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# THESIS

THE POTENTIAL BENEFITS OF USING  
TELECONFERENCE TECHNOLOGY IN THE  
CLASSROOM ENVIRONMENT  
FOR U.S. NAVY TRAINING COURSES

by

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March 1988

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<p>▲ This study assesses both the desirability and the feasibility of introducing present videoconference technology into the traditional classroom setting used by most Navy courses.</p> <p>While training is always a critical need for a high-tech organization like the Navy, the costs involved with training are rising at an alarming rate. This study examines the effectiveness of videoconferencing as a medium for Navy training in light of current trends in videoconference systems that may lower training costs. It also explains why it is widely accepted that there is unlimited potential for video teleconference systems to improve training effectiveness.</p> <p>First, the current level of effectiveness and efficiency in the Navy training environment is discussed. Then a brief description of teleconference technology follows. Overall teleconference system costs compared to current training costs are evaluated and support the proposal to substitute videoconferencing for travel. How videoconferencing affects student productivity and performance is also considered; research indicates students will learn as much through teletraining as in a traditional training environment. Finally, this thesis examines why the Navy training community, specifically local training commands, may experience significant change in hierarchal structure and authority. (The end). (C)</p>				
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The Potential Benefits of Using  
Teleconference Technology in the Classroom Environment  
for U.S. Navy Training Courses

by

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Lieutenant, United States Navy  
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Submitted in partial fulfillment of the  
requirements for the degree of

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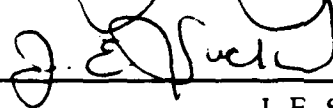
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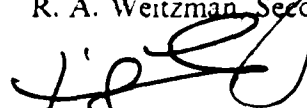
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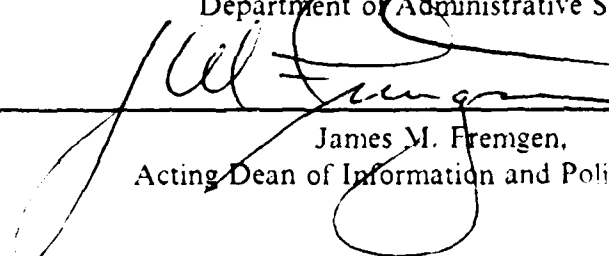
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## ABSTRACT

This study assesses both the desirability and the feasibility of introducing present videoconference technology into the traditional classroom setting used by most Navy courses.

While training is always a critical need for a high-tech organization like the Navy, the costs involved with training are rising at an alarming rate. This study examines the effectiveness of videoconferencing as a medium for Navy training in light of current trends in videoconference systems that may lower training costs. It also explains why it is widely accepted that there is unlimited potential for video teleconference systems to improve training effectiveness.

First, the current level of effectiveness and efficiency in the Navy training environment is discussed. Then a brief description of teleconference technology follows. Overall teleconference system costs compared to current training costs are evaluated and support the proposal to substitute videoconferencing for travel. How videoconferencing affects student productivity and performance is also considered; research indicates students will learn as much through teletraining as in a traditional training environment. Finally, this thesis examines why the Navy training community, specifically local training commands, may experience significant change in hierarchal structure and authority.



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## I. INTRODUCTION

### A. BACKGROUND

Current Navy training methods fall short of developing the required skills necessary in today's technologically advanced fleet. Lack of truly qualified instructors, shortage of funds, and low priority compared to building and maintenance programs have been cited as reasons for the low quality of Navy education. Furthermore, the occupational standards available are inadequate to design training programs. Hence, school commands take the initiative to design their own courses causing programs for the same ratings to vary from school to school [Ref. 1: p. 56]. As a result, sailors often arrive to their first commands totally unprepared to assume immediately the duties they were supposedly trained to undertake. The outcome is confusion and unhappiness with both the sailors and commanders. A possible solution to this problem is to centralize training schools through a videoconference system.

The Commander for Naval Education and Training (CNET) was inaugurated approximately fifteen years ago to take on the issue of quality Navy training by centralizing the responsibility for that difficult task. Since then, CNET's aim has been to standardize navy education and provide the fleet with the best trained personnel. As early as 1982, with the increase in shipbuilding programs under the leadership of Secretary Lehman, the Navy faced a shortage of instructors [Ref. 2: p. 60]. The result was a backlog of students waiting to complete required courses prior to reporting to their ship. Even with instructor billets prioritized for shore duty manning, Navy schools still lacked instructors who knew how to teach.

In a perfect world, warfare commanders would solely fund all training programs to meet their needs and would ensure no cuts were made. However, in the imperfect budgetary world in which we live sponsors cannot fund all requirements equally and completely. Tradeoffs must be made to meet mission requirements, and unfortunately equipment requirements usually override training requirements. Former CNET, VADM James A. Sagerholm, wrote:

Our facilities are badly in need of improvement and have suffered from money swapping....Money is not the only shortage we foresee in the future. We also anticipate a reduced manpower supply. By 1990, there will be a drop of more than twenty-five percent in the pool of seventeen year old males and females. Added to the people problems are the high cost of providing skill training and moving people

to training sites....With the present resources, we will be able to train only the same number of people we are now training; therefore, people in ratings that do not necessarily require classroom training may be limited to on-the-job training, making room in the schools for people in more skilled areas. [Ref. 2: p. 64]

In the days of wooden ship's under sail, on-the-job training may have been appropriate. However, today's Navy is changing at the same rapid rate as our "rapidly evolving" technology. Consequently, sailors are having trouble keeping up with the state of the art. On-the-job training must be supplemented with more school training. However, Navy schools are not providing the leadership training where they should, and the future training picture looks grim without some necessary change.

## **B. PROBLEMS**

To help the reader understand why this thesis is taking the approach that current Navy training methods are ineffective, specific examples are discussed below. Although these examples are anecdotal, they should serve the purpose of informing the reader why this stand is being made. The examples will cover the problems of inexperienced instructors, navy required course quotas, and availability of standard leadership and management courses of instruction.

### **1. Inexperienced Instructors**

Some Navy instructors lack the experience, knowledge, or skills to teach. Because an individual has attained a certain specialty, that does not qualify him to impart that knowledge in a formal classroom setting. Many navy instructors have practical knowledge, but little understanding of theories. Some instructors have a difficult time with public speaking--hardly the problem to have as a teacher.

This author once witnessed a general shipboard damage control course taught by a third class hull technician. The hull technician continuously made mistakes that had to be corrected by his students. His speech delivery lacked confidence and the students appeared to be disgusted to the point they were nearly rude to him. Classroom decorum became minimal. At the end of the two-day course, both teacher and students alike had a negative attitude. The man-hours involved were wasted. Nothing was gained but discontent among the commands involved. Whose fault was it?

There is really no one to blame in this instance. The hull-technician was not performing as a hull-technician. Teaching is a different skill that requires time and effort to develop. Although the hull-technician did his best under the circumstances, he should never have been given that assignment.

This case may be extreme, but the point is clear: it should never have happened. However, with the current instructor training system, cases like this may be hard to avoid. Many instructors are nonvolunteers and therefore lack motivation for their instructor assignment. Even at the collegiate level, students cite course failures because of the shortcomings of a professor. Surely the problem of poor teaching is magnified at the navy course level where instructors are less experienced. This illustration is not to disgrace worthy and sometimes laudable efforts of those who teach navy courses. It is merely used as an example of the problems the navy faces and should try to overcome.

## **2. Navy Required Course Quotas**

Specific courses are mandated by Navy directives to be offered and taken by specific commands. Commands usually plan to send the required attendees when operations are slow and the billet must be filled. In most cases proper planning avoids any problems, but there are instances when quotas are hard to meet because a command lacks time or travel funds to send an individual to the course. The following case will illustrate this point.

A recent well publicized spy scandal in the U. S. Navy dictated the severe action of stripping many individuals of their security clearance and assigning new inexperienced people to become responsible for highly classified material. Commands were required to send those new individuals for immediate training to either Norfolk or San Diego, the only places the courses were offered in communication security. Naturally, the training command facilities were not designed to handle such a large number of trainees over a short period (less than one year). Also, individual commands either lacked money or the time to get someone new qualified in such short notice. With the national security at stake, crisis management was controlling the problem. Both training and operational commands suffered through the ordeal to expedite the training process of teaching new people how to be responsible for material sensitive to national security. This training effort was not done efficiently or effectively, because the chaotic handling of trainees overruled any chance of a smooth transition of personnel turnover.

As in the previous example, this case illustrates the extreme. The courses should have been offered in more locales (i.e., near where each command is located). However, the system did not allow that because there were only a certain amount of "qualified" teachers who could not be everywhere at once.

Another example of how the quota system can work against a command involved a ship that needed an officer to get qualified as a helicopter landing officer in case something happened to the only other qualified individual. The ship was scheduled for a big operation and felt it would be appropriate to get the officer qualified prior to it. The course was offered in only one place over four hundred miles from the ship's homeport. Even though the command lacked funds to send an individual, one enterprising officer volunteered to take the course and travel at his own cost. The ship was able to reserve a seat in the class for the officer, but he was denied to take the course because his orders were stamped "no cost to the government." For some reason, the training command could not authorize the officer to be a student in the class since the government did not pay for his travel.

This scenario is true, though it may seem incredible. Had the officer been stationed in an area where the course was offered, he could have attended the course at no additional cost to the government or himself. Again the problem is the course could only be offered in one locale for various reasons, thus causing commands outside the locale to suffer the additional travel cost and time required to send someone to attend it.

### **3. Leadership and Management Training**

The Navy has great room for improvement in the area of leadership training. This statement seems ironic because in no other organization are leadership abilities as closely scrutinized as the military. When people discuss military issues, they want to know who the leaders are. One might expect leadership training to be the cornerstone of such an organization.

Leadership, Management, and Education Training (LMET) supposedly sets the standard for leadership fundamentals, but this goal cannot be achieved under the current system. Although LMET instructors have a Navy course outline to follow, most teach leadership skills and theory based on their own experiences. Each instructor views leadership differently. Some may be inclined to impart their own style as gospel. Even with an outline, the instructor is bound to concentrate on his own expertise and experience, thus not giving fair distribution to all areas of leadership theory in the course.

On the other hand, LMET is a course where instructor's availability is at a premium. Although most new junior officers take the course, only a small minority of new petty officers receive formal education in leadership. In most cases, that promotional step is the first time sailors are put in places of responsibility, and they do not

know how to handle it. For those individuals, they usually receive their education via the command master chief whose opinions are always valued but easily biased by years of "experience." This training needs standardization so every sailor can equally take away from the course exactly what the Navy policies are for leadership and management. LMET is a typical course that needs great distribution on a general scale to offer more people the opportunity to be formally educated by qualified instructors on how to lead other personnel.

#### **4. Teletrain: A Possible Solution**

Teletraining using videoconferencing techniques may be a suitable change from the current training methods being employed today. This technology has been lauded by many experts for its potential to reduce costs and increase productivity. However, considerable resistance to this change has been evident in some parts of the private sector because videoconferencing replaces traditional face-to-face communication.

### **C. OBJECTIVES**

There are various ways to prepare an individual for a specific task, job, or position in the work force. The value of experience, trial and error, and on-the-job training are great in terms of risk. With on-the-job training, the probability of a personnel or equipment casualty is much greater because learning is not done in a controlled environment. The more one can learn in a controlled environment, the better his skills can be honed and confidence gained prior to assuming his role in the work place. However, there is no secret formula that tells us how much each individual should be taught and what is the best way to do it. Further complicating that problem is finding the best way to motivate each student to compel him to give his best effort. Still, nothing designed in the classroom totally ensures a certain type of performance in the field. Therefore, the task at hand is to find better ways to teach a given subject. It is the responsibility of organizations at the micro and macro level to support the goal of attaining the most out of human potential. Organizations must encourage better ways to generate better human performance. [Ref. 3: p. 364]

Therefore, the aim of this study is to determine if using videoconference technology for classroom instruction is a suitable alternative method to the current style of teaching Navy courses. In general, the following research questions will be answered.

1. Can centralized training centers for a decentralized population of students be able to attain the output level of competency desired by the fleet commanders?
2. Can costs be reduced using videoconferencing as a substitute for travel?

### 3. Can this proposed change be implemented?

Videoconferencing may not be a panacea to our problems with Navy training methods, but it is a technology that may offer benefits that should be explored. This study will see if those benefits should indeed be explored.

## D. ORGANIZATION

This thesis will use existing reports, studies, and articles as a theoretical basis. New data was not collected because the fundamental question this study should resolve is the theoretical feasibility of introducing present videoconference technology into the traditional classroom environment.

The first chapter provides the background of the current level of effectiveness and efficiency in the Navy training environment. The second chapter describes teleconference technology. Chapter three gets to the heart of the thesis material: how people react to this technology. It describes the barriers that has slowed the progress and acceptance of videoconferencing. The fourth chapter will demonstrate the cost effectiveness of this type of system. Chapter five gives a brief explanation of how one can incorporate the change to videoconference technology. The sixth chapter summarizes the report, provides conclusions reached by the author, and recommends what direction further research should go.

## II. TELECONFERENCE TECHNOLOGY

### A. HISTORY

An historical perspective is important when any new proposal is discussed because understanding the past of a program prevents duplication of efforts and avoids past mistakes. Unless otherwise noted, the history of teleconference technology in this thesis was derived from the writing of Stanley Earl Snead and Leslie Howard Duncan [Ref. 4: pp. 7-40]. This chapter will first discuss the history of videoconferencing then explain the three major areas of teleconferencing to help the reader understand the evolution of videoconference technology. Current teleconferencing trends will then follow.

#### 1. The Picturephone

The concept of videoconferencing is not new. On 7 April 1926, Secretary of Commerce, Herbert Hoover, spoke on a videoconference system with Walter S. Gifford, President of AT&T. Over the next thirty years, Bell Laboratories continued to work on that system to improve upon it and to develop it for commercial use. By 1956, Bell Labs was ready to demonstrate their videoconference system to the Institute of Radio Engineers. That system was crude by today's standards, with separate components to make up each part of the videoconference unit. Soon, Bell engineers were able to incorporate the separate components into a single complete unit, and in 1964, this system was shown to the public. Taking action on recommendations from the public, Picturephone was developed a year later and promised to become the selling product of the future.

##### *a. Simplicity*

Picturephone was a simple system to operate. When a call was initiated, the user merely dialed the phone number desired after pushing one button to activate the video process. The person on the receiving end could identify a Picturephone call by the ring and a light (red for Picturephone otherwise white). However, the wire connection between the two was a bit more complex. Two wires were used for the audio portion while the remaining four were used for video. Although three people could be on the camera at a single moment, the five by five and one half inch screen made it difficult to view standard sized texts and graphs.



*b. First Operational Test*

In 1969, Picturephone was operationally tested with the assistance of the Westinghouse Electric Company. A network between Westinghouse offices in Pittsburgh and New York was installed. The test was successful as Westinghouse managers cited significant cost savings in business travel.

*c. Marketing the Picturephone and Its Demise*

By 1970, Bell Labs were ready to market the Picturephone to the general public. Seventy square blocks in Chicago were chosen for the first area to sell Picturephone. However, Picturephone failed at this time because no one was interested. The Picturephone was too expensive for a single resident to consider buying the system for private use. Bell's irrational marketing strategy of trying to sell the Picturephone to the general public instead of big business where it succeeded (i.e., Westinghouse) was the main cause of its failure. The standard telephone had served the general public well, and there was no reason to shift to the new style. The fact the graphics were not sharp and the picture was small did not help. Furthermore, internal problems with the Picturephone such as the complexity and cost of special hardware made the overall cost of the system unreasonable for the public. Instead of trying a new marketing strategy in the business community, AT&T shelved the project. While AT&T was testing the Picturephone with Westinghouse, other countries and companies began their own systems. As Picturephone met its demise in 1973, so did most of the others for mainly the same reasons, marketing videoconference units to the general public at great cost to the consumer. Although this mistake seems perfectly clear today, it was not then.

*d. Videoconferencing Reemerges*

Another significant event happened in the early 1970's: the oil shortage. As a result, transportation costs skyrocketed, and alternative methods of travelling, especially in the business sector, were sought. This period started new interest in videoconference technology. In economic terms, the crossed-price elasticity of using videoconferencing was more beneficial than any method of transportation (i.e., it was cheaper to videoconference than travel by auto or plane).

The telefacsimile system which was available in 1974 was initially the most desired method of videoconferencing, having the ability to transmit high speed facsimile at the rate of forty seconds per page to teleconference groups that were as much as fifty persons in size. A telephone was used in tandem with the telefacsimile machine. At that

time, this method was a significant improvement over a strictly audio teleconference because more information could be processed.

Today, videoconferencing is used primarily by private industry and large government organizations. Current videoconference systems are generally:

1. privately owned
2. large screen--and the trend is toward even larger screens
3. multi-mode, i.e., conference mode, text, and graphics mode
4. user operated
5. CCTV (closed circuit television)
6. black and white--but the trend is toward full color
7. point to point, two-way only--but the trend is toward simultaneous, multi-location conferencing.
8. transmitted over a variety of broadband links-- but the trend is toward simultaneous multi-location conferencing
9. located on-premise. [Ref. 4 p. 35]

## **B. CATEGORIES OF TELECONFERENCING**

When discussing teleconferencing methods, we can use three separate characteristics for description and identification: audio, visual, and audio-visual. The basic home telephone system is the cornerstone of the audio teleconference, while *facsimile* and *computers* are solely a visual communication network when used without telephones. Videoconference centers combine the two technologies and is the proposed system this thesis will explore. All three styles of teleconferencing have their distinct tradeoffs which will be discussed below.

### **1. Audio**

The audio system of teleconference networks is the most traditional of the three types. An audio network can have the makeup of a party line where many single units have access to the transmission line. Protocol concerning when to speak can be a severe drawback to that method.

Another common audio system is when one individual talks to various groups over a single dedicated line. This system, called the loudspeaker telephone, may be common in business circles when one manager must communicate with the employees at a branch office.

The advantage of an audio system are:

- cost relative to other teleconference systems is much lower

- easy access to many locations because of the wide distribution of telephones
- information is transmitted instantaneously.

The disadvantages are:

- inability to view the people spoken to or documents spoken about (if not already possessed)
- users can easily be distracted without something visual to focus on (e.g., doodling, making signatures on other correspondence)
- without nonverbal cues, feedback is difficult
- good discussions require experience on the system. [Ref. 5: p. 94]

Several manufacturers have built on the basic concept of the loudspeaking telephone mentioned earlier. Instead of one single box for everyone to share, the advanced system includes several microphones that can be placed on a desk. This feature allows group size to increase from five to approximately twenty-five [Ref. 6: p. 31].

## 2. Visual

After the telephone, visual teleconferencing is probably the most often used [Ref. 5: p.96]. Facsimile is an example of visual communication that can transmit and receive images such as pictures, graphs, and texts over the telephone line. The images can be produced either from hardcopy or from a CRT(cathode ray tube) terminal. Western Union's Telex service is an example of a facsimile production.

Facsimile machines in conjunction with telephones is the most common form of teleconferencing. Participants in business meetings and in training sessions via phone conversations can process more information when text or graphs are used as aids. The improved communication is because the bandwidth is longer: "Bandwidth is the information transmission capacity of the available sensory channels (visual, auditory, tactile, gustatory, and olfactory) for verbal and nonverbal communication" [Ref. 7: p. 38]. Communication using audio and graphics use only the auditory and visual senses. More about audio-visual communication will be discussed in the next section.

Computer conferencing is another method of electronic communication which exemplifies visual teleconference prominence. Interactive computer terminals are connected over a variety of networks for educational, business, and governmental needs. For example, the Defense Data Network (DDN), a computer conference system, is strongly gaining acceptance in the Department of Defense because of its simplicity, reliability, and relative low cost.

The chief advantages of visual teleconference methods are:

- visual information transmitted at a relative low cost
- ability to ensure users communicate exactly what they want
- immediate feedback available if desired
- narrow bandwidth required enables the use of existing telephone lines.

While the disadvantages are:

- special equipment is required
- nonverbal cues are absent
- sight only information lacks the richness of information that is coupled with additional senses. [Ref. 5: p. 98]

### 3. Audio-visual

While audio and visual communication provide valuable information in the teleconference arena, the combination of the two through video conferencing offers the most promise as a communication tool in the education and business sectors. Freeze-frame and full motion are the two types of videoconference methods.

Freeze-frame video teleconferencing is more sophisticated than a telex message and it completes the same task while using audio in conjunction with a facsimile machine. This type of videoconferencing is used to help communicate visual aids such as graphs and text. The goal is to minimize delay in this process caused by human interaction which may interfere with the progress of the meeting or training session [Ref. 7 : p. 46]. For example, suppose a teleconference via telephone is in process, and one member of the group makes reference to a certain report the other party should also possess. The teleconference may be delayed if the other party does not have that report in close proximity and must locate it in a file. Freeze frame video avoids that awkward moment by transmitting the referenced document.

Pictures of participants in a freeze-frame teleconference is encouraged to lend some credibiltiy to the participant's messages [Ref. 7: p. 46]. However, this attempt to further personalize a teleconference still lacks the important nonverbal cues [Ref. 7: p. 46]. Therefore, full-motion video teleconference methods are the closest thing to face-to-face communications. That is, the goal with full-motion videoconferencing is to achieve the same semblance as face-to-face communications. (e.g., meeting room environment). However, being the most advanced method of teleconferencing, full-motion video is both costly and complicated.

There are six elements that define a video teleconference system:

1. a high quality yet inconspicuous audio system;
2. full motion color video or;
3. freeze frame or slow scan video system;
4. controls to establish the transmission system;
5. high resolution graphics via a graphics or digital system;
6. special features such as electronic blackboards, titlers, and electronic cursors. [Ref. 5: p. 99]

**Table 1. COMPARISON OF COMMUNICATION METHODS**

<i>Comparison</i>	<i>Face to Face</i>	<i>Video Conferencing</i>	<i>Audio</i>	<i>Computer Conferencing</i>
<b>Geographic coincidence?</b>	<i>yes</i>	<i>no</i>	<i>no</i>	<i>no</i>
<b>Time coincidence?</b>	<i>yes</i>	<i>yes</i>	<i>yes</i>	<i>no</i>
<b>Group size limit</b>	<i>tens to hundreds</i>	<i>few tens</i>	<i>few tens</i>	<i>hundreds</i>
<b>Speed</b>	<i>talking rate</i>	<i>talking rate</i>	<i>talking rate</i>	<i>reading rate</i>
<b>Nonverbal cues</b>	<i>all</i>	<i>most</i>	<i>audio only</i>	<i>none</i>
<b>Memory</b>	<i>recordings</i>	<i>recordings</i>	<i>recordings</i>	<i>unlimited retrieval and modification</i>

Several television news talk shows, such as the Larry King Show (Cable News Network), use videoconference technology during their broadcast when one party is at the television studio and the other is at a different location. On these occasions, one may notice how both parties can have a discussion from remote areas and still see each other and their surroundings. The advantages of videoconferencing are:

- possible substitute for face-to-face communications
- effective for task oriented, short, goal-oriented meetings (e.g., training courses)

While the disadvantages are:

- cannot use most telephone lines (i.e., must rely on satellite relays). [Ref. 5: p. 101]

The three categories of teleconferencing offer various tradeoffs among each other. For educational purposes, videoconferencing may offer the best variant of teleconferencing. Table 1 summarizes these tradeoffs and comparisons [Ref. 8: p. 159].

### **C. CURRENT TELECONFERENCE TRENDS**

Four specific examples will show that teleconference technology is growing rapidly. Each example will cite a separate category of teleconferencing. Surprisingly, none of the five categories dominate in demand. Each category offers different features that attract different customers.

#### **1. Krisken Electronics**

Krisken Electronics Corporation boasts great demand for their CONFER system, an audio teleconference unit [Ref. 9: p. 54]. Designed for use by brokerage firms, CONFER is a digital audio conference system that is supposedly very reliable. It can be initiated by any phone and any speaker can interrupt the call without degrading communication performance. Obviously, these would be important features for a communication system used by a brokerage house.

#### **2. Keesler Air Force Base**

At Keesler Air Force Base, the Air Force uses computers and Interactive Video Discs (IVD) to train technicians [Ref. 10: p. 17]. The system is used to test the students' progress in lieu of a programmed text. As students answer incorrectly on the computers to programmed questions, the IVD displays the correct answer and explains it citing reference material. A variety of schematics are reviewed in the process. The software for this system increases training costs, but the Air Force believes the educational benefits outweigh the cost tradeoff.

#### **3. Naval Underwater Systems Command**

The Naval Underwater Systems Command (NUSC) links to the Naval Sea Systems Command (NAVSEA) with a full-motion, interactive, encrypted, color video conference system [Ref. 11]. This system substitutes for the inordinate travel required by individuals at the two commands. Both commands are very satisfied with this system and use it often.

#### **4. Business Television**

Private television networks provide services to over 5000 locations primarily for business enterprises' training programs [Ref. 12: p. 10]. These networks operate via satellite.

Practical satellite transmission came only several years ago when the Federal Communications Commission set aside designated frequencies (called the KU-band) for such services. This gives privately owned television networks a frequency that will remain free from interference other broadcast signals. The band also permits the use of broadcast equipment that is less costly than conventional television. What's more, signals can be scrambled to assure that they will be seen in only authorized viewing locations--called downlinks--which may be in a company's offices ... or any other place a satellite can reach. [Ref. 12: p. 11]

## **5. Summary**

These four different but equally worthwhile teleconferencing systems are merely examples of what is in use today. Communication technology is constantly being improved. For example, the latest technological breakthrough is fiber optic cable. By using a medium of light, information will travel faster and be more reliable. However, there will always be advantages and disadvantages to every new system. To single one system as "the best" is senseless because each system supplies a service for a specific demand. The only trend important to note is that the growth rate of videoconferencing is overwhelming, and the unlimited potential uses of teleconference technology is staggering. However, one should still determine which system is best suited to meet his own specific needs.

Cost is usually the greatest factor that determines the feasibility of a system. The next chapter will review the cost benefits of teleconferencing.

### III. TELECONFERENCING COST BENEFITS

#### A. INTRODUCTION

Training costs in the Navy have increased throughout this decade. This trend was not expected in 1980 when the Navy embarked on a campaign to improve the quality of life for sailors and thus improve retention [Ref. 13: p. 1]. The increased retention rate was expected to offset the need to train new personnel. Without having to train new personnel, training costs were expected to decrease. However, the opposite happened.

A study conducted by the Center for Navy Analysis (CNA) discovered some obvious reasons for the increase in training costs. First, an accounting procedure concerning the finance method for retirement pay was changed in 1985 [Ref. 13: p. 1]. Second, inflation added to the increase. The final factor was another accounting change in the financing of nuclear power training [Ref. 13: p. 28]. Training costs still show a significant upward trend with the above three factors eliminated from the equation. The CNA study then focused on *specialized skill training*, which will be discussed below.

Later in this chapter the cost analysis of centralized training will be reviewed. Possible teletraining sites and their estimated costs will follow that section. The chapter will end with the discussion of the benefits of videoconference technology as a substitute for travel.

#### B. TRAINING COSTS

The CNA conducted a study which was published in 1987 about the factors that dominate navy individual training costs. This study focused on specialized skill training as the main variable in the cost equation. Specialized skill training is broken down into three categories:

- **A-school:** initial skill training that follows boot camp, normally a large amount of hands-on training
- **C-school:** a more advanced school than A-school which concentrates on theories and advanced hands-on applications
- **F-school:** a functional school such as firefighting which provides general training normally applicable to all rates. [Ref. 14: p. 4]

The major cost elements of specialized skill training are:

- civilian personnel staff
- costs associated with military instructors



- stock fund supplies and materials
- contract maintenance and repair services
- printing and reproduction services
- minor equipment purchases. [Ref. 13: p. 9]

The major finding in the CNA study was that the increase in training costs was a result of the increased student load during the early part of this decade. Retention rates had increased as expected, but with the increased reenlistments came more C-school training (various reenlistment incentive programs promised C-school training prior to the next duty station). Since cost per student and student teacher ratios remained relatively unchanged, the influx of students and teachers was the major factor for the increased training costs [Ref. 13: p. 28]. Appendix B provides an overall summary of Navy training costs by training category [Ref. 13: p. 3].

**Table 2. NAVY TRAINING COST TREND**

<i>year</i>	<i>budget (\$billions)</i>	<i>training costs (\$billions)</i>
1981	71.5	3.575
1982	80.3	3.935
1983	91.7	3.943
1984	94.2	4.522
1985	100.3	5.817
1986	100.2	6.212

### 1. CNA Study

The CNA study observed that the Navy had made great efforts to retain individuals within the fleet to increase the level of expertise gained from experience. Unfortunately, the Navy was not able to reduce the need for as much formal training. Student load for each type of specialized skill training rose causing training costs to likewise increase. Table 2 summarizes the rising training cost trend that has plagued the Navy this decade [Ref. 13: p. 2].

The Navy's plan mentioned earlier backfired. Quality of life and retention rates did improve. However, formal school training was still as sorely needed as ever. The Navy unrealistically hoped on-the-job experience would make up for less formal training (and training costs). Since standards to qualify personnel for certain responsibilities did

not decrease (which typically includes several hours of formal training), student loads were not going to decrease either.

*a. Student Load*

The relationship between training costs and student load is significant. CNA found that relationship to be the main factor in training costs. The study considered student load the number of students actually under instruction as compared to those awaiting instruction. By breaking their study down to the cost for individual students being trained, the CNA report was able to pinpoint the reason training costs continued to rise.

There was an overall 16.4 percent increase in students under instruction between fiscal years 1981 and 1986 (see Figures 1 thru 3) [Ref. 13: pp. 25-27]. A thirty-five percent increase in C-school students was the prime reason for that large increase. The operational costs and cost per student for C-schools are staggering compared to A and F schools (i.e., almost five times as much). Therefore, the overall training costs rose corresponding to the jump in C-school attendance.

The Navy maintains an extremely low student instructor ratio for C-schools (approximately 1.5 to 1) because of the intensity of that level of training. With the increased attendance in C-schools the past seven years, a large proportion of new instructors have likewise reported to train the new students. This trend has ultimately been the major cause for the sharp increase in costs [Ref. 13 : p. 24].

*b. Study's Conclusion*

The CNA study does not address any recommendations to fight training costs increases. One fact stipulated was that instructors assigned to teach C-school impact training costs. On a broader scale, the report found the number of military instructors determined by the student load to be the predominant reason training costs continue to rise. That finding combined with inflation, and two new accounting changes caused the marked increase in training costs between 1981 and 1987.

**C. CENTRALIZATION**

One way to offset the rising training costs mentioned in the CNA study is to centralize training sites. Certain economies might be achieved through centralization; however, some of the qualitative benefits associated with multiple sites such as diversity and autonomy might be lost. There are three possible ways to centralize real-time training:

	FY 1982	FY 1983	FY 1984	FY 1985	FY 1986	Percent 1982-86
<b>A school</b>						
Students under instruction	25,565	27,276	26,711	27,820	28,109	8.6%
Instructors	4,327	4,529	4,533	4,517	4,543	12.6%
Student/instructor ratio	6.4:1	5.8:1	5.9:1	6.2:1	6.2:1	
<b>C school</b>						
Students under instruction	12,274	13,581	14,350	14,612	15,738	35.0%
Instructors	9,465	10,215	10,196	10,064	10,807	28.0%
Student/instructor ratio	1.3:1	1.3:1	1.4:1	1.5:1	1.5:1	
<b>F school</b>						
Students under instruction	4,459	4,436	4,575	4,779	4,923	13.0%
Instructors	48	50	78	92	95	97.9%
Student/instructor ratio	89.2:1	76.5:1	58.6:1	51.9:1	51.8:1	
<b>All schools</b>						
Students under instruction	44,748	44,293	45,636	47,211	48,770	16.4%
Instructors	13,842	14,802	14,807	14,673	15,445	23.3%
Student/instructor ratio	3.2:1	3.0:1	3.1:1	3.2:1	3.2:1	

Figure 1. Student/Instructor Ratios

A school	FY 1982	FY 1983	FY 1984	FY 1985	FY 1986
Cost per student (dollars)	5,006	5,598	5,406	5,252	4,821
Student/instructor ratio	6.4:1	5.8:1	5.9:1	6.2:1	6.2:1
C school					
Cost per student (dollars)	22,218	22,274	21,666	20,983	20,905
Student/instructor ratio	1.3:1	1.3:1	1.4:1	1.5:1	1.5:1
F school					
Cost per student (dollars)	3,476	4,261	4,109	3,808	4,002
Student/instructor ratio	89.2:1	76.5:1	58.6:1	51.9:1	51.8:1
All schools					
Cost per student (dollars)	9,748	10,575	10,411	9,974	9,969
Student/instructor ratio	3.2:1	3.0:1	3.1:1	3.2:1	3.2:1

Figure 2. Trends in Student Costs

	FY 1982	FY 1983	FY 1984	FY 1985	FY 1986	Percent increase (FY 1981-1986)
<b>Students under instruction</b>						
A school	27,565	26,276	26,711	27,820	28,109	8.6%
C school	12,724	13,581	14,350	14,612	15,738	35.0%
F school	4,459	4,436	4,575	4,779	4,923	13.0%
Total	44,748	44,293	45,636	47,211	48,770	16.4%
<b>Training operations costs (millions of dollars)</b>						
A school	138.0	147.0	144.4	146.1	137.5	14.2%
C school	282.7	302.5	310.9	306.6	329.0	26.3%
F school	15.5	18.9	19.8	18.2	19.7	37.8%
Total	436.2	468.4	475.1	470.9	486.2	23.1%
<b>Cost per student (dollars)</b>						
A school	5,006	5,598	5,406	5,252	4,822	
C school	22,218	22,274	21,666	20,983	20,905	
F school	3,476	4,261	4,328	3,808	4,002	
Average--all schools	9,748	10,575	10,411	9,974	9,969	

Figure 3. Relationships Between Costs and Student Loads

1. Reduce the number of locations of training sites and send all students to those locations (a minimum of one site).
2. Provide mobile training teams, home based in one location, to travel to selected sites for training.
3. Videoconference the course to all students in various locations.

#### **1. Reduce the Number of Training Sites**

A study conducted by the Navy in 1981 about centralizing instructor training concluded that any decision to centralize must be based on factors other than cost [Ref. 15: p. 60]. It recommended the decision to centralize should be based on "the need to consolidate management or curriculum control, consideration of individual warfare specialty community requirements, and the responsiveness of the program to local operational needs and or training activities" [Ref. 15: pp. 60-61]. As the number of training sites are reduced for a single course, instructor staffs have an easier time coordinating their combined efforts to develop, revise, and schedule a particular course to meet the Navy's needs.

The above study strongly recommended against using one training site alone as a way to centralize because travel costs would be extremely high. Videoconference technology was not considered as a tool to centralize most likely because that technology was not as widespread or well-tested in 1981.

#### **2. Mobile Training Teams**

Mobile training is used extensively in the areas of engineering and combat systems team training for ships preparing to deploy. Standardization, control of course content, and method of presentation are training features that benefit from mobile training teams. Conversely, the main disadvantage of mobile training teams is the inability to justify follow-up training because there are extra travel costs involved. Mobile training teams serve best as outside observers who can point out shortcomings to individual commands to improve upon before the upcoming deployment (i.e., consulting).

#### **3. Videoconference**

Training via videoconference technology, otherwise known as teletraining, is the most recent step in the evolutionary process of alternative education systems [Ref. 16: p. 36]. For instance, correspondence courses may be a more archaic way of accomplishing what teletraining does today: training individuals in diverse locales simultaneously (i.e., centralized training). According to some experts on videoconferencing, teletraining

can be as effective from a learning standpoint as the conventional face-to-face method of instruction according to a number of tests conducted by universities and corporate users. Teletraining is even more effective in areas such as providing timely training to personnel who now are often forced to wait months before a classroom seat becomes available. [Ref. 16: p. 36]

The Air Force Institute of Technology in Dayton, Ohio initiated teletraining in 1979 and discovered a savings of \$520,000 over a one year study [Ref. 16: p. 37]. The savings were due mainly from reduced travel. Another benefit was eliminating the student course backlog.

Whether or not teletraining is an effective substitute for the conventional method of face-to-face instruction will be developed more in chapter four. However, the possible cost savings will be discussed now.

#### **D. COSTS OF SELECTED VIDEO CONFERENCE SYSTEMS**

Two video conference systems will be considered for the purpose of this study to give a broad view of the costs involved. It will provide a framework in determining whether it is in the Navy's best interest to procure video teleconference systems for training, considering all costs and benefits involved. The first system to be analyzed is full-motion video; the other will be audio-visual. Both of these systems were explained in detail in the previous chapter.

The network model for this analysis is comprised of four sites (San Diego, Long Beach, San Francisco, and Seattle). Each site is a location where surface warships are homeported, although some aviation and submarine commands are also homeported in those areas. San Diego is the hub for training on the west coast, thus 1884 combined miles separate the other locations from San Diego. These assumptions are made to facilitate this model. In the final section of this chapter, it will be determined if videoconferencing is a valid substitute for conventional modes of travel.

##### **1. Full-Motion Video Model**

The detailed costs for a four-site full-motion video teleconference model system are shown in Figure 4. The information for this cost structure was gleaned from a report conducted for the Department of Defense in 1981 [Ref. 17: p. 47]. This model does not take into account inflation, recent technological improvements, or operator salary. Therefore, it would be inappropriate to use this model to estimate the cost of any specific system. Its sole purpose is to demonstrate that initial costs for a videoconference system are extremely high in the short run but might be favorable as a substitute communication medium when costs are averaged in the long run.

ONE-TIME

## Equipment:

## Site Costs (4)

Audio System (4 @ \$500 each)	\$ 2,000
Switching (4 @ \$3000 each)	12,000
Furniture, lighting, Video switches (4 @ \$4500 each)	<u>18,000</u>
	32,000

## Surrogates (1/site)

Small BW monitors (4 @ \$200 each)	800
BW cameras( 4 @ \$500 each)	2,000
Cabinets(4 @ \$100 each)	<u>400</u>
	3,200

## Shared Graphical Work Space(1/site)

High resolution BW cameras (4 @ \$1200 each)	4,800
High resolution 19" BW cameras (4 @ \$800 each)	<u>3,200</u>
	8,000

## Central Features

CPU	11,500
Videotape	1,800
BW hard copy	5,000
Time-based corrector	20,000
Other	<u>10,000</u>
	48,300

Equipment total 81,500

Software (including image processing, network control, data base management, and other)	150,000
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## Installation:

Cable cost (1 line/site, 4 sites, .1mi./line,.10¢/ft. of cable)	397,892.80
Cable installation(1884 mi. @ \$400/mi.)	753,600
Site installation(4 sites @ \$1000/site)	4,000
Site construction(4 sites @ \$1000/site)	<u>4,000</u>
	1,159,492.80

ONE-TIME TOTAL \$1,389,192.80ONGOING

Maintenance (1% of Equipment Cost/month)	\$9,780/yr.
--	-------------

Figure 4. Detailed costs for a Four-Site Teleconference System



The term surrogate in this model refers to the number of monitors. Shared Graphical Workspace is a type of electronic blackboard. BW refers to black and white monitors. Central features make up the hardware associated with controlling the system's functions. Chapter four will describe in detail different features of teleconferencing and how they affect the user.

The most expensive variables in this model are related to the cable. The cost assumptions for the cable may be inaccurate because the information was taken from a model that did not consider the system proposed for this thesis. Furthermore, it may be more feasible to use a satellite when distances of one thousand miles are considered.

Organizations can expect to spend anywhere from \$300,000 to \$1 million on setting up a satellite network, depending on its size and sophistication [Ref. 12: p. 11]. Also, transmission time via satellite will cost as high as \$1000 per hour. Detailed cost data for satellite systems was not available.

**Table 3. TELECONFERENCING SYSTEMS COMPARATIVE COSTS**

<i>Teleconferencing System</i>	<i>\$ Per Hour</i>
Full-motion video---AT&T Picturephone Meeting Service	2400
Full-motion video---special event style	600
Audio conference---AT&T	341
Slow-scan video	150
Electronic bulletin board---AT&T Gemini	66
Computer conferencing---Matrix	25

Table 3 provides a comparison to demonstrate relative costs of systems; actual costs may differ [Ref. 18: p. 46]. It is important to note the significant cost difference between full-motion video and other types of videoconferencing.

## **2. Audio-visual Costs**

AT&T markets audio-visual teletraining to the general public. In a one year study conducted by AT&T, the average cost per student for the system was \$113 [Ref. 16: p. 38]. That system used existing telephone lines and did not provide shared graphic work space; hence, the relative lower costs. However, AT&T may provide more features now which may have increased the average cost per student. Table 4 provides a quick guide to teleconferencing costs [Ref. 19: p. 149].

## E. VIDEOCONFERENCING AS A SUBSTITUTE FOR TRAVEL

Although travel costs are not the driving factor in rising training costs, the benefits of substituting videoconference technology for travel will now be reviewed. The four site videoconference system will continue as the model for this thesis. Training travel costs for the Navy are summarized in Table 5 [Ref. 20: p. 1-75].

### 1. Model Continued

Current air travel fares with military discount roundtrip are summarized in Table 6. These fares are subject to change depending on fuel and labor costs, empty seats, inflation, airport landing fees, and airline insurance rates. Both fares have San Diego for destination points because, as mentioned earlier, it the hub for most Navy training on the west coast.

Table 4. QUICK GUIDE TO TELECONFERENCING COSTS

<i>Teleconferencing Option</i>	<i>Cost Components</i>
Audio: office-to-office	** communications tariff (per minute) ** speaker phones (optional)
Audio: conference room	** communication tariff (per minute) ** conference bridge ** omnidirectional microphone ** multiple speakers ** acoustical preparation of room
Enhanced audio	** conference room (see above) ** facsimile and communications ** tariff (per minute) ** text processing ** personal computer ** telewriting or electric blackboard ** integrating controls ** installation and maintenance
video-full motion	** conference room (see above) ** studio lighting ** video cameras ** video switches ** audio-video master control ** video monitors and or large screen ** projection system ** video communications tariffs, cable, microwave, or satellite ** installation and maintenance ** facility director
video-slow speed	** conference room (see above) ** video monitors ** slow-scan video system
computer	** communications tariffs (per minute) ** personal computer or communicating computer terminal, communicating word processor

**Table 5. NAVY TRAINING TRAVEL COSTS**

<i>year</i>	<i>1985</i>	<i>1986</i>	<i>1987</i>
no. of moves	37,137	36,146	34,693
amount (\$millions)	57,792,000	61,385,000	60,213,000

**Table 6. COMMERCIAL AIR FARE  
WITH MILITARY DIS-  
COUNT**

<i>From</i>	<i>Cost(\$)</i>
San Francisco	110
Seattle	318

Travel from Long Beach to San Diego will be most likely by auto. If a member travels by private auto he would be reimbursed \$33.60 (current allowance for travel is .15 cents mile).

For simplicity reasons, course length will be assumed to be five days and the videoconference sites will be used every week of the year. Per diem rates will be assumed to be \$50 per day, although it would be less if the member stayed in government quarters. The classroom size considered will allow twenty individuals (five from each site) to be trained eight hours per day.

**Table 7. MODEL SUMMARY  
TRAVEL COSTS**

<i>From</i>	<i>Cost(\$)</i>
Seattle (5X318)	1590
San Francisco (5X110)	550
Long Beach (5X33.60)	168
Total per week	2308

Annual travel costs:  $2308 \times 52 \text{ weeks} = \$120,016$

Annual per diem costs:

$15 \text{ individuals} \times \$50 \times 5 \text{ days} \times 52 \text{ weeks} = \$195,000$

**TOTAL ANNUAL COSTS FOR TRAVEL: \$315,016**

**Figure 5. Annual Travel Costs Model**

## **2. Model Cost Comparisons**

The question of the substitution potential of videoconference technology is answered mainly by economic considerations. The decision is made by comparing the relative costs of travel and videoconferencing. Where travel costs are expected to remain steady or rise in the future, videoconferencing costs may decrease as communication technology improves with the advancements in satellite and fiber optic research. In addition to these points, the following specific comparison between videoconferencing and travel costs will be presented.

Figure 5 is a summary of the annual travel costs for the model previously described. The total annual travel costs for this model is \$315,016. Travel costs are expected to rise or remain steady for the following reasons:

- Commercial air fares have remained fairly steady since the initial decrease in prices when the industry was first deregulated. Now air fares correlate strongly to fuel and labor costs which are not expected to decrease in the future.
- As the world fuel supply is depleted (or perceived to be depleted) fuel costs rise to curb the market demand. For example, the fuel oil crisis in the 1970's made fuel oil prices soar and demonstrated the instability of that market.
- Inflation is expected to rise at a steady rate.

The videoconference system described in Figure 4 is expected to have a useful life of twenty years. Therefore, by substituting that system for conventional travel with a cost model described in Figure 5, the following cost savings can be realized:

- \$306,236 per year; and
- \$5,199,776 over the life of the videoconference system.

Figure 6 contains the calculations for the cost savings just described. Notice that the installation cost of the videoconference system can be recouped in almost four years with those savings. Hence, these two models illustrate one essential point: annual

Annual Travel Costs.....	\$315,106
(less)Annual Videoconference	
Maintenance Costs.....	9,780
Annual Cost Savings.....	\$306,236

TIME TO RECOVER INITIAL VIDEOCONFERENCE INVESTMENT:  
\$1,389,192.80 divided by \$306,236 year equals 4.53 years.

SAVINGS OVER SYSTEM LIFE:  
20 years - 4 years(approx.) = 16 years  
16 years X \$306,236 year = \$5,199,776

**Figure 6. Model Cost Comparisons**

travel costs will be constantly high, while annual videoconference costs are significantly lower.

Naturally other factors such as depreciation, inflation, taxes, and instructor training costs can be added into the equation, but they probably would not alter the conclusion that the payoffs are in favor of substituting videoconferencing for travel. Also, another cost factor not represented in this model is the fact videoconferencing allows more individuals to be trained at one time. For instance, if twenty individuals per conference site were allowed to take the course proposed in the model, eighty people (four times twenty) can be trained by videoconferencing instead of only twenty in the single conventional classroom.

The comparison of the two models also demonstrates that a major barrier to marketing videoconference systems may be the initial high cost of installation and development. After a system is installed, however, cost savings in the long run are expected to rapidly make up the difference for the short term cost of building the system. The added feature of being able to train more individuals at virtually no marginal cost makes videoconferencing even more attractive.

## **F. CHAPTER SUMMARY**

Training costs continue to increase as the number of military instructors determined by student load continues to rise. These costs could be curbed by centralizing the training system by using videoconference technology. Centralization will lessen the requirement for as many military instructors, thus lowering costs, improve standardization, and possibly improve the quality of training.

A four site video-teleconference model was considered to demonstrate the costs involved with that type of system. In the short term, the initial cost to set up a videoconference system may seem high. However, in the long term substantial savings could occur.

The last section of this chapter suggested benefits could be realized by substituting videoconference technology for travel. In today's deregulated air travel service, it may not seem feasible to make the big investment for videoconferencing in the short term; however, costs involving fuel prices are not stable. Therefore, the cost benefits of investing in videoconference training in the Navy are very favorable because it is a cost efficient substitute for travel in the long run.

## **IV. THE EFFECT OF TELECONFERENCE SYSTEMS ON HUMAN PERFORMANCE**

### **A. APPREHENSION**

Many people are apprehensive of technical systems [Ref. 21: p. 41]. This apprehension is particularly of interest in the videoconference arena because it may compound any fear one may already have using typical communication methods (e.g., public speaking). This chapter will discuss those apprehensions and how they can be overcome. In the next section, specific studies concerning individuals response to videoconferencing will be introduced. How the physical design of teleconference rooms affects communication effectiveness will then be explored. Insight into the security factor of teleconferencing will be mentioned, and the chapter will be summarized by comparing face-to-face communications with electronic communication.

#### **1. Resistance to Change**

Although many individuals have found videoconference systems to be more useful than traditional modes of communication, some people still resist this new technology because they are fearful of change.

There are many reasons to resist change. For instance, fear of failure to adapt easily to a new environment can be a main factor why one eventually fails in that new environment. When complex change is strongly resisted, misperception of how that change will affect the current way of doing things is often the major cause of that resistance [Ref. 21: p. 51]. Some individuals may just have a built-in aversion to anything new. This resistance builds up stress in the individual making it difficult for him to operate satisfactorily [Ref. 22: p. 27].

To blindly recommend a change without recognizing how it affects both the majority and minority would be careless. The rest of this section will concentrate on why fear of change occurs, its relation to apprehension of new technology, and how it can be avoided.

#### **2. Fear of Failure**

Ignorance or the fear of being ignorant is the greatest cause of stress [Ref. 22: p. 29]. Therefore, resistance or fear can be overcome through proper training and some idea of what the end state will be after the change is implemented. Individuals who fear failure must be reassured what their roles will be and that the new technology will not

adversely affect them. They must believe the new system will not capitalize on any of their shortcomings or weaknesses. Their fear can be overcome through trust in the system's ability to enhance their good traits and not capitalize on their bad ones. The focus of their education should be on the system's usefulness as a management tool or training aid. The emphasis must be placed on building their confidence with using the system.

### **3. Pessimism**

Another reason for apprehension is the anticipation of technical problems [Ref. 21: p. 39]. Individuals may only have had bad past experience with new communication technologies. Because of the complexity of a certain system, it may have lacked redundant features to prevent failures, been too demanding on the communication process, or finally just been too difficult to repair.

Individuals sometimes avoid technological changes because they feel those changes will not improve anything but will require them to work harder. Implementing change sometimes requires extra effort and time from those involved. The adage, "If it isn't broke, don't fix it" applies here. People with this outlook are happy with the status quo and pessimistic about any recommended improvements. A Harvard professor found from one of his studies that "acceptance (of videoconference systems) varied according to two criteria, participants familiarity with the application and the potential for reduction of less productive activities" [Ref. 23: p. 146].

Many individuals relate change to discomfort. Their experience with change has been painful. Therefore, pessimistic individuals must learn to trust the system's technical features. Their education of the new system should center on the system's ability to duplicate existing ways of accomplishing certain tasks more efficiently and with less effort. Only in that regard will their pessimism toward change be overcome.

### **4. The Human Element**

Resistance to change as a result of apprehension as it relates to videoconferencing could result from the fear of losing the human element (i.e., face-to-face communication). "A relatively 'warm' setting (e.g., face-to-face interaction) is capable of transmitting more information than a relatively 'cold' setting (e.g., electronic interaction) because of its greater ability to send and receive nonverbal cues" [Ref. 24: p. 25]. However, recent studies found videoconferencing to be a suitable alternative in a variety of arenas where nothing is lost in a "relatively cold setting" (e.g., classroom environment). Whether or not videoconferencing will become a dominant communication form in the training environment will depend on:



1. the quality or comparative outcome of the videoconference process; and
2. Whether potential users will overcome their negative attitudes towards videoconference technology, and invest the time and resources needed to try the new technology. [Ref. 8: p. 435]

## **B. PREVIOUS QUANTITATIVE STUDIES IN VIDEOCONFERENCING**

Quantitative analysis done by two researchers will provide the reader with a comprehensive view of how a random population performs in a videoconference environment. Each section will be divided into three sub-sections consisting of the background information, author's findings, and a summary. Both studies were well done; and the second one, by Kathleen Hansell and her associates, has even been cited in a number of other papers along the same topic. In hope of providing the reader an opposite viewpoint, no such study could be found.

The first study is by Larry Smeltzer of Louisiana State University [Ref. 21]. He specifically concentrates on teleteaching and videoconferencing in the training environment. The second study is by Kathleen Hansell, David Green, and Lutz Erbring of Satellite Business Systems [Ref. 25]. Their viewpoint is more broad and they look at users responses to videoconferencing in American business.

### **1. Smeltzer's Study**

#### ***a. Background***

The goal of this report was to determine if students perceived teletraining as a plus or a minus in terms of learning ability. Smeltzer wanted to know how the student, the one who is ultimately expected to benefit from the learning experience, reacts in this new environment. Furthermore, the teacher in this case was a professional who knew how to teach in front of a camera, was comfortable with videoconferencing, and thus not made part of the Smeltzer's study for any empirical data. Finally, there were three areas of the learning process about which he was concerned: student stimulation, reinforcement, and participation. Smeltzer felt these elements are essential and require nurturement during the learning process.

There were five research questions he wanted to answer:

1. Does the lack of nonverbal feedback affect the student's perceived effectiveness of the communication process?
2. Do students believe they are less stimulated with teleteaching than in the traditional format?
3. Do students believe they receive less positive feedback, and hence fewer rewards, in the teleteaching process than in the traditional teaching format?

4. Do students believe there is less participation with teleteaching than in the traditional format?
5. Are students level of communication apprehension related to their level of perceived effectiveness of teleteaching? [Ref. 21: p. 42]

He approached these questions by conducting a field-study and using twenty-three management trainees. Planted among this group were two additional observers to amplify information. Appendix A contains the questions and responses. Smeltzer used statistical analysis to evaluate the data. To make sense of that data, the following definitions are offered:

- *mean* the arithmetic average of the data
- *std.dev.(standard deviation)* the concentrated average groupings of data around the mean (i.e., one standard deviation includes 68 percent of the normal distribution, two standard deviations include 95 percent of the normal distribution, and 3 standard deviations include 99 percent of the normal distribution). Therefore, if one is given a std. dev. with the value of 1.5, then he should understand 68 percent of the response is within 1.5 units of the mean.
- *R-squared* the correlation coefficient, it measures the linear relationship one variable has with another (e.g., 0 = no correlation while 1 = perfect correlation).

#### *b. Findings*

Smeltzer found the overall effectiveness of teleteaching compared favorably to the traditional approach. There are four areas in the data collected worthy to note:

- Students seemed to have more cohesion than in a traditional classroom.
- There was consensus that it was difficult to get the teacher's attention to answer questions in the videoconference environment.
- Overall videoconference system performance was good.
- Students became more comfortable with the system the more they used it.

The significance of these four observations will be discussed below.

(1) *Cohesion.* Students in the teleconferencing class were much more cohesive because of the way the class structure affected them. Interest in the subject was apparently stimulated by classmate reinforcement. When the professor was unable to give the students nonverbal feedback such as eye contact or other sensory channels, each student received feedback via other students' responses to their own questions and answers.

The participant observers noticed a minority group within the classroom that initiated communication while the professor was speaking to clarify what was being instructed. The observers noted that this was a "supportive rather than a

disruptive factor." In a navy training course, it probably would be beneficial to have a "classroom facilitator" fill this role, because his assignment would represent authority and knowledge on the subject matter. That position could also be a point-of-contact anytime a student fell behind or needed extra instruction.

(2) *Teacher's Attention.* A classroom facilitator would also be beneficial to help field questions for the professor. No explanation was given in Smeltzer's study why it was difficult to get the teacher's attention. However, it seems apparent that this problem was a factor that helped build student cohesion. The question-answer situations could be standardized through some protocol. Since teleteaching is relatively new, problems such as this may still occur, but they could be easily corrected with time.

(3) *Videoconference System Performance.* The significance of finding that the students felt the overall videoconference system performance was good brings out two conclusions:

- By declaring in a positive manner how the system performed, one can assume the students would have noticed a poor system and been distracted by it. This conclusion means system's performance is a valuable feature when designing or buying a videoconference system.
- The vote of confidence in the system performance means this technology was an acceptable substitute for conventional methods of training. Therefore, one may infer this technology would probably be accepted over a larger population.

(4) *Student's Confidence.* Students gained greater confidence in the system the more they used it. Any apprehension of the students with the system was hardly noticed toward the end of the study. This observation underscores the recommendation to properly educate videoconference users about the system's performance.

#### c. *Summary*

The answers to the five questions proposed in the background section of Smeltzer's study will serve as a summary. Lack of nonverbal feedback from the teacher was augmented by feedback from fellow students. Hence, no feedback was lost although the source of the feedback did change. Apparently, that shift in the sources of feedback had no adverse effect on the communication process. As Smeltzer points out, "The use of graphics and audio in combination with the nonverbal and verbal support from fellow students appears to have provided stimulation comparable to the traditional format for most students" [Ref. 21: p. 50]. That support from fellow students also seemed to suffice any desire for recognition with respect to positive feedback one normally expects in a traditional classroom setting. Hence, students also believed participation increased compared to a traditional setting because of the interaction with

their peers. Finally, any apprehension on the student's part to accept this technology was minimal. However, from the data presented, this last question could not be fully answered without a larger population to study. It has been recommended that a classroom facilitator would be beneficial in a Navy teletraining environment. That billet would be able to serve as a control point in the training arena.

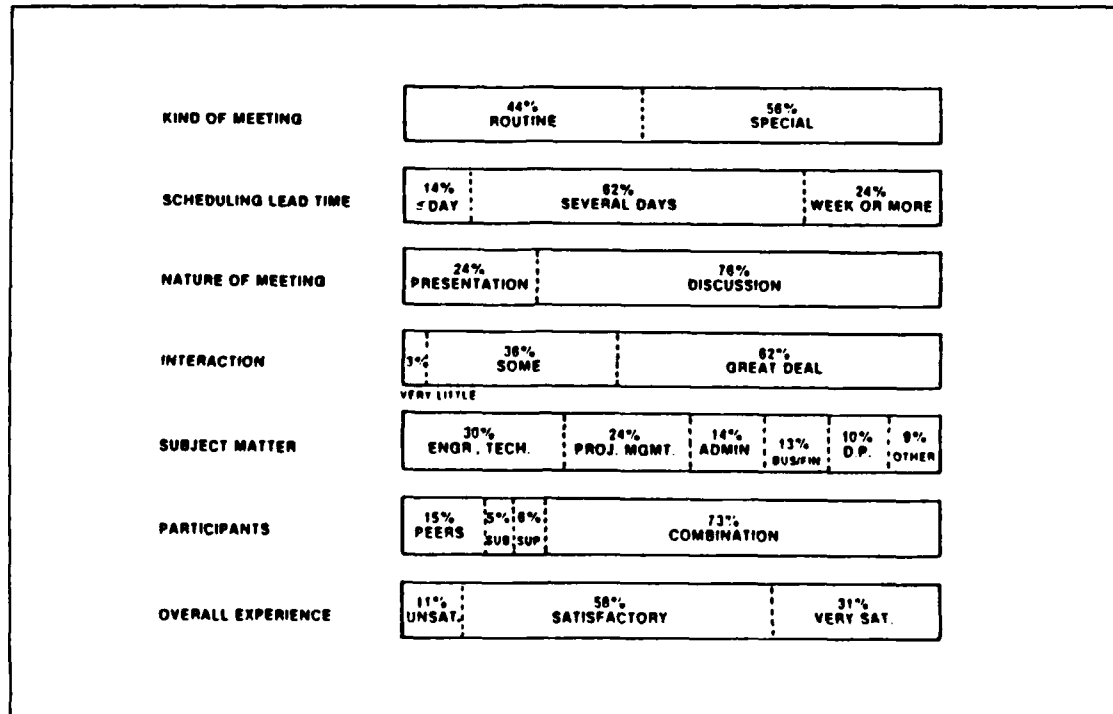


Figure 7. Videoconference Profile

## 2. Sattelite Business Systems Study

Sattelite Business Systems (SBS) undertook a study in late 1981 to determine for the first time in video conference research how managerial productivity was effected by this new technology. The study was completed in 1982. SBS stated the purpose of their study was "to explore and understand corporate users' perception of benefits resulting from videoconferencing" [Ref. 25: p. 228]. Ten large organizations were chosen as part of the study. The majority of those ten cited the reason they used videoconferencing was to improve communications among geographically separated personnel. One hundred sixty five people were questioned. The range of questions were general and open-ended, inviting those questioned to support their responses with specific examples. Figure 7 contains the videoconference profile [Ref. 25 : p. 230]. The bottom line of

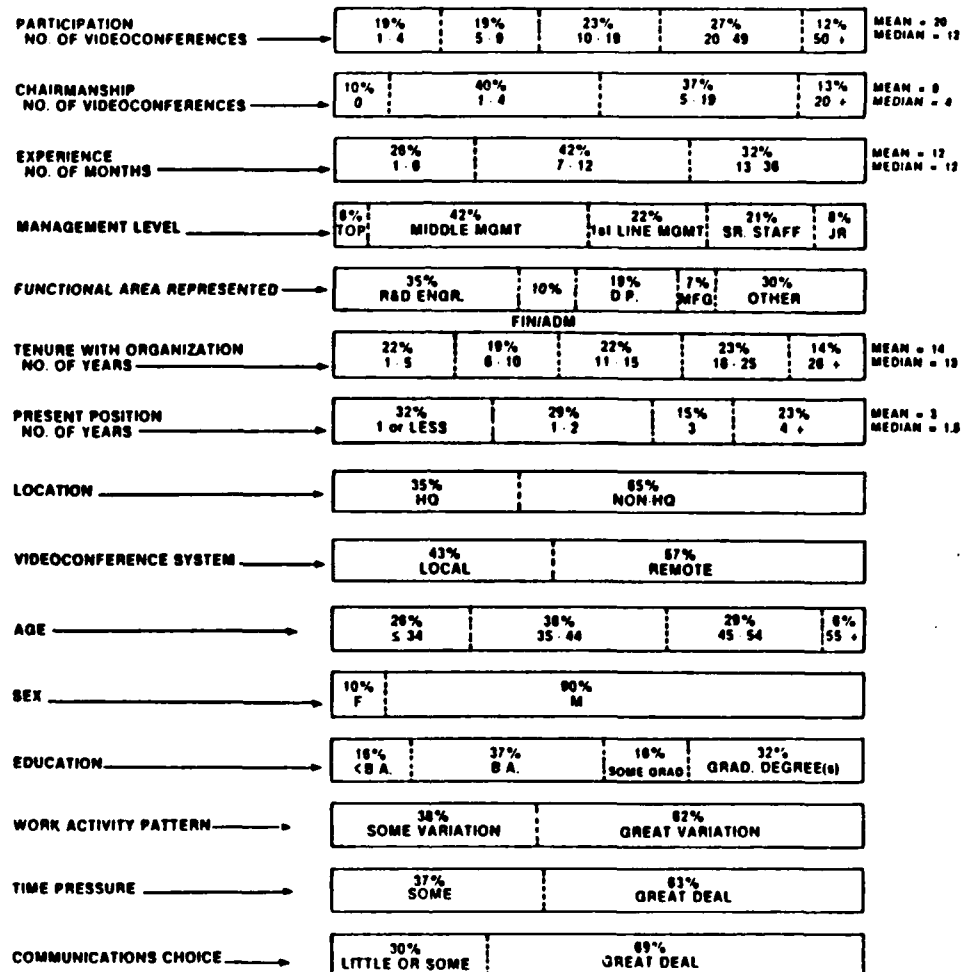


Figure 8. User Profile

that profile is that almost ninety percent of the participants in a videoconference found the overall experience satisfactory or better.

Figure 8 contains the user profile [Ref. 25 : p. 229]. The user profile is more complex, however, SBS was able to determine that personnel productivity increased overall.

Productivity is hard to clearly define. Productivity can be a result of many things: less time wasted, better group cohesion, time savings, etc.. Personal productivity is usually measured by evaluations from superiors, awards, and remarks from fellow workers. SBS remarked, however, that productivity is not merely a private concern of individual respondents, but is ultimately the cornerstone of organizational performance and corporate success [Ref. 25: p. 233].

The SBS study found that videoconferencing would increase productivity mainly because of the significant decrease in travel expenses and time savings. Their study, though general by design, serves as a benchmark in the study of human productivity during videoconferencing. SBS stated the full effects of videoconferencing would not be realized or understood for several years until more people gained experience. With Smeltzer's study completed in 1986, one can see how videoconferencing has influenced personnel productivity in the training environment.

### **C. VIDEOCONFERENCE ROOM AND EQUIPMENT**

This chapter has focused so far on why some people may resist new technological breakthroughs such as videoconferencing and how videoconferencing may affect user productivity. This section merges those two issues. In a study conducted in 1985, researchers found that "Probably, more than any other factor the architectural design of the room determines how readily users accept and feel comfortable with a teleconferencing system" [Ref. 26: p. 18]. The needs of the user must, however, be balanced against equipment limitations. Acoustics, lighting, and space are the elements the design engineer considers as he constructs a videoconference room to meet users' needs and system's requirements. This section will discuss the concepts and tools involved in teleconference room design: specifically mentioned will be the virtual space concept, shared graph work space (SGWS), facsimile, and overall system security.

#### **1. Virtual Space**

Virtual space technology was implemented in the teleconference to better approximate face-to-face communication. With this technology users can maintain eye contact throughout the meeting (see Figure 9) [Ref. 27: p. 967]. Researchers from

Decisions and Designs, Inc. wrote, "Virtual space improves video teleconferencing by providing:

- face-on viewing of each surrogate monitor by each conferee (e.g., for a seven member teleconference, each member would have six monitors to view the other six individuals).
- spatial reference, that is a sense of physical presence and of space (someone on your right sees you on his left, and similarly for all viewing angles); and
- the same geometry of conferee A's image on conferee B's retina as if B were in B's corresponding position at A's site, and thus the ability to follow eye contact and gestural addressing and to see who is looking at whom." [Ref. 17: p. 9]

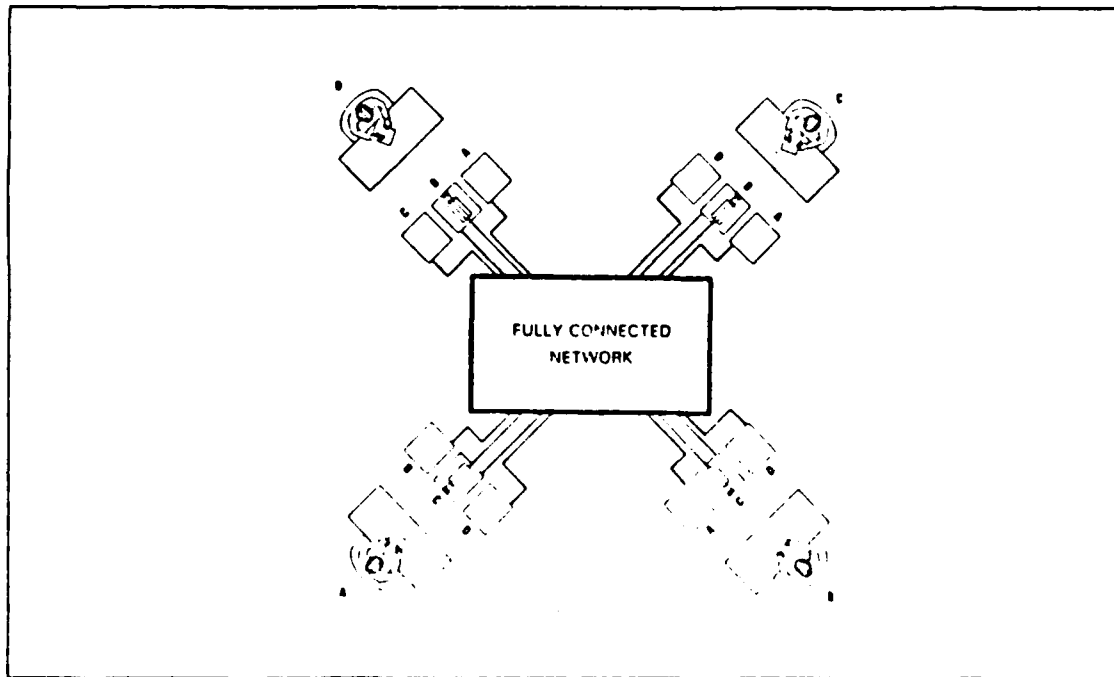


Figure 9. Virtual Space Network

In a study conducted in 1981 for DARPA (Defence Advanced Research Projects Agency) researchers stated virtual space would be more beneficial for larger groups than smaller groups for certain tasks [Ref. 17: p. 9]. This finding was based on the premise virtual space makes it easier for the user to receive nonverbal cues. Teleteaching is one task that may not benefit from virtual space. All the extra monitors to watch could be distracting for both the teacher and the students.

## 2. Shared Graph Work Space (SGWS)

In a teleteaching environment, the SGWS would be very useful for the teacher and classroom facilitator mentioned earlier. With the SGWS, participants can share and

annotate material such as texts and graphs. Normally, work done on the SGWS is done prior to the meeting because several minutes are required to process and distribute the image to the various recipients.

In another DARPA sponsored research project, SGWS was described as a "multi-page electronic reusable or easy to edit notebook [Ref. 28: p. 31]." The SGWS is comprised of a computer terminal, a TV monitor, a camera, and an optical video disc player to record images processed. Users also have the ability of directly writing on the screen to make annotations. With that capability and a special menu that displays the capability of the computer, one can manipulate data easily. [Ref. 26: p. 4].

### **3. Facsimile**

Facsimile provides the rapid transfer of information that SGWS is not capable of performing. Today, facsimile machines for video teleconferences usually offer the electronic pen feature. That feature allows the user to annotate graphs and texts like the SGWS. Its disadvantage, compared to SGWS, is lack of memory, and the only record of material sent is the hardcopy of the recipient. Where SGWS can store information for further use, facsimile can only refer to the item that was just transferred. Facsimile would be very useful for student's use in each classroom meeting.

### **4. Security**

It is more difficult to provide a secure atmosphere in a video teleconference than in a meeting. Security is at a greater risk because:

- an individual can escape the camera's field of view and still gain access to the classified information being transmitted (i.e., with the exception of conferee A's word, conferee B cannot be certain conferee A's room has been sanitized of all risks to security);
- transmissions can be electronically intercepted.

Videoconference security is not always necessary. However, system security would be essential to teach certain navy courses. Classroom facilitators would have to monitor security where the students are located, while the teacher could monitor his own security. Electronic transmissions can be coded to prevent interception. Room construction should not be any different than other videoconference rooms. Therefore, it is possible to provide secure videoconferencing. However, the extra cost for hardware may be too high to make the "secure option" worthwhile. More independent research is required in this area.



## **5. Summary**

Videoconference user comfort is based on the premise the surrounding aesthetics improve the atmosphere and thus reduce fear of using the system. Hence, state-of-the-art equipment has been designed with that in mind. However, teleteaching does not require state-of-the-art equipment. Specifically, virtual space technology would not be worthwhile in the teleteach environment. However, proper room lighting is always important for both equipment and personnel. And audio features must provide the best sound system to make sure the learning process does not suffer from poor speaker quality or room echo that could be distracting. Likewise, video features should be useful to the student and teacher as learning tools. SGWS is a great teaching aid for the teacher, while the facsimile would serve both students and teachers well. A big concern in videoconferencing is security because it is more difficult to control compared to face-to-face dialogue. The security issue can be overcome if one is willing to pay the price. That issue requires more independent study.

## **D. COMMUNICATION AND NONVERBAL CUES**

In this section, the legitimacy of using videoconference technology as a substitute for face-to-face communication will be discussed. To accomplish this, electronic communication will be compared to face-to-face communication.

Communication effectiveness and efficiency of the two media will be explored. Communication effectiveness is the ability of one individual to correctly convey his idea so another individual can understand exactly what he means. Communication efficiency is measured by the time to convey specific information effectively, number of remarks exchanged, and the percentage of discussion remarks about the central theme of discussion rather than about extraneous topics [Ref. 29: p. 1128]. Nonverbal communication will be discussed first, followed by electronic communication and its absence of nonverbal cues.

### **1. Nonverbal Communication**

In research funded by the United States Public Health Service by Albert Mehrabian, he stated "the use of nonverbal cues can be a valuable means of determining the attitude of a communicator" [Ref. 30: p. 359]. Attitude is defined by Mehrabian as "the degree of liking, positive evaluation, and or preference of one person for another" [Ref. 30: p. 359]. The significance of knowing the attitude (i.e., anger, happy, tutorial, etc.) of the speaker helps convey the message he is sending. With the knowledge of the speaker's attitude, the desire for feedback is indirectly fulfilled.

Distance, eye contact, body orientation, and accessibility of body are all forms of nonverbal cues. However, studies about body orientation and accessibility are more ambiguous than those considering eye contact and distance [Ref. 30: p. 366]. Therefore, only eye contact and distance will be discussed below.

**a. *Eye Contact***

Eye contact during social interaction signals that the communication channel is open or closed, and thus serves as feedback [Ref. 31: p. 304]. In a study conducted by two Oxford professors, they found, "eye contact is minimal for disliked addressees, approaches a maximum value for addressees toward whom the attitude is neutral, and slightly diminishes for addressees who are liked very much [Ref. 30: p. 370]." For example, an instructor who is not prepared for class might constantly refer to class notes and focus at what he writes on the board to avoid any confrontation with students. Students who want the teacher to call on them may stare at the teacher while other students might glance away. A student who responds correctly to a teacher's inquiry will look to his peers for approval, but a student who blunders will "bury his head" into the text.

**b. *Physical Proximity***

Mehrabian also wrote, "The distance between a communicator and his addressee is a decreasing linear function of the degree of liking of the addressee" (e.g. the closer one approaches the addressee the more he must like him) [Ref. 30: p. 370]. One researcher has gone further to say that increasing physical proximity will lead to less eye contact and thus some sort of equilibrium among nonverbal cues [Ref. 31: p. 304]. This suggests that there is some accepted level of nonverbal communication for a given situation. For example, some students who sit in the front of a classroom will not maintain as much eye contact with the teacher because they do not want to be perceived as any more eager than the other students. Conversely, some students cannot get close enough and maintain enough eye contact to satisfy their desires. Teachers sometimes will not allow physical proximity to be a factor by situating the class in a round forum circling the teacher. In this case, teachers and students rely totally on eye contact for feedback.

**2. *Electronic Communication***

Electronic communication, including videoconferencing, conveys fewer nonverbal cues. Consequently, with electronic communication there are fewer accepted standards to control communication effectiveness and efficiency. Hence, communication via electronics can be affected in three areas:

- the lack of nonverbal cues might make it more difficult to coordinate and comprehend messages
- social influence among communicators might become more equal because hierarchal structure is hidden without governed norms
- social standards will be less important and communication will be more impersonal and more free because the rapid exchange of text, the lack of social feedback, and the absence of norms governing the social interaction redirect attention away from others and toward the message itself. [Ref. 29: p. 1126]

#### *a. Lack of Nonverbal Cues*

Actual eye contact is at a minimum and physical proximity is not a factor in the student-teacher relationship with electronic communication. For videoconferencing, aside from facial expressions, nonverbal cues are virtually nonexistent. Even in virtual space, participants would be distracted by looking at all the monitors for eye contact. This lack of nonverbal cues would make it difficult to comprehend messages if there was no student cohesion as discussed earlier. Teachers can overcome the nonverbal cue problem with the assistance of a facilitator who monitors class response to videoconference lectures. The facilitators' gazes, expressions, and physical proximity will in a sense provide feedback. For that matter, the facilitator may function well as a surrogate instructor.

#### *b. Social Influence*

Students are usually concerned about the amount learned and their standing in a class. The impersonal behavior of electronic communication may promote cooperation among student and teacher and hence better learning because the student is less intimidated by the lack of physical proximity to the teacher (a student may also be intimidated by the mere hierarchal position a teacher has over a student). One may view the physical separation as a buffer zone. This analogy is not to imply an adversarial relationship between teacher and student is common, because normally it is not. However, with teleteaching students may be more willing to approach the instructor for assistance via electronic means because the student always knows he can fall back on the assistance from his peers if a student-teacher conflict arises [Ref. 29: p. 1127].

As we have seen in Smeltzer's study, student cohesion improves because students feel encouraged to attack a problem together to make the situation more simple. Without a hierarchy, there are no student-teacher defenses to restrict communication. The student-teacher relationship must function as a team in teletraining for effective communications. In that regard, everyone in the process may view themselves as equal and social barriers may not be evident as a result of any hierarchy. The

teacher, however, may have to be willing to let go some of the traditional authority he carried in the typical classroom.

*c. Social Standards*

When electronic communications, such as videoconferencing, become similar to face-to-face dialogue, social standards gain greater significance. Electronic communication focuses on the subject and not the addressee except in full-motion video. The way someone looks, speaks, or moves does not distract one's attention from the subject during most types of electronic communication. However, there are certain aspects to consider with use of full-motion video. Because some people are better looking and sound better than others in a videoconference, the "hollywood effect" must be overcome [Ref. 19: p. 28]. Personal attributes such as these will affect information flow because of subconscious attitudes about appearance.

**3. Summary**

Videoconference technology can be a substitute mode of communication for face-to-face dialogue. When that happens, the absence of nonverbal cues can severely alter communication efficiency and effectiveness unless different standards are used. These new standards must be socially acceptable and lack any inherent prejudices that may be considered more typical in the traditional forums. The effectiveness and efficiency of the communication process might be measured as the amount of subject content successfully communicated in a limited amount of time.

The next chapter will give an overview of how one can incorporate the change to videoconferencing and still maintain communication effectiveness and efficiency.

## **V. CHANGE AND THE SHIFT TO VIDEOCONFERENCING**

### **A. THE IMPACT OF CHANGE**

The intellectual pursuit to make something better causes change to occur. This action is called innovation. Chapter five will first concentrate on how change is accepted by people and then will determine the best way to incorporate innovative change such as using videoconference technology for training purposes in the Navy.

#### **1. Information Technologies Influence on Change**

Classroom training is merely the dissemination of specific information about a subject. Students must decipher what information is critical to know for their benefit. Sometimes students are overloaded with too much information with the consequence being they are poorly trained. Besides volume of information, the information overload might have resulted from lack of standard learning objectives, erroneous information provided, or poorly skilled instructors.

New information technologies such as videoconferencing have been developed to improve the communication process and prevent information overload. Videoconferencing prevents information overload because it increases the number of channels to use and thus diffuses information among the channels when communicating by electronic means (i.e., the extra sensory channels provide synergy in the communication process).

Information technologies are only as worthy as their ability to help the user process information. Therefore, when new information technologies are introduced, the human element is the most important aspect to consider. Dordick and Williams wrote there are three dimensions of change that impact human performance that can be expected from implementing new information technologies:

1. change in the organization and its power structure
2. change in information flow
3. change in employee attitude about work. [Ref. 19: p.25]

#### ***a. Organization and Power Structure Change***

The nature of teletraining centralizes the training process which is a change from the typical organizational structure for training. With a centralized training program, individual training sites cannot be as flexible with their training courses.

Opposition may grow with videoconferencing because the traditional hierarchy may be bypassed for information within the new training network. Individual school commands will probably no longer be the final authority about what happens in the classrooms in their commands. In that case, they will be less autonomous in the decision making process which may dissatisfy them.

Usually, initial opposition cannot be avoided despite any attempts to circumvent the resistance, and it will most likely be in the following passive form:

criticism of specific details of the plan, foot-dragging, low response to requests, unavailability, or arguments for preferential allocation of scarce time and resources to other pet projects. [Ref. 32: p. 230]

Resistance continues unless proper indoctrination takes place. That affect will be discussed later. At this point, it is more important to appreciate how even with well-planned strategy, resistance to change is apt to occur. The introduction of new information technology is usually destined to experience growing pains from the organizational change it creates.

***b. Change in Information Flow***

If teletraining produces a favorable attitude toward videoconferencing, people will begin to communicate differently. Because more people will have access to vital training, information will be more widely disseminated. The knowledge base for selected topics will improve. As that knowledge base grows, better ideas will follow and a cycle of improving concepts should result.

Perhaps this scenario is a bit too optimistic. However, the fundamental idea that core of knowledge will be broader with teletraining is probable. The adage "two heads are better than one" applies here. With a network of school commands connected by videoconferencing, greater control over curriculum and teaching quality is bound to happen. It is inevitable the flow of information will improve with a good videoconference network.

Even with a good network, developing videoconference communication skills will take time and effort. The motivation to develop those skills will depend on how both teachers and students react to electronic communication instead of face-to-face dialogue which was discussed in detail in chapter four.

***c. Employee Attitude***

Employee attitude includes both students and teachers for the purpose of this thesis. Their attitudes and adjustment to videoconferencing are crucial to the

success of implementing the change to teletrain Navy courses. The NUSC NAVSEA video teleconference project team noted in its report that no matter how good a proposed videoconference system may be,

people will not come thronging to it as soon as the doors open. Rather they must be made aware of the system, its applications, its benefits, and its limitations, and they must be oriented to using it effectively and comfortably. This process of user development, moreover, must be continual, not occurring only when the system is new. [Ref. 11: p. 12]

User development is probably more crucial for Navy instructors because teleteaching is extremely different from classroom teaching. Teleteaching means teaching to a camera not a class of students. Teachers will not be able to decipher nonverbal cues from their students to determine if their teaching tempo is accurate, whether or not the students understand the subject material, or if the students are even listening. Teaching in front of a camera requires enough self-confidence that one does not require "normal" feedback on how well he is accomplishing his task.

Some instructors may also view videoconference technology as a threat toward their position in the organization (e.g., instructors replaced by monitors). Videoconference technology can leave a detailed record of their performance. For example, tapes of videoconference training sessions can document whether an instructor is teaching up to par. That feature would most likely be viewed negatively by many instructors. Instructors might also become dissatisfied when their supervisors do not realize how this proposed change will affect work patterns and worker productivity (i.e., subordinates worry they may be tasked with too much to do when the change is implemented). Dordick and Williams wrote:

On a general level are differences in the willingness of individuals to try new media. Personal attitude looms as a critical variable in technological adoption. Frankly, there are more than a few individuals who will never adapt, or the cost of their trials and tribulations to the organization will likely be prohibitive. There are also sizeable numbers of individuals who will only "tolerate" a change, but never achieve the higher levels of productivity or effectiveness presumably associated with technological adoption. [Ref. 19: p. 28]

## **2. The Question of Change**

The impact change can place on human performance is great. Since the success of an organization rests on the performance of those in it, two important questions should be considered prior to making a change:

1. Relative to valued added effectiveness, is it likely the purchase of videoconference equipment for teletraining will result in the payoffs we want?
2. Given a payoff goal, what management activities will be required to achieve it? [Ref. 19: p. 34]

In chapters three and four, I have taken the stand videoconferencing will be beneficial for Navy training. The payoffs we want from purchasing videoconference equipment for teletraining are:

- cost savings from travel expense;
- better qualified instructors as a result of centralizing the responsibility of teaching;
- the ability to train more individuals during any given period;
- an easier time changing course material to provide commands with the latest technological improvements;
- better control of the standard items being taught to ensure there is an accepted Navy-wide knowledge base.

The next section of this chapter will answer the second question.

## **B. IMPLEMENTING CHANGE**

This section will discuss how to implement the change to videoconferencing. There are three conditions that involve organizational change: the future state, where the organization wants to get to; the present state, where the organization is; and the transition state, the condition an organization is in during the process of change from the present state to the future state [Ref. 33: p. 29]. Many factors determine if change is necessary. The need for change can be driven by innovation, legislation, the introduction of new technology (discussed earlier), or cultural shifts (e.g., leadership turnover). In this section we will discuss the future, present, and transition state of Navy training with videoconference technology.

### **1. The Future State**

Before teletraining is implemented one should define what he wants teletraining to accomplish, how he expects it to happen, when it should be accomplished, and by whom. Just because teletraining might be cost effective is not a reason to mandate that change. Some changes happen as a result of a perceived need for improvement in a specific area. In the case of teletraining this perceived need is for better instruction (see chapter one).

Problem identification often precedes problem definition [Ref. 32: p. 218]. However, conflicting ideas to solve the problem can cloud the issue which is, "Where do



we want to be?" Therefore, defining the future state gets all parties on the same track and working together.

The importance of defining the future state of Navy training is that it develops a map or course to follow to achieve the end state we desire. Beckhard and Harris feel this initial step will yield goals that will produce the following results:

- optimism replaces pessimism as the driving force in considering the possibilities for managing the change
- the detailed behavior spelled out in the description of the future allows members of the organization to visualize their own role in the change, improving employee compliance
- the description of the future state specifies the nature of the projected changes and offers a rationale for managerial actions, reducing uncertainty
- the task pulls management away from the tendency to attack symptoms and "solve problems" and focuses attention on defining what's needed to make the organization effective. [Ref. 33: p. 49]

The strategy selected from defining the future state prevents "quick fixes" that do not solve the problem. When short term solutions are applied to a problem they simply provide short term results. For instance, some Navy instructors merely read their standard course outline to the class. That style of teaching maybe standardizes what is taught but bores the class in the long run and wastes time. Emphasis must be placed on rewarding those who clearly solve a problem and not to those who just redirect it. Many experts find that when managers concentrate on long range goals, the insights they gain will lead to the development of more effective strategies and better performance [Ref. 33 : p. 52]. Teletraining Navy courses may be the best strategy to improve student and teacher performance.

In the case of Navy training, we desire a cost effective method of training our sailors more efficiently. Teletraining allows standardization to improve fleet performance and may be easier to control. We cannot allow poorly qualified Navy instructors to teach our new sailors the ways of the fleet. Unfortunately, the knack of being a good teacher is a quality that many knowledgeable people do not possess. The strategy to introduce videoconference technology as a tool for instruction should help us arrive at the end state we desire: the best people teaching to large groups spread out through the country, and thus saving travel costs.

## **2. The Present State**

Prior to making any specific choices about what change strategy to select, an assessment of the present state should first take place [Ref. 33: p. 52]. This assessment

must determine what actually does and does not need to be changed considering the change options. During this evaluation, one must guard against confusing the central issue with new issues created from the whole decision process.

With the proposed change to use videoconferencing, the central issue must focus on what is wrong with Navy training today. Chapter one discussed those problems: high travel costs, inability to meet Navy required course quotas, and inexperienced instructors.

The assessment of the present state should produce the organizations' readiness for the proposed change. It is during the present state assessment the resistance must be faced head-on. If some people in the organization oppose the proposed change, some method to convince the decision makers about the value of the concept is necessary to warm them to the proposed idea. The NUSC/NAVSEA videoconference project team solved this problem by bringing a group of NUSC's top managers to a different organization's videoconference which was in session. This experience proved to be a good "selling" job for them [Ref. 11: p.9]. Their top managers became more open to the idea of using videoconference technology for meetings.

As more individuals agree teletraining is necessary, a majority or consensus will push the idea through. However, the organization's hierarchal structure might be an obstacle. Proper channels that can authorize the proposed change must be considered. The path to institutionalize the new idea must be established. Also, the level in the organization who can provide funds must be determined. These are all issues recommended for further study.

Once the changes required are agreed upon, a consensus to the new idea is built, and the road to institute the plan is established, the transition to the future state can then begin.

### **3. Transition State**

The transition state is troublesome because the organization is leaving its traditional environment. This period is characterized by controlled chaos. To alleviate internal pressures, great doses of education about why this change is taking place and what effects it will have are essential. However, educating workers about a desired future state is often abstract and the method to educate them is normally quite general, simply because the end state has not yet happened. Therefore, any task force overseeing the change should specify midpoint goals to motivate members to make a real

commitment of time, energy, and resources to the change [Ref. 33 : p. 46]. In any case, the goal during this period is to create as little stress as possible within the organization.

To implement videoconferencing in the Navy training sector, it might be a good idea to build teletraining networks slowly so the change will not seem to be too drastic. Since the greatest resistance will probably be from the "old hands" in the Navy, it might be beneficial to first try teletraining with new recruits (i.e., network the three boot camps of San Diego, Great Lakes, and Orlando) who may not be as prone to stress from such a radical change.

Some telecommunications experts feel training is the key to relieve stress during the change process [Ref. 19: p. 30]. For some odd reason, this realization is often the most overlooked during the transition state. Dordick and Williams wrote, "the more sophisticated the technology, or the more radical the change in the the work environment, the more training will be necessary" [Ref. 19: p. 30].

The recommended switch to teletraining is a radical change using sophisticated technology. If the Navy implements this proposed change, their greatest mistake might be underestimating the importance of indoctrinating teletraining users (i.e., both teachers and students). The future of this new technology rides on user reaction. However, users may feel they are losing control. In fact, teletraining might meet considerable resistance from those instructors who desire autonomy in the classroom.

Even if this change was widely accepted throughout the Navy, new Navy personnel unaccustomed to videoconferencing would need to be indoctrinated prior to becoming a user. Hence, the transition state for videoconference technology might take a very long time (e.g., perhaps as long as twenty years). Some people may spend their entire Navy career during the transition state for this proposed change.

Therefore, during the transition and training process, individuals must be made aware they are in a transition state. Nothing is worse than to believe the transition process is the norm. Its seemingly chaotic state can build up the greatest stress within a person. Consequently, it is useful to have steering committees or task forces during the transition state to manage the process [Ref. 32: p. 195]. They can facilitate the transition and keep it distinguishable from both the present state of operations and the future state of affairs [Ref. 33: p. 78]. The steering committee can also be the best judge of when the end state has arrived.

### **C. CHAPTER CONCLUSION**

Change requires commitment from all levels of the organization. Commitment involves making the best decisions based on the facts presented and working to make those decisions operationally successful.

Introducing videoconference technology into the Navy training system will change the whole training environment, hierarchal structure of training school commands, individual roles in the training organization, and simply the way things are done. Videoconference program directors must make program indoctrination a high priority and closely monitor user response to the system. Goals must be attainable, time specific, and understood by all. The success of a new program such as the one proposed in this thesis rests on the organization's ability to handle change.

## VI. CONCLUSION

Although the aim of this study was to determine if using videoconference technology for classroom instruction is a suitable alternative method to the current style of teaching Navy courses, several other questions must be further researched:

- Can Navy courses that use classified information be taught via teletraining?
- Specifically which Navy courses are best suited for teletraining?
- What would be the best videoconference network for teletraining in terms of cost benefits and areas serviced?
- What would be the best way to implement a videoconference network into the current Navy training organization and how will it specifically affect those people involved with that change?
- Can teletraining centers be used for other means (i.e., command and control, fleet level meetings, etc.)?
- How should Navy instructors for teletraining be selected?
- What authority is required to develop a videoconference network for Navy training?

Even though several areas in the subject of teletraining Navy courses require more research, this study is able to make these conclusions:

- videoconferencing is a viable and cost effective substitute for travel;
- teletraining does not adversely affect the learning process;
- Navy instructors indoctrination to teletraining is equally crucial to the success of teletraining as student indoctrination; and
- the implementation of teletraining would be a radical change to the current method of teaching in the Navy.

Two models were developed to show the differences in costs associated with videoconferencing and conventional travel. These models were meant to be generic by design. Their purpose was to demonstrate the cost comparisons over both the long and short run of the two modes of networking. In the short run, videoconference costs are expected to be very high; however, in the long run those costs should drop significantly. Conventional travel costs, however, are expected to remain steady and not be cost-efficient compared to videoconferencing over the long run.

Besides costs, an important feature about teletraining is that it does not adversely affect the learning process. Because nonverbal cues and feedback are not as apparent

with videoconferencing, the mutual support among each class of students makes up for anything lost in the new communication process. It is debatable whether teaching by videoconference actually enhances student performance.

Where student acceptance to teletraining seems abundant, it is hazy how well Navy instructors will accept this new technology in the classroom. Teaching to a camera requires different talents and skills compared to face-to-face teaching. Before instituting this program, teachers must be thoroughly indoctrinated to ensure their self-confidence in teaching does not diminish and adversely affect the students' learning process. Hopefully, only the best qualified Navy instructors will be made available to be assigned to teletraining billets.

Regardless of how much improvement teletraining may offer in the Navy training environment, the first step planners must take in the strategy to improve Navy training through videoconference technology is to realize this change would be a radical one compared to the current method of teaching. This strategy, however, will provide a long term view of the future of Navy training and willingness to take a risk that may not necessarily make sense in the short term.

Therefore, the majority of the problems mentioned with using videoconference technology can probably be overcome with persistence and guidance in the short term. The only fair way to measure the effectiveness of this proposed change is to compare the long term payoffs to the short term costs. If the payoffs are sufficiently greater than the costs, then the Navy should adapt the change to teletraining.

The quality of Navy training should improve if it is going to keep up with the rapidly changing technology of today's fleet. Videoconferencing may not be a panacea to our problems with the quality and cost of Navy training, but it is a technology that offers significant benefits that should be continued to be explored for Navy training development.

## APPENDIX A. SMELTZER STUDY DATA ANALