechnical systems attempts to understand the relationships between technology and people. Kenyon B. De Greene (De Greene, 1973) stated that in trying to understand the "people" aspect of a sociotechnical system, one must be "concerned with those features of behavior, perceptual, motivational, decisional, attitudinal, and so on, manifested by people collectively" (p. 3). De Greene defined the "technology" aspect as "the collective body of scientific concept, experimentation, and analysis; engineering design; industrial production; hardware and gadgets; and consumer utilization" (p. 3). Technology has also been described in terms of "complexity" (Woodward, 1965), "variability" (Hickson, Pugh, and Pheysey, 1963), "interdependence" (Hrebiniak, 1974), "routine-nonroutine"

(Perrow, 1967, 1970), and "manageability of raw materials" (Mohr, 1979) as cited by David (David, 1989, p. 235).

Pasmore (Pasmore, 1988) stated,

The sociotechnical systems perspective considers every organization to be made up of people (the social system) using tools, techniques and knowledge (the technical system) to produce goods or services valued by customers (who are part of the organization's external environment). How well the social and technical systems are designed with respect to one another and with respect to the demands of the external environment determines to a large extent how effective the organization will be. (p. 1)

Pasmore (Pasmore, 1988) continued by providing a review (Friedlander and Brown, 1974, Taylor, 1977, Walton, 1974, and Pasmore et al., 1982) of the actual use of sociotechnical systems. Pasmore (Pasmore, 1988) stated,

The most popular design feature has been the formation of autonomous groups. When these groups were utilized and results were reported, they were associated with improvements in productivity, costs, attitudes, and quality over 80% of the time....Training to enhance the level of technical knowledge of the work force has been used next most often, in about 40% of the reported cases. In order to be able to control variances at their source, employees must understand both the equipment they use in the conversion process and the process itself. Improving technical skills enhances troubleshooting capabilities and also increases the likelihood that operators will be able to offer meaningful suggestions to improve how work is done. Training was associated with improvements in performance in over 90% of the cases which reported its use....Surprisingly, only 16% of the organizations which understood sociotechnical systems design reported making technological changes. It seems that the bulk of sociotechnical efforts have failed to take advantage of the power technological change can have in changing behaviors and enhancing organizational effectiveness. Apparently, we need to do more to educate and

involve the designers of technical systems in sociotechnical concepts. In the organizations which did undertake changes in their technical systems and reported results, all were successful in improving quality but only 60% were successful in raising productivity. Again, it seems surprising that new technology does not always produce better bottom-line results, particularly since improving the bottom-line is the primary motivation for technological change. Clearly, more work needs to be done to understand what is happening in experiments involving new technology or changes in existing technology. (p. 103)

In conclusion of this section, it is important to note Pasmore's (Pasmore, 1988) belief that sociotechnical systems design should "allow organizations to make better use of people and machines" (p. 101). Pasmore (Pasmore, 1988) continued,

Whenever there are people, working together in a system with technology, in an environment that provides resources the system needs, there is the possibility of adapting sociotechnical systems thinking to help improve the system's effectiveness. (p. 155)

The Group As An Organization

De Greene (De Greene, 1973) referenced the work of Lichtman and Hunt (1971) who prepared a thorough literature review and developed a classification of theorists involved in studying the relationship between persons and organizations. The second of Lichtman and Hunt's four classifications relates to this study and is entitled "modern structural theorists", a group of theorists who generalized "that man is self-actualizing; hence, organizational design should result in a looser, more

decentralized structure than bureaucracy" (p. 17). Lichtman and Hunt cited Argyris as a "modern structural theorist" who felt that

organizational structure, to achieve efficiently its objectives, should provide increasing opportunity for self-esteem and at the same time reduce compulsive, defensive behavior associated with low morale, feelings of insecurity, etc. (p. 17)

The third of Lichtman and Hunt's theorist classifications as referenced by De Greene (De Greene, 1973) was "personalistic theorists", who

emphasize individual differences in human cognition, emotion, experience, and so forth. Emphasis is thus at the level of the individual or small group (the psychological level) rather than at the sociological level of organizational structure. (p. 17)

In this classification of theorists, Lichtman and Hunt cited Lewin who felt that

man reacts to an organization on the basis of his perceptions of it and the perceptions in turn are based on man's needs, motives, values, and attitudes. Hence, to change an organization one must alter the perceptions of people (by the group-dynamics-based T-group approach, for example). (p. 18)

Lichtman and Hunt also cited Mayo and the Hawthorne studies in which

friendship patterns or human relations provide the essential, if informal, structure of an organization. Management's interest can best be served by changing people's perceptions toward work and toward the organization as it is. 'Participative management' thus turns out to be manipulative. (p. 18)

Additionally, Lichtman and Hunt cited Likert, a "personalistic theorist" based on their definition. Likert

felt that for an organization to most effectively work, it should concentrate its structure not on individual levels but on work groups which "should be overlapping in both the hierarchical and horizontal senses, in order to enhance employee participation in decision-making" (p. 18).

Fisher (Fisher, 1980) referenced the definition of a group given by Shaw (1976) as "...two or more persons who are interacting with one another in such a manner that each person influences and is influenced by each other person" (p. 17). Fisher (Fisher, 1980) also cited the work of Brilhart (1978) who specified five characteristics of a group that distinguish a group from a collection of individuals. These five characteristics are given as follows:

1. A number of people sufficiently small for each to be aware of and have some reaction to each other...
2. A mutually interdependent purpose in which the success of each is contingent upon the success of the others in achieving this goal.
3. Each person has a sense of belonging or membership, identifying himself with the other members of the group.
4. Oral interaction (not all of the interaction will be oral, but a significant characteristic of a discussion group is reciprocal influence exercised by talking).
5. Behavior based on norms and procedures accepted by all members. (p. 17)

The work group as an organization of individuals has multidimensional, interdependent factors such as individuals' "attitudes, motives, formal structure, interactions, goals, status, and authority" (p. 13) as

stated by De Greene (1973). Pearce and David (1983) and Tichy, Tushman and Fombrun (1979), as referenced by David, Randolph and Pearce (David, Randolph, Pearce, 1989), felt that group structure deals with the "nature and strength of patterns of relationships among individuals in work groups" (p. 234). David, Randolph and Pearce (David, Randolph and Pearce, 1989) referenced three common group structural properties listed as follows:

1. *Connectedness*: the extent to which group members identify with the goals of other members in their group. This is a measure of group cohesiveness (O'Reilly and Roberts, 1977).
2. *Vertical Differentiation*: the number of different levels of the organizational hierarchy represented in an emergent group (O'Reilly and Roberts, 1977).
3. *Horizontal Differentiation*: the number of different job areas represented in an emergent group (Mohr, 1979). (p. 234)

For their study of group technology and structure, David, Randolph and Pearce (David, Randolph and Pearce, 1989) used these group structural properties:

1. *Vertical Differentiation*: a ratio of the number of different hierarchical levels (from the organization chart) represented in an emergent group to the respective number of group members (O'Reilly and Roberts, 1977).
2. *Horizontal Differentiation*: a ratio of the number of different work areas (individuals reporting to the same superior) represented in an emergent group to the respective number of group members (Pearce and David, 1983).
3. *Connectedness*: a ratio of the number of communication links in an emergent group divided by the total possible number of links in that group (Tichy and Fombrun, 1979). (p. 236)

Pasmore (Pasmore, 1988) described effective organizations as those

which produce excellent results by any measure of costs, quality, or efficiency while simultaneously enhancing the energy and commitment of organizational members to the success of the enterprise. (p. 1)

He also stressed that the need for determining better methods of organizing for increased effectiveness has become of greater concern during the past several years. From their study, David, Randolph and Pearce (David, Randolph and Pearce, 1989) determined that effectively balanced technology and group structure "promises to offer benefits for group interaction, communication, and performance" (p. 240). Weisbord (Weisbord, 1987) cited the work of Emery (1964) who developed a list of six factors which provide job satisfaction. These factors are:

1. Variety and change,
2. Elbow room for decision making,
3. Feedback and learning,
4. Mutual support and respect,
5. Wholeness and meaning,
6. Room to grow - a bright future. (p. 167)

Therefore, investigating the structure of the work group may lead to understanding factors important to group effectiveness.

Systems Theory and Groups

Von Bertalanffy (Von Bertalanffy, 1968) was one of the major founders of systems theory, and he stated that an open

system is defined as a "system in exchange of matter with its environment, presenting import and export, building-up and breaking-down of its material components" (De Greene, 1973, p. 35). An open system is maintained in a steady state and despite continual irreversible actions, the system remains in this steady state. As De Greene (De Greene, 1973) stated, "open systems are those with a continuous flow of energy, information, or materials from environment to system and return" (pg. 36).

Fisher (Fisher, 1980) described a system "...simply as an entity which behaves as an entity because of the interdependence of its members" (p. 19). He also stated that systems have three elements: structure, function, and evolution, which describe it. He described the "structure" of the system "...as the physical arrangement of components in space at any given point in time" (p. 19). The "function" of a system "may be defined as the relationships among components in time" (p. 19). The "evolution" of a system "embodies the history of the progressive and possibly regressive changes through time" (p. 19).

For this study, the group was viewed from a systems perspective based on Fisher's three elements where the group membership served as the *structure* of the system, the *function* defined the group interaction process and the *evolution* of the system (or group) was considered the evolution of the group during the time of this study.

Cybernetics

Von Bertalanffy (1968) contrasted two important system concepts, an open-systems model and a cybernetics model. The focus of an open-systems model is on the dynamic interaction of the system components and a closed feedback loop. In the cybernetics model, the information feedback loop is active, a value is maintained, and a goal is reached. Norbert Wiener (1948) further developed the concept of cybernetics involving information, communication, feedback, and control. As De Greene (1973) states, "basically, cybernetics involves the transfer of information (communication) between the system and its environment" (p. 41).

As stated by Fisher (Fisher, 1980),

feedback responses are constantly occurring throughout the interaction among group members. One's self-concept, or one's beliefs and attitudes about self, also develop through communicating with others. (p. 71)

Fisher (Fisher, 1980) also believed that the process feedback was unavoidable and that despite the chosen method "...used to understand the nature of communication...one cannot *not* communicate...one cannot avoid making a feedback response" (p. 70).

The Group Process

In his book, Autonomous Group Functioning, P. G. Herbst outlined what he called the "parameters in the relationship

between the variables of group functioning". He described these parameters as

(i) *characteristics of the task*, such as work load and the type of interdependence between task components; (ii) *internal characteristics of the group*, such as performance expectations and frustration threshold, (iii) *characteristics of the relationship of the group to its environment*, such as stress tolerance and the optimal stress level, and (iv) *minimum boundary levels*, which specify the survival conditions of the group. (p. 12)

Additionally, as described by Herbst (Herbst, 1962),

performance of a group will depend on the work effort by individual team members and on the quality of their co-operation in carrying out the group task. In order to investigate the relationship between these variables, two measurement problems will need to be considered: (i) constructing measures of the group process and (ii) determining how these measures should be combined to construct an index of the quality of the group process or level of group integration. (p. 13)

The concept of measuring the effectiveness of the group process is complex but must be studied in investigating ways to improve the quality of group communication.

Fry and Slocum (1984), Hrebiniak (1974), and Randolph (1981) provided a conceptual approach to defining three dimensions of group technology. These are described by David, Randolph and Pearce (David, Randolph and Pearce, 1989) as follows:

1. *Task predictability*: the degree to which stimuli required in performing a job are perceived as familiar or unfamiliar (few versus many exceptions) by group members. Work groups that perform tasks with few exceptions experience more certainty, which allows individuals to predict problems and activities in advance.

2. *Problem analyzability*: the nature of the search that is undertaken by individuals when exceptions occur in performing their job. Problem analyzability becomes less difficult when objective or computational procedures are available to facilitate the generation and evaluation of alternative solutions.

3. *Interdependence*: the degree to which individuals are dependent on and support others in task accomplishment. The greater the interdependence, the greater the need to gather, analyze, and distribute information among group members. (p. 233)

These dimensions of group technology can affect the group process of interaction.

As described by Fisher (Fisher, 1980), both task and social dimensions must be investigated in the process of group decision making and interaction. Fisher referred to "task dimension" as the "relationship between group members and the work they are to perform - the job they have to do and how they go about doing it" (p. 38). He referred to the "social dimension" as the "relationships of group members with one another - how they feel toward one another and about their membership in the group" (p. 38). Fisher felt that outputs of the task and social dimensions, specifically, productivity and cohesiveness are related such that as productivity increases, cohesiveness also increases to a point of "diminishing returns" (Fisher, 1980, p. 38) ; when a group becomes so highly cohesive, the phenomenon of "groupthink" (Fisher, 1980, p. 38) may occur "which inhibits conflict and thus, results in defective and low-quality decisions which achieve consensus" (Fisher, 1980, p. 46).

Weisbord (Weisbord, 1987) stated that there are four "conditions for success" for team building. These four conditions are:

1. *Interdependence.* The team is working on important problems in which each person has a stake. In other words, teamwork is central to future success, not an expression of ideology or some misplaced 'ought to.'
2. *Leadership.* The boss wants so strongly to improve group performance that he or she will take risks.
3. *Joint decision.* All members agree to participate.
4. *Equal influence.* Each person has a chance to influence the agenda. (p. 299)

These four aspects are considered in this study of group effectiveness.

Group Communication

As mentioned by Fisher (Fisher, 1980), "communication is the organizing element of a social system" and should not be considered as a "thing"; rather communication should be considered "a process which is constantly...[and] continually developing" (p. 4). Fisher (Fisher, 1980) also pointed out that the process of communication

involves considering the entire conversation or discussion of the communicators...as a single process...Rather than think of each individual action separately, we think of the *connections* between actions and thus view the communicative process as a *system* of communication rather than as actions and reactions by individual persons. (p. 99)

Kreps (Kreps, 1990) defined human communication as occurring

when a person responds to a message and assigns meaning to it. The two key parts to this definition are the message and the meaning. Messages are any symbol or thing that people attend to and create meanings for in the communication process. Messages can take many forms: spoken words, written words, facial expressions, environmental cues, thoughts, or feelings...Meanings are mental images that we create to help us interpret phenomena and develop a sense of understanding. (p. 25)

Kreps (Kreps, 1990) also presented several other important aspects of communication such as "perception" which he defined as "the process by which people become aware of internal and external messages and interpret these messages into meanings" (p. 29). Because of obvious limitations, people are not able to perceive all available messages in any given situation and therefore, "selective perception" takes place which Kreps described as

the process by which people attend to the most important messages out of the total pool of potentially perceivable messages and use those chosen messages to make sense out of their current situation. (p. 40)

Kreps (Kreps, 1990) also described the "content" level of communication referring to the "basic factual information being presented in the message" (p. 32). The "relationship" level of communication

refers to the subjective feelings that communicators express through their communication...[such as] expressions of respect or disrespect, like or dislike, powerfulness or powerlessness, love or hate, and comfort or discomfort. (p. 33)

Kreps (Kreps, 1990) also discussed a form of feedback called "metacommunication" which he described as "communication about communication" (p. 35). In this process, the communicator is given feedback about his communicative behavior and effectiveness; this information can be essential in learning the rules of interaction of the communication process. Kreps felt that it is very important that participants in the group interaction process recognize messages given to them through metacommunication in order to learn the rules for appropriate communication behavior for that organization or group.

Task predictability has been shown to play an important role in group functioning and group communication, as studied by David, Randolph and Pearce (David, Randolph, Pearce, 1989). They described task predictability as the variation and change that group members experience in their work. These researchers felt that as task predictability decreases, group members need to communicate more with other group members to effectively deal with the variations arising with group tasks.

In describing the communication process in groups, Fisher (Fisher, 1980), stated that

a healthy group is apt to be noisy. Its members are uninhibited and probably not governed by norms of politeness. There are frequent disagreements, arguments, and constant interruptions which reflect the members' eagerness and commitment to their group - high group identification. Members who are major contributors to the group's verbal interaction are

actively a part of the group. They are alert and nonverbally appear interested in the comments of others. (p. 56)

Additionally, Fisher (Fisher, 1980) pointed out that the "successful and socially healthy group is not characterized by an absence of social tension but, rather, by successful management of social tension" (p. 56).

Fisher (Fisher, 1980) also referenced the work of Harnack, Fest, and Jones (1977) who described eight "characteristics of desirable contribution" in group interactions as "relevance, relatedness, good timing, sufficient length, clarity, informativeness, openness to evaluation, and provocativeness" (p. 74). Harnack, Fest and Jones (1977) felt their these characteristics were a checklist for improving the contributions of group members during group meetings. Fisher (Fisher, 1980) also cited Gulley and Leathers (1977) who discussed the "codability" (p. 75) of messages exchanged in group interaction. Gulley and Leathers suggested that often the communication messages exchanged by group members are ambiguous, unclear, and therefore, these have "low codability" (p. 75); often, group members do not seek clarification of these "low codability" messages.

Kreps (Kreps, 1990) stated that "nonverbal communication surrounds and influences all verbal communication" (p. 42), and he provided an overview of seven interrelated nonverbal

message systems which are given as follows: "Artifactics" describes people's "physical appearance, personal appearance, objects that (they) carry, and objects that (they) use to decorate their environment" (p. 42); "Kinesics" describes "the ways people move their bodies and position themselves, including postures, gestures, head nods, and leg movements" (p. 43); "Occulesics" considers "facial expressions and eye behaviors" (p. 43); "Paralinguistics" describes the "vocal cues, such as volume, tone, pitch, and expression of the voice and describes environmental sounds such as music, wind, or machine noise" (p. 44); "Tactilics" involves "touching behaviors" (p. 45); "Proxemics" involves the study of the "distance between people and objects, including the distances established in interpersonal relationships, group meetings, and environmental design" (p. 45); "Chronemics" describes "the effect of time on communication, including communication behaviors patterned over time, appointment keeping, and length of time in communication with others" (p. 46). Fisher (Fisher, 1990) described "proxemics" as the "principles behind the ways in which group members use, arrange, and perceive physical space" (p. 296).

Technical Tools

As mentioned in the discussion of sociotechnical systems, one must study the technical aspects of group

communication to fully understand what is going on in the sociotechnical group process, not only in looking at the actual technical tools themselves but the way in which tools are used. Throughout history, man has focused on discovering new technological advances and methods to allow him greater capabilities and higher productivity. Pasmore (Pasmore, 1988) described the technical system of an organization as one consisting of the:

tools, techniques, devices, artifacts, methods, configurations, procedures and knowledge used by organizational members to acquire inputs, transform inputs into outputs and provide outputs or services to clients or customers. In the sociotechnical systems perspective, choices about such things as how the technology is laid out are as important as choices about which technologies to use, since the layout and type of technology both affect how humans feel about their work and consequently how well they perform it. (p. 55)

Pasmore (Pasmore, 1988) additionally stated that,

Technological arrangements which minimize barriers to problem solving and maximize both cooperation and flexibility are more likely to result in organizational effectiveness over the long run...Jobs will be more stimulating when the technology: (1) demands a variety of skills on part of employees; (2) demands higher level skills which require time to learn and master; (3) requires higher levels of interaction among employees; (4) involves greater variability to inputs, conversion processes, and outputs; (5) is subject to continuous change or modification; (6) is designed to provide more direct and immediate feedback; (7) allows greater flexibility in geographic movement and work patterns; and (8) leaves a significant degree of relevant decision making to employees. (p. 63)

An important aspect of technology is discussed by Weisbord (Weisbord, 1987) who envisioned looking at what he

considered the "whole system - economics, technology and people" (p. 273). In discussing technology, Weisbord felt that an important question within the organization is "do systems work as intended?" (p. 273); if not, the group should investigate methods to enhance technical systems to maximize effectiveness. As described by Winograd and Flores (Winograd, Flores, 1987),

Many innovations are minor - they simply improve some aspect of the network without altering its structure. The automatic transmission made automobiles easier to use, but did not change their role. Other inventions, such as the computer, are radical innovations that cannot be understood in terms of the previously existing network. The printing press, the automobile, and television are all examples of radical innovations that opened up whole new domains of possibilities for the network of human interactions. Just as the automobile had impacts on our society far beyond speeding up what had been done with horses, the use of computers will lead to changes far beyond those of a fancy typewriter. The nature of publishing, the structure of communication within organizations, and the social organization of knowledge will all be altered, as they were with the emergence of other technologies for language, such as the printing press. (p. 6)

Pava (Pava, 1983) defined the technical part of a sociotechnical system "as the tools and techniques used to transform input into output" (p. 20). Pava (Pava, 1983) additionally described methods of utilizing the principles of sociotechnical systems theory and provided guidance on establishing a work system design. As part of this work system design, Pava discussed technical enhancements:

The design team will suggest changes in office technology to assist the major deliberations.

First, the team should propose new information handling procedures; these specify how information is to be gathered, recorded, deciphered, circulated, reviewed, and reformulated...Next the design team suggests new devices to implement existing and proposed procedures. The team should construct a list of procedures that need improvement and identify both high and low technology solutions. (p. 108)

Pava (Pava, 1983) also stated that

New office technology, as one major aspect of a larger transformation in our tool stock, will mobilize a variety of interest groups outside the enterprise. Management will have to acknowledge and forge relationships with them and use contention so as to yield more intelligent applications of new technology. At the same time, the deluge of new equipment will create opportunities for new patterns of office organization and of life in society at large. (p. 162)

Agency Setting

An important aspect of this study was its location, the Naval Undersea Warfare Center Detachment, Norfolk, a government agency with workload concentration in the area of naval defense. This agency has a wide range of technical expertise crossing multiple scientific and engineering disciplines. Often, within the organizational section from which the study sample group was selected, new technical projects are assigned or engineering problems are investigated, and typically a group of technical experts from varied disciplines and organizational sections are assigned to work together. The groups usually have one member who serves as a pseudo group leader during the task

duration, but this group leader does not directly "supervise" the other members. The agency setting was useful for this type of study because the sample group was in the initial phases of working together, the group was semi-autonomous in nature, and the group consisted of multi-disciplinary technical group members engaged in working with engineering issues and problems.

The agency which included the study sample, employs approximately 800 workers. Employees, unless in management positions, work in four-man cubicles with VAX terminals or personal computer workstations at each desk. The VAX terminals and personal computer workstations are linked via a VAX mainframe computer system which allows electronic mail to be sent among employees including those of the study sample. No other electronic information sharing system was available for group member use at the time of this study.

Group members had access to meeting in one another's cubicle areas (group members did not work in the same cubicle) or conference room facilities. Whiteboards with and without printout capability, overhead projectors, telephones, computer terminals or workstations (some with Computer Aided Design software capability), conference tables, etc. were some of the technical tools which group members had available for use during group meetings. It is important to note that the personal computer workstations

were located at each individual group member desk, not in areas where "group" access could be accomplished easily.

Description of the Study Sample

The study sample was a group of three members with various technical backgrounds and experience; one member, Group Member A, a naval architect, with less than five years of work experience; another member, Group Member B, a technician, with between ten and fifteen years of technical work experience; and Group Member C, an electrical engineer, with between five and ten years of work experience. The group members came from different organizational sections and had not worked together on projects until their group establishment a few weeks prior to the beginning of this study. Group Members B and C had worked in several other groups of this type before the formation of the study sample group. The reason for establishing the group was the need for preparing a new engineering design which required concurrent input from all the areas represented by the technical backgrounds of group members; in effect, a concurrent engineering task.

The group was semi-autonomous in that one group member, Group Member C, served as a design or group leader but did not supervise group members in accordance with the organizational charts of the agency. Each group member was responsible for a different area of the design, with Group

Member C coordinating the efforts and bringing group suggestions to the attention of management. Group Member C was not responsible for evaluating group member performance but was responsible for notifying upper management (senior level bosses) of group progress which could indirectly affect group member evaluation.

In order to gain historical information about group member education associated with communication skills, specific questions Questionnaire - Part A were asked. Based on the Questionnaire - Part A responses to question 7 by group members (see Appendix C), Group Member A had taken three to four courses in which communication skills related to technical writing and group design projects were the focus. Group Member B had taken three to four courses in which technical writing, group communication, and public speaking were discussed. Group Member C had not taken any course work in communication skills studies.

Additional information about group member background was provided in Questionnaire - Part A, question 8 (see Appendix C). Group Member A had read more than six books or articles which discussed group communication, and these articles taught Group Member A "nothing except how important good communications are". Group Member B had also read more than six books or articles in the area of group communication, and he learned "that in order to meet the goals in schedules, quality, etc., you must make this information

clear to other participants so that they are focused on the same goals". Group Member C had not read any books or articles in the area of group communication.

A final note of this section is that each group member completed the required consent forms to participate in this research as approved by the Graduate Program Director.

CHAPTER 3
PROCEDURE

In carrying out this investigation, the researcher utilized two questionnaires to gather information, observed and videotaped two group meetings, and provided an educational briefing on group communication. This chapter discusses each component of the procedure in order of their occurrence.

First Questionnaire

Questionnaire - Part A, the initial questionnaire given to group members, served as the first step of this study. Responses to this questionnaire are shown in detail in Appendix C. The purpose of the questionnaire was to gain an understanding of the individual group member perception of how effectively the group communicated during meetings and to determine the technical tools used by group members during group meetings. Additionally, the questionnaire was intended to gain information about how education in group communication and use of technical tools could effect group communication. Findings and interpretations of

Questionnaire - Part A responses are provided in Chapter 4, Interpretations and Discussion of Findings.

First Observation

The next step of this study was the observation of a "typical" group meeting. The arrangement of the meeting space for the first observation is shown in Figure 1. The researcher served only as an observer during this group meeting which was videotaped for further study. The group meeting was held in a four-desk office cubicle in which two of the group members normally work. Two other workers, not part of this group, share the cubicle but were not present during the meeting.

The work table between group member seats was completely covered with paperwork and books and could not be used during the meeting because of the height of the paperwork. The room contained no blackboard, whiteboard or other space for group members to write on for all members to see. Personal computer workstations were located on each desk behind each group member but were not used during the meeting. Telephones were located on each desk and were also not used during the meeting. The phones could not be forwarded and would have to be answered by a group member if they had rung during the meeting.

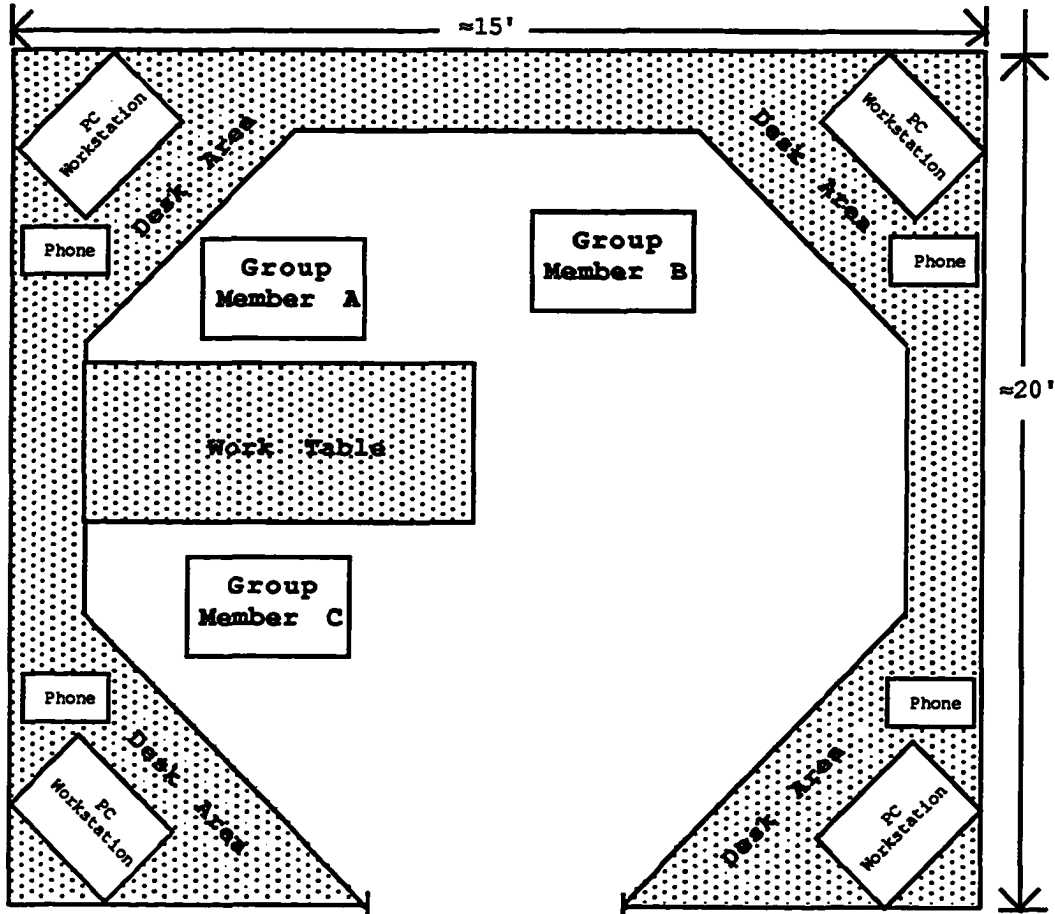


Figure 1. Meeting Room Layout for First Meeting.

The meeting started slightly later than planned because one group member was late and another was finishing a computer project at his workstation. Group Member C handed out an agenda to each group member prior to the start of the meeting and followed it item-by-item until the group meeting was interrupted. The communication process was almost completely one-sided with talking mainly done by Group Member C. Group Member C rarely looked up from his meeting agenda sheet as he talked; when he did make eye contact, it was with Group Member B. Group Member A did not talk at all during the entire forty-five minute meeting; he did acknowledge certain discussion points with a nod of his head. Group Member A mainly looked at his meeting agenda, twirled his pen but did not take notes. Group Member B did discuss some issues during the meeting but the conversation exchange was directly with Group Member C, as indicated by Group Member B's eye contact and remarks. Group Member B was the only member to take notes during the meeting, and these were taken on a notebook in his lap.

During the meeting, there were two interruptions when other employees walked into the cubicle to see one of the group members. Group Member B handled the first interruption by asking the person who needed information from him to stop by later. The second interruption involved someone needing information from Group Member C; Group Member C abruptly closed the meeting at this point.

Approximately eighty percent of the topics on the agenda had been covered when the second interruption occurred.

Interpretations of the first meeting are discussed in Chapter 4, Interpretations and Discussion of Findings.

Educational Briefing

The educational briefing, led by the researcher, was a ten-minute presentation which occurred just a few minutes before the second group meeting. The researcher provided an overview of the information presented in Chapter 2, Background of the Study, Review of Literature. The intent of the educational segment was to provide theoretical information on group communication and also to make group members aware of the concept of metacommunication and its benefits as described by researchers. Due to scheduling difficulties, the educational segment was very short and proved not as effective as the researcher had originally hoped. Group members showed interest in the material by asking questions and Group Members A and B took some notes; time constraints did not allow for a complete and thorough discussion among all group members and the researcher from the researcher's perspective. Interpretations of the impact of the educational briefing are discussed in Chapter 4, Interpretations and Discussion of Findings.

Second Observation

For the second observation, the technical "tools" employed for the group communication process were changed. For this observation, the group meeting was held in a private conference room with a large conference table. Figure 2 illustrates the seating arrangement and room layout for this second observed meeting. The meeting was initiated on time because the room was reserved for a specific time slot of one hour that could not be shifted; therefore, all members were told by Group Member C to be on time for the meeting.

For this meeting, no agenda was handed out and discussion continued to be dominated by Group Member C. However, all group members participated in the discussion not only in talking with Group Member C, but with one another as well, as indicated by group member eye contact with one another and physical posture while speaking. Group Members A and B each took notes during the meeting. Group Member C did not take notes. Study of the physical appearance of the group members indicates that they were more interested in this meeting than the first observed meeting. Their eye contact with those that were talking, their note taking, their posture (leaning forward during the discussion), and overall group participation in group discussion indicated increased interest.

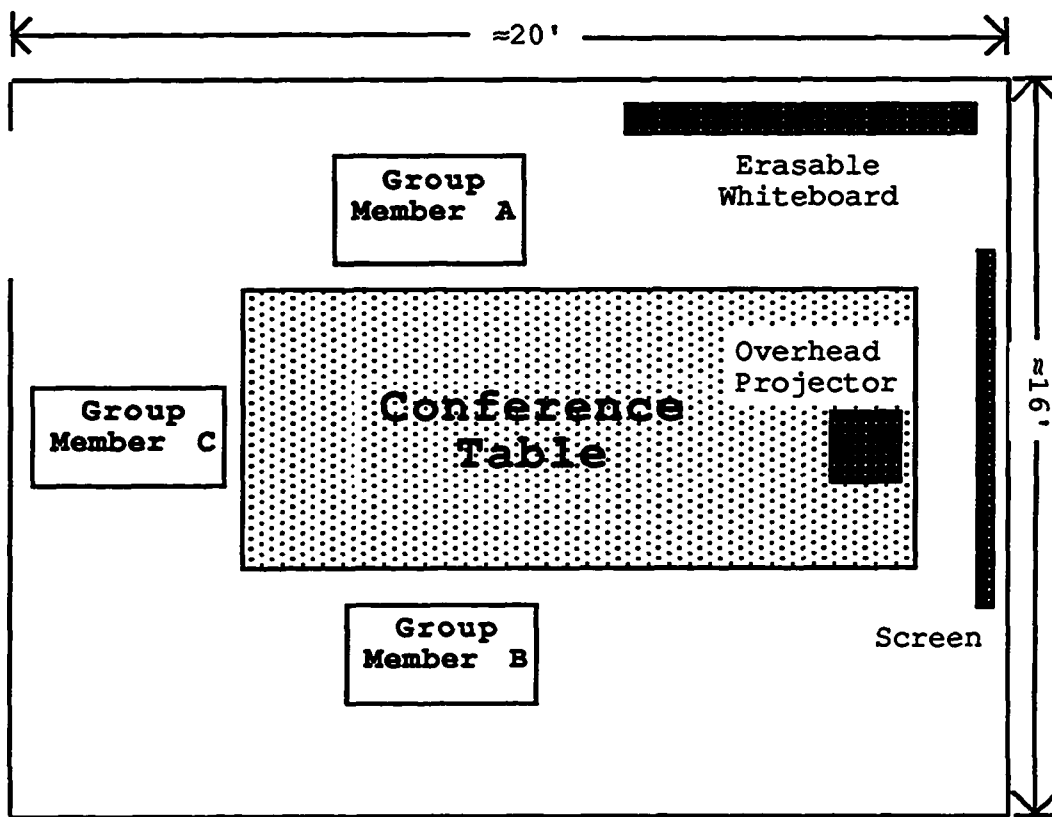


Figure 2. Meeting Room Layout for Second Meeting.

Since the meeting was held in a private conference room away from the group members' work areas, there were no telephone or other interruptions. The conference room table was completely clear of paperwork and books; Group Members A and B used the table to take individual notes which were not shared with other members during the meeting.

There were several additional technical tools available to the group during the second meeting. For instance, there was an overhead projector with screen, an erasable whiteboard, and a large conference table for ease of writing and sharing information among group members. The material discussed during the meeting was mainly introduced by Group Member C, who did not use any of the tools. As noted previously, Group Members A and B used the conference table when taking notes. The other tools in the room were not used.

Interpretations of the second observed meeting occurrences are provided in Chapter 4, Interpretations and Discussion of Findings.

Second Questionnaire

The second questionnaire was given to group members following the second observed group meeting. The results of the second questionnaire are summarized in Appendix D. The purpose of the second questionnaire was to compare data between Questionnaires - Parts A and B and also to study the

effect, if any, that the educational segment and participation in this study had on group members' perception of the group communication process, both socially and in the use of technical tools during group meetings. Findings and interpretations of Questionnaire - Part B responses are provided in Chapter 4, Interpretations and Discussion of Findings.

CHAPTER 4
INTERPRETATIONS AND DISCUSSION OF FINDINGS

First Questionnaire

The first questionnaire provides a great deal of insight on communication within the group under study. Discussion of the group's responses on the questionnaires is grouped by subject area.

Frequency of Meetings

In studying the results from Questionnaire - Part A, it is interesting to note several of the responses. For example, Question 1 asked how often group meetings were held, and each group member provided a different time period from once a week to once a month. One explanation for the variation in responses may be the different perceptions which each individual has of the organization or group; this explanation is supports the theory that the individual's reaction to the group is based on his perception of the organization as Lewin, cited by Lichtman and Hunt (1971), believed. Another possibility is that group members did not perceive themselves as a group because the procedures (e.g., group meetings) associated with the group were not clearly

understood or accepted by all group members. Brillhart (as cited by Fisher, 1978) felt that one of the five characteristics of groups are "behavior based on norms and procedures accepted by all members" (p. 20). It is clear from the different responses given by each group member that there is a misunderstanding between group members of when group meetings occur or possibly in understanding what is meant by "group meeting".

Communication Among Group Members

Question 4 of Questionnaire - Part A involved the group member rating of how well they communicated with others during group meetings. It is interesting to note that again, responses by the group members were quite varied: Group Member C felt that his communication with others was excellent (providing a rating of ten out of ten); Group Member B felt his communication with others was quite good but not excellent (providing a rating of eight out of ten); and Group Member A felt his communication with others in the group was slightly above average (providing a rating of six out of ten). Fisher (Fisher, 1980) stated that

feedback responses are constantly occurring throughout the interaction among group members. One's self-concept, or one's beliefs and attitudes about self, also develop through communicating with others. (p. 71)

Group member rating was based on their own perception of their communication. Possibly the feedback, verbal and

nonverbal, which group members received from one another played a factor in developing their perception of communication with other group members.

Group Communication

Questions 2 and 3 asked group members how they would rate the overall group communication process of their group and why they selected their rating. Again, the responses were quite varied: Group Member C felt that the group communication process was excellent (providing a rating of ten out of ten and based his rating selection on his perception that "everybody knows what's going on"); Group Member B felt that the group communication process was slightly above average (providing a rating of six out of ten and based his rating on his perception that "there were periods when the communication broke down causing a feeling of being excluded from the information loop"); and Group Member A felt that the group communication process was rather poor and below average (providing a rating of four out of ten and based his rating on his perception that information was not relayed quickly enough with "usually several day laps [sic] between changes and others becoming aware of the changes").

Gulley and Leathers (1977), cited by Fisher (Fisher, 1980), described the concept of "codability" (p. 75) of messages during group communication. "Low codability" (p.

75) messages are ambiguous and unclear, and often group members do not seek clarification of these messages. The group members of this study may have based their ratings of the group communication process on their perceptions of message codability. For instance, Group Member C may have clearly understood all messages presented during group meetings by giving an outstanding rating (ten out of ten) for the group communication process; Group Member B based his rating (six out of ten) and his response on his perception that "there were periods when the communications broke down" communicated to him may have been unclear and hence, he felt that communication was poor.

Question 6 asked group members what rating they thought the other group members would give for the communication process within the group. Again, responses were varied but not as much as those for Questions 2 and 4: Group Member C felt that the rating would be good but not excellent (selecting a rating of eight out of ten); Group Member B felt that group members would rate the group process as between average and excellent (selecting a rating of seven out of ten); and Group Member A selected a rating slightly above average (selecting a rating of six out of ten). Fisher (Fisher, 1980) described both "task and social dimensions" (p. 38) of the group process; Fisher described the social dimension "as the relationships of group members with one another - how they feel toward one another and

about their membership in the group" (p. 38). Group members may have based their ratings on their perceptions of group member relationships or their affiliation with the group.

Effective Communication

Questions 2, 3, 4, and 6 relate to how group members defined "effective communication" asked in Question 5. The researcher believes that the perception that group members had of "effective communication" may have formed the basis for their rating schemes of the communication process. It is interesting that Group Members C and A defined "effective communication" very similarly; Group Member C stated that effective communication is "knowing what's going on" and Group Member A described effective communication as "knowing how everything affects his system". For Group Members C and A, knowledge of project status through group member communication was the basis for their definition of effective group communication. Additional research supports the group member definitions of effective communication. Fisher (Fisher, 1980) described a "healthy group" (p. 56) as one in which there is a lot of discussion (a lot of communication). This characteristic links closely with needs of Group Members C and A for knowledge and understanding of group task progress gained from thorough communication. Group Member B's definition of effective communication involved everyone having the opportunity to

express opinions and focused on enhancing the team concept, although he did not indicate how to improve the team process. Herbst (1962) noted that team member cooperation with group tasks was also important to group performance.

It is interesting to note the comparison of ratings between Questions 2, 4 and 6. Group Member C provided excellent ratings (ten out of ten) for both his perception of the overall group communication process and with how he felt he communicated with others in the group. He also gave a high (eight out of ten) rating for what he felt other group members would rate the communication process for the group. Group Member C's overall average rating of these three ratings was 9.3. Group Member B also tended to be fairly consistent with his ratings for the three areas (a six out of ten for the overall group communication process; an eight out of ten for his communication with others; and a seven out of ten for the rating he felt other group members would give for the group communication process). Group Member B's average of the three ratings was 7.0. Group Member A was also fairly consistent with his ratings (a four out of ten for the overall group communication process; a six out of ten for his communication with others; and a six out of ten for the rating he felt other group members would give for the communication process of the group). Group Member A's average of the three ratings was 5.3. Averages

of the ratings provide an overall rating of each group members' feelings toward group communication.

Group Communication Tools

Questionnaire - Part A also addressed the tools which group members used during group communication and asked group members to list tools they use during meetings. Group Member B listed the most tools, followed by Group Member A and then C. Common items cited by all three were: (1) pen/pencil for taking meeting notes, (2) blackboard, and (3) conference room and table. It is interesting to note that although these tools were mentioned by group members as typically used during group meetings, only one of the three listed above (pen/pencil for taking meeting notes) was used during the first group meeting (by Group Member B only). Only two (pen/pencil for taking meeting notes and conference room and table) were used during the second observed meeting.

Environmental Issues

Questions 10 and 11 dealt with the environmental aspects of group meetings such as social problems (e.g., interruptions from other employees) and technical problems (e.g., difficulty with the use of tools, poor facilities). Group Member C did not state that there were any problems related with the environment and replied that "all that is

required is an empty room", which is a technical factor. However, he did select a slightly higher rating than other group members (three out of ten compared with two out of ten) for the impact of the environment relative to group meeting success. Group Member B felt that social aspects such as "people showing up late or at the last minute, due to unexpected events" were the greatest environmental impact. Group Member A felt that interruptions were not a problem but felt that it was very important to have people "openly discuss their areas of uncertainty or conflict", a social aspect. Both Group Members B and A rated the effect of the environment on meeting success as very low (two out of ten).

Improving Group Communication

The purpose of Question 12 was to become aware of areas that group members felt could improve the group communication process. Group Members A and B had identical responses of "hold more meetings" and "hold shorter meetings". Group Member C felt that what was needed to improve the group communication process was encouragement for "people to talk to each other. Stay informed of the design process." His response also suggested the need for more group communication. The need by group members for increased communication was based on the "interdependence"

concept as described by David, Randolph and Pearce (David, Randolph, Pearce, 1989) who felt that "interdependence" was

the degree to which individuals are dependent on and support others in task accomplishment. The greater the interdependence, the greater the need to gather, analyze, and distribute information among group members. (p. 233)

Understanding that the group's mission of technical design through the concurrent engineering efforts of group members, it would seem necessary for group members to communicate frequently and effectively.

Unfortunately for this research, responses to question 13 (why did you select the tools and/or materials you did in Question 12?) were limited and may have been caused by the researcher's assumption that responses for Question 12 would have been changes in tools or materials (technical areas) rather than social issues. However, Group Member A's response in Question 13 supported the concept of "interdependence" as discussed above; Group Member A felt that there should be more but shorter meetings (maximum of fifteen minutes in length) to "keep the group more informed and get conflicts out in the open sooner, rather than allowing design development to continue, even though there may be a problem". Group Member A may have sensed that because of the concurrent engineering project, a greater interdependence among group members was essential and therefore, increased communication with group members was required.

Training

Question 14 asked group members if there was specific communication training that they would like for themselves or for the benefit of the group. Despite Group Member A's low ratings of himself as a communicator with the group and the group communication process, he answered "no" to training. Group Member C gave the same response. Group Member B felt that training was needed and that it should teach ways to "focus on the goal - eliminate or minimize finger pointing/jealousy which can destroy communication." It is interesting to note that the areas Group Member B identified for training were not listed in his suggestions for improving group communication or in his written criteria for rating the group communication. The need for training to reduce "finger pointing/jealousy" is supported by Weisbord (Weisbord, 1987) citing Emery's (1964) six factors of job satisfaction, the fourth of which is providing for "mutual support and respect" (p. 167).

Leadership

Question 15 asked group members about the leadership of the group - who is the leader of the group and what qualities did this person display to show leadership. The responses to this question were very interesting in that Group Member A and B both agreed that Group Member C was the leader but did not directly discuss characteristics of Group

Member C that supported their answer. Group Member A simply stated that Group Member C was "defined as the design lead". Group Member B stated that "leaders of the groups are not assigned based on communication skills. Assignments are based on technical expertise. (Group Member C) was assigned team leader..." Group Member B's response indicates that he feels that both expertise in technical areas and effective communication skills are needed for group leadership. Group Member C agreed that he was the leader based on his "willingness to take responsibility" and his "job title as team leader".

First Observation

Findings and interpretations of the first observed meeting build upon some of the questionnaire responses. Discussion during the first observed meeting was almost completely done by Group Member C with interjections occasionally from Group Member B; in fact, the meeting closely resembled a monologue. This characteristic of the group meeting was quite unlike the "healthy group" described by Fisher (Fisher, 1980) that has "frequent disagreements, arguments, and constant interruptions which reflect the members' eagerness and commitment to their group..." (p. 56). At this point in the study, it was difficult to determine the cause of the lack of verbal communication by Group Member A and the dominance of discussion by Group

Member C. One explanation may be that the group was interrupted prior to a point when questions about the information Group Member C was providing could be raised or concerns addressed.

Fisher (Fisher, 1980) described the concept of "groupthink" (p. 38) as the situation that can arise when a group becomes so highly cohesive that no disagreements occur and the benefit of having different perspectives or points of view is diminished. Without the prior knowledge of Questionnaire - Part A responses, one would have believed that "groupthink" might have taken place based on the observation that no disagreements or lively discussion among group members occurred. However, with Group Member A and B's responses indicating that the group communication process needs improvement, the likelihood that "groupthink" occurred is very small.

The questionnaire may also explain Group Member A's lack of verbal communication during the observed meeting. Group Member A provided the lowest rating (six out of ten) for his communication with others in the group; possibly his lack of oral communication during the meeting was due to being inhibited by others in the group. Fisher (Fisher, 1980) described the "healthy group" as one in which

its members are uninhibited and probably not governed by norms of politeness...Members who are

major contributors to the group's verbal interaction are actively a part of the group. (p. 56)

It is possible that Group Member A felt inhibited by other group members and therefore did not express his thoughts during the observed meeting.

Another important area of investigation is the nonverbal communication which took place during the meeting. Kreps (Kreps, 1990) discussed non-verbal communications such as "kinesics" for "the ways people move their bodies and position themselves, including postures, gesture, head nods, and leg movements" (p. 43). Group Members A and B seemed quite interested in the group discussion based on "kinesics". Group Member A frequently nodded his head and made eye contact in most cases with those who were speaking. Group Member B also demonstrated an interest in the group discussion through his body language. He faced Group Member C during the discussion, nodded his head frequently, made eye contact with Group Member C, and leaned forward several times as if to listen more intently. Group Member C made eye contact with Group Member B only when Group Member B spoke. Group Member C, although he faced Group Members A and B, leaned back in his seat and mainly looked at the agenda when speaking.

It is interesting to study the effect of the technical aspects during the observed group meeting. Pasmore (Pasmore, 1988) described the technical system of an

organization as the "tools, techniques, devices, artifacts, methods, configurations, procedures and knowledge used by organizational members" (p. 55). With such a complete list of potential technical areas, it would require considerable effort to identify and discuss all of these for the observed group meeting; therefore, this study focuses on the physical properties of the technical system, technical tools. As previously mentioned, of the tools used by group members which were mentioned in Questionnaire - Part A, only a "pen/pencil for taking meeting notes" was used during this group meeting. Group Member B was the only one who took notes. Group Member A had pen and paper but did not take notes. Group Member C was the only member who seemed to use the meeting agenda sheet and looked at it frequently during the meeting. The personal computer workstations, desks, telephones, and centralized work table were not used during the meeting. At this point, it was difficult to tell how great an impact technical tools may have had on the group communication process without gathering additional data.

Educational Briefing

The educational briefing was intended to cover the background information of this study to aid in the area of "metacommunication" described by Kreps (Kreps, 1990) as "communication about communication" (p. 39). Kreps felt that metacommunication was very important to group success

in that group members obtain feedback about their communication process in order to learn the "rules" for appropriate communication behavior. The impact of the educational briefing could not be determined until more data was collected from the group communication investigation.

Second Observation

Findings and interpretations of the second observed group meeting were quite different from the first meeting. Group communication took place verbally with all members contributing to the discussion which seemed much more closely associated with Fisher's (Fisher, 1980) "healthy group" definition. Group Member C still did most of the verbal communicating, but Group Member A and B contributed more to the discussion than in the previous meeting. Additionally, group members followed Fisher's (Fisher, 1980) "healthy group" concept by seeming "alert and nonverbally appear(ing) interested in the comments of others" (p. 56).

"Kinesics" as described by Kreps (Kreps, 1990) was an important part of the observation notes. All group members demonstrated head nodding, and Group Members A and B leaned forward with their elbows on the table showing interest in the conversation. Kreps (Kreps, 1990) also discussed "oculesics" which consists of "facial expressions and eye behaviors" (p. 43). All group members made eye contact with one another more frequently in this meeting than in the

first observed meeting; Group Member C still did not make eye contact as often as Group Members A and B. When talking and not making eye contact with others, Group Member C looked at the table.

As previously mentioned, the group had access to several additional technical tools for this second meeting. The noted changes between the first and second meetings were that Group Member A used pen and paper to take notes, Group Members A and B used the conference table when taking notes, and no agenda was used for the meeting. None of the other tools located in the conference room (e.g., overhead projector, whiteboard) were used during the meeting, nor were handouts or hard copy data distributed to group members.

Second Questionnaire

Questionnaire - Part B revealed additional information about the group members' perceptions of their group communication process. First, all group members indicated that responding to Questionnaire - Part A did not cause them to react differently during the first group meeting. Additionally, group members felt that they did not behave differently during the observed sessions compared with their "regular" group meetings. It is important to know that participating in the Questionnaire - Part A and the researcher's presence at the group meeting did not

significantly alter results based on group member questionnaire response.

Second Evaluation of First Meeting

Question 3 of the questionnaire asked group members to rate the overall group communication process for the first observed meeting. It is interesting to note that Group Members A and B provided the same ratings that they had given in Questionnaire - Part A for their rating of the group communication process; Group Member A gave a rating of four (on a scale of zero to ten) for both questions indicating he thought the process was rather poor; Group Member B gave a rating of six (on a scale of zero to ten) for both questions indicating that he thought the process was relatively good but needed improvement. Group Member C's response was interesting because he selected a rating of seven out of ten for the first meeting unlike the ten (on a scale of zero to ten) rating he selected for the group communication process for his response in Questionnaire - Part A. It would seem that something occurred to change Group Member C's perception of the group communication process from "excellent" to a rating indicating need for improvement.

When asked the reason for their ratings for the first group meeting, Group Member A stated that he "did not remember communications being very good". Group Member B

stated that "the source of information was (Group Member C) and participation in discussions by other members was timid". These answers support the observations of the researcher. Group Member C's basis for his rating of the first group meeting was that "the required information was shared". Again, it is interesting to attempt to understand the differences for Group Member C's ratings. His reasons for rating selection were very similar; however, additional factors must have affected his rating scheme.

Evaluation of the Second Meeting

Question 5 asked group members to rate the group communication process for the second meeting. Again, the comparison of responses given for this question and Question 3 (rating of the first meeting group communication process) provides additional insight. Group Member A remained consistent, selecting a four out of ten as before and the same reason for rating selection, not recalling that communications went well. Group Member B increase his rating of the second group meeting by two (giving a rating of eight out of ten) compared with his rating of the first group meeting. His reason for the rating was "as the development progressed people became more knowledgeable about the goals and more comfortable about expressing thoughts and sharing information". Group Member B's response is supported by Fisher (Fisher, 1980) who cited

Brilhart's (1978) five characteristics of a group that distinguish it from a collection of individuals. The second of these characteristics addresses group goals by indicating that goals of the group must be very interdependent such that success for one goal is dependent upon the success of another. The third and fourth of Brilhart's characteristics of a group have to do with the need for the sense of belonging as group members.

Improving Group Communication

Question 8 asked the group members to list ways in which the group communication process could be improved. This question had also been asked in Questionnaire - Part A. Group Members A and B provided the same responses as they had previously in Questionnaire - Part A ("hold more meetings" and "hold shorter meetings"). Additionally, Group Member B also listed "provide communication training to group members". He had previously responded in Questionnaire - Part A with training concerns and described areas in which he would like to see training. Group Member C did not list anything for improvement of the group communication process.

Question 9 asked group members if their organization was placing enough emphasis on developing "effective" group communication skills. Group Members A and B stated that not enough emphasis was being placed on this concept. No

methods for increasing the emphasis on communications were given. Group Member C felt that there was enough emphasis on development of "effective" communication skills.

Benefits From Participating in the Study

Lastly, Question 10 asked group members if participating in this study had been useful. Group Members A and B gave a definite "yes". Group Member A went on to say "It wasn't so much beneficial as it was that it made me reflect on the lack of communication within most large projects". His response supports the possibility that "metacommunication" as described by Kreps (Kreps, 1990) may have helped Group Member A realize some important considerations of group communication. Again, Group Member A emphasized his need for increased communication. Group Member B stated that participation in this research "made (him) aware of many aspects of a meeting which I often took for granted". His response may also be related to metacommunication. Finally, Group Member C stated his views on communication, "I am a strong believer in constant communication between all involved and I promote problem solving at the lowest level. As team leader seldom do a few days pass without (me) talking to all team members. The net result is that large formal meetings tend to be anti-climatic". Based on Group Member C's response in Questionnaire - Part A, that "group meetings" occur less than once a month, the researcher

assumes that Group Member C views "large formal meetings" to equate to "group meetings" and that his discussions with team members (which occur every few days) may be one-on-one meetings instead of having all group members present. This may explain some of the responses given by Group Members A and B and their need for increased frequency of group communication. The interdependence of group members in performing their concurrent engineering tasks is the likely cause of this feeling.

CHAPTER 5

CONCLUSIONS

This chapter summarizes the major findings of the research. Applications and limitations of the research are also discussed. In addition, directions for future research are presented. It is important to note that the findings of this research are limited due to the relatively small amount of data collected. A significant aspect of this research however, is the process by which group communication effectiveness was studied. Through several methods of data collection, the researcher uncovered a number of important sociotechnical factors of group communication. With refinement of questionnaires, additional groups for study over longer periods of time, enhanced education and metacommunication discussions, and an established method for measuring group effectiveness (e.g., achieving a certain level of productivity, meeting goals and objectives, completion of tasks, or a method defined by the group to indicate their effectiveness), data collection may be such that several hypotheses may be proven and determined to enhance group effectiveness from a sociotechnical perspective.

Major Findings

There were several major findings associated with the social aspects of the group study. Group communication during the second observed meeting appeared to be more effective as indicated by the researcher's observations and the questionnaire responses of group members. Although it would take considerably more investigation to validate, *metacommunication*, through the educational segment and participation in the research, may have caused improvement in the group communication process. Group Member C's responses indicated that something changed his views of the group communication effectiveness between the first questionnaire and the second; possibly, education or increased awareness of communication affected his perceptions. Additionally, the responses of Questionnaire - Part B indicated that Group Members A and B felt that not enough emphasis is placed on developing effective communication skills. Further research into education to aid communication could provide additional insight into what group members felt was lacking with their group communication.

Findings in the area of technical tools and their use also indicate a need for considerable investigation in order to solidify a strong hypothesis for understanding the specific effects of technical tools on group communication. The improvement between the first and second meetings may be

attributable to the change in meeting location and facilities. Additionally, the need for more communication between group members may also support the need for use of additional technical tools for more effective communication.

Limitations of the Research

This study attempted to investigate the sociotechnical aspects of group communication and gain an understanding of how group members define "effective" group communication, whether in terms of social aspects, technical factors, or a combination of both. This study was not intended to establish or develop methods for measuring group effectiveness but simply to identify aspects that should be considered when investigating effective technical work groups. Realizing the magnitude of factors associated with the social aspects of group communication, this study focused on investigating those which seemed important to group members in identifying group communication effectiveness, as identified in their responses to the questionnaires, as well as some observed social behavior patterns during group meetings. Additionally, the technical factors of the group communication process were limited to a study of the physical tools used by the group during group interaction.

This study was limited to one group for two meetings, with an educational briefing between meetings and two

questionnaires. A more complete study of how group members define effective communication and the impact of technical tools would require extensive research by involving several groups, including data on varying the technical tools and their use.

Directions for Future Research

Because of the limitations described above, there are several areas which would provide additional insight into the study of sociotechnical aspects of group communication and the impact of technical tools. Additional research is needed on the content and meaning of messages transmitted between group members and networking of group members. These social areas are important to understanding group communication effectiveness. Technical issues include understanding the processes or data used by the group during group meetings and the communication tools employed. These areas are important to more completely understand the sociotechnical process and to suggest methods for enhancing work groups in technical organizations. As Pasmore stated (Pasmore, 1988) "whenever there are people, working together in a system with technology, in an environment that provides resources the system needs, there is the possibility of adapting sociotechnical system thinking to help improve the system's effectiveness" (p. 155).

The impact of an educational segment also needs additional research. Among the questions that need further study are: how long should the educational segment have been? Would a longer educational session have changed the second meeting or group member response to Questionnaire - Part B more drastically? What would have been the effect of several educational briefings between meeting one and two? These are some questions that should be addressed if one is to solidify the effectiveness of educational briefings on the group communication process.

A great deal has been learned from the literature review and this experiment. Follow-on research in the area of sociotechnical studies of group communication in addressing some of the areas as discussed above would be quite interesting and may prove to offer great benefits to industry and government work teams.

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APPENDIX A
QUESTIONNAIRE - PART A

QUESTIONNAIRE - Part A

1. How often are your typical group meetings held?
 - a. Once a month
 - b. Once a week
 - c. 2-3 times per week
 - d. 4-5 times per week
 - e. More than 5 times per week

2. Please rate how you feel about the overall group communication process in your group
(1- very, very poor, 10 - excellent). Circle one.
1 2 3 4 5 6 7 8 9 10

3. What criteria did you use to select the rating?

4. How well do you feel that you communicate with others during group meetings? (1 - very, very poor, 10 - excellent)
1 2 3 4 5 6 7 8 9 10

5. How would you define "effective group communication"?

6. What rating do you think other group members would give the group communication process of your group? (1 - very, very poor, 10 - excellent). Circle one.

1 2 3 4 5 6 7 8 9 10

7. How many courses have you taken in which communication skills was a topic for discussion?

- a. 1-2
- b. 3-4
- c. 5-6
- d. Greater than 6

What was the specific focus of the communication studies (e.g., group communication, interpersonal communication, technical writing)?

8. How many books/articles have you read in the area of group communication?

- a. 1-2
- b. 3-4
- c. 5-6
- d. Greater than 6

What if anything did this (these) article(s) teach you about group communication?

-
-
9. What "tools" do you use during group meetings and for group communication? Circle all that apply.
- a. Pen/Pencil and paper for yourself to take meeting notes
 - b. Pen/Pencil and paper which the group shares to take notes for the group as a whole
 - c. Blackboard
 - d. Whiteboard which allows copies to be made of things written on it
 - e. Networked computer system to allow group interaction at meetings
 - f. Overhead projector
 - g. Electronic mail
 - h. Plain whiteboard
 - i. Conference room and table
 - j. Office with desk and extra seating
 - k. Conference calling
 - l. Video Conference
 - m. Other _____
10. Based on the environment information for your meetings, what are the things that take place or which you have to deal with that effect the group communication process (e.g., telephone calls, interruptions, people forgetting about the meeting or showing up late, people not getting

the word about the meeting, crowded conditions, or other problems with the facilities or the tools used to communicate about the meeting)?

11. How much affect/impact does the environment (facilities, materials needed for a meeting) have on the overall success of a meeting? (1 - very, very low impact, 10 - very high impact) Circle one.

1 2 3 4 5 6 7 8 9 10

12. If you could improve the communication in your group, how would you try to do it? Select all that apply.

- a. Hold more meetings
- b. Hold fewer meetings
- c. Hold longer meetings
- d. Hold shorter meetings
- e. Purchase additional tools for group communication (e.g. networked computers, blackboards, conference table)
- f. Provide better meeting facilities (e.g. larger space, better lighting)
- g. Provide communication training to group members
- h. Other _____

13. Why did you select the tools and/or materials you did in question 12?

14. Is there specific communication training that you need help with or would like to see offered to the group? If so, what is the training?

15. Is there one person in particular who seems to "lead" your group? If so, who is this person? What does this person do to make you feel that he/she is a "leader"?

APPENDIX B

QUESTIONNAIRE - PART B

QUESTIONNAIRE - Part B

1. Did participating in the pre-interview cause you to react differently in the observed group meeting?

Yes _____ No _____

If you answered "yes", what did you do during the group meeting that was different?

2. Do you feel that the group interaction process of your group was "different" during the observed sessions than regular sessions?

Yes _____ No _____

If you answered "yes", what was "different" during the observed group meetings ?

3. Please rate the overall communication process of your group during the first observation meeting (1 - very, very poor, 10 - excellent). Circle one.

1 2 3 4 5 6 7 8 9 10

4. What criteria did you use to select the rating?

5. Please rate the overall communication process of your group during the second observation meeting (1 - very, very poor, 10 - excellent). Circle one.

1 2 3 4 5 6 7 8 9 10

6. What criteria did you use to select the rating?

7. What "tools" would you want to see used at future group meetings? Circle all that apply.

- a. Pen/Pencil and paper for yourself to take meeting notes
- b. Pen/Pencil and paper which the group shares to take notes for the group as a whole
- c. Blackboard
- d. Whiteboard which allows copies to be made of things written on it
- e. Networked computer system
- f. Other _____

8. If you could improve the communication in your group, how would you try to do it? Select all that apply.
- a. Hold more meetings
 - b. Hold fewer meetings
 - c. Hold longer meetings
 - d. Hold shorter meetings
 - e. Purchase additional tools for group communication (e.g. networked computers, blackboards, conference table)
 - f. Provide better meeting facilities (e.g. larger space, better lighting)
 - g. Provide communication training to group members
 - i. Other _____
9. Do you feel that enough emphasis is placed on developing "effective" group communication skills?
- Yes _____ No _____
10. Did you find it beneficial to participate in this research?
- Yes _____ No _____
- If yes, what was the most helpful part?

APPENDIX C

QUESTIONNAIRE - PART A GROUP MEMBER RESPONSES

Questionnaire - Part A Group Member Responses

1. How often are your typical group meetings held?

Group Member A: Once a week

Group Member B: Once a month

Group Member C: Less than once a month

2. Please rate how you feel about the overall group communication process in your group (1 - very, very poor, 10 - excellent).

Group Member A: 4

Group Member B: 6

Group Member C: 10

3. What criteria did you use to select the rating?

Group Member A: "Design changes were not relayed to others involved rapidly. Usually several day laps [sic] between changes and others becoming aware of changes."

Group Member B: "Although the communication within the group was good there were periods when the communication broke down causing a feeling of being excluded from the information loop."

Group Member C: "Everybody knows what's going on."

4. How well do you feel that you communicate with others during group meetings (1 - very, very poor, 10 - excellent)?

Group Member A: 6

Group Member B: 8

Group Member C: 10

5. How would you define "effective group communication"?

Group Member A: "Everyone involved in project knowing how everything affects his system. Knowing the current state of all systems involved."

Group Member B: "A method to stimulate a team concept which enhances the quality of the product. Everyone being allowed to voice his opinion."

Group Member C: "Everybody knows what's going on. All views expressed."

6. What rating do you think other group members would give the group communication process of your group (1 - very, very poor, 10 - excellent)?

Group Member A: 6

Group Member B: 7

Group Member C: 8

7. How many courses have you taken in which communication skills was a topic for discussion?

Group Member A: 3-4

Group Member B: 3-4

Group Member C: None

What was the specific focus of the communication studies (e.g., group communication, interpersonal communication, technical writing)?

Group Member A: Technical writing, several group design projects

Group Member B: Technical writing, group communication, public speaking

Group Member C: -----

8. How many books/articles have you read in the area of group communication?

Group Member A: Greater than 6

Group Member B: Greater than 6

Group Member C: None

What if anything did this (these) article(s) teach you about group communication?

Group Member A: "Nothing except how important good communications are."

Group Member B: "That in order to meet goals in schedules, quality, etc., you must make this information clear to other participants so that they are focused on the same goals."

Group Member C: -----

9. What "tools" do you use during group meetings and for group communication?

Group Member A: Pen/Pencil and paper for yourself to
take meeting notes

Blackboard

Conference room and table

Office with desk and extra seating

Group Member B: Pen/Pencil and paper for yourself to
take meeting notes

Whiteboard which allows copies to be
made of things written on it

Overhead projector

Plain whiteboard

Conference room and table

Office with desk and extra seating

Conference calling

Group Member C: Pen/Pencil and paper for yourself to
take meeting notes

Blackboard

Conference room and table

10. Based on the environment information for your meetings, what are the things that take place or which you have to deal with that effect the group communication process (e.g., telephone calls, interruptions, people forgetting about the meeting or showing up late, people not getting the word about the meeting, crowded conditions, or other

problems with the facilities or the tools used to communicate about the meeting)?

Group Member A: "Usually no major interruptions. Just a matter of getting people to openly discuss their areas of uncertainty or conflict."

Group Member B: "People showing up late or at the last minute, due to unexpected events, cannot attend."

Group Member C: "All that is required is an empty room."

11. How much affect/impact does the environment (facilities, materials needed for a meeting) have on the overall success of a meeting? (1 - very, very low impact, 10 - very high impact).

Group Member A: 2

Group Member B: 2

Group Member C: 3

12. If you could improve the communication in your group, how would you try to do it?

Group Member A: Hold more meetings
Hold shorter meetings

Group Member B: Hold more meetings
Hold shorter meetings

Group Member C: "Encourage people to talk to each other.
Stay informed of the design process."

13. Why did you select the tools and/or materials you did in question 12?

Group Member A: "I think more but shorter, (say 15 min max), meetings keep the group more informed and get conflicts out in the open sooner, rather than allowing design development to continue, even though there may be a problem."

Group Member B: -----

Group Member C: -----

14. Is there specific communication training that you need help with or would like to see offered to the group? If so, what is the training?

Group Member A: "No."

Group Member B: "To focus on the goal - eliminate or minimize finger pointing/jealousy which can destroy communication."

Group Member C: "No."

15. Is there one person in particular who seems to "lead" your group? If so, who is this person? What does this person do to make you feel that he/she is a "leader"?

Group Member A: "(Group member C). He was defined as the design lead."

Group Member B: "Leaders of the groups are not assigned based on communication skills. Assignments are based on technical

expertise. (Group member C) was assigned team leader and as such was the source of information."

Group Member C: "I lead the group. Willingness to take responsibility. Job title as team leader."

APPENDIX D

QUESTIONNAIRE - PART B GROUP MEMBER RESPONSES

Questionnaire - Part B Group Member Responses

1. Did participating in the pre-interview cause you to react differently in the observed group meeting?
Group Member A: "No"
Group Member B: "No"
Group Member C: "No"
2. Do you feel that the group interaction process of your group was "different" during the observed sessions than regular sessions?
Group Member A: "No"
Group Member B: "No"
Group Member C: "No"
3. Please rate the overall communication process of your group during the first observation meeting (1 - very, very poor, 10 - excellent).
Group Member A: 4
Group Member B: 6
Group Member C: 7
4. What criteria did you use to select the rating?
Group Member A: "I just don't remember communications being very good."
Group Member B: "The source of information was the group leader (group member C) and participation in discussions by other members was timid."

Group Member C: "The required information was shared."

5. Please rate the overall communication process of your group during the second observation meeting (1 - very, very poor, 10 - excellent).

Group Member A: 4

Group Member B: 8

Group Member C: 8

6. What criteria did you use to select the rating?

Group Member A: "Same as above."

Group Member B: "As the development progressed people became more knowledgeable about the goals and were more comfortable about expressing thoughts and sharing information."

Group Member C: "The required information was shared."

7. What "tools" would you want to see used at future group meetings?

Group Member A: Pen/Pencil and paper for yourself to take meeting notes

Pen/Pencil and paper which the group shares to take notes for the group as a whole

Group Member B: Pen/Pencil and paper for yourself to take meeting notes

Whiteboard which allows copies to be made of things written on it

Group Member C: Pen/Pencil and paper for yourself to
take meeting notes

8. If you could improve the communication in your group,
how would you try to do it?

Group Member A: Hold more meetings
Hold shorter meetings

Group Member B: Hold more meetings
Hold shorter meetings
Provide communication training to group
members

Group Member C: -----

9. Do you feel that enough emphasis is placed on developing
"effective" group communication skills?

Group Member A: "No"

Group Member B: "No"

Group Member C: "Yes"

10. Did you find it beneficial to participate in this
research?

If yes, what was the most helpful part?

Group Member A: "Yes. It wasn't so much beneficial as
it was that it made me reflect on the
lack of communication within most large
projects."

Group Member B: "Yes. It made me aware of many aspects
of a meeting which I often took for
granted."

Group Member C: "I am a strong believer in constant communication between all involved and I promote problem solving at the lowest level. As team leader seldom do a few days pass without talking to all team members. The net result is that large formal meetings tend to be anti-climatic."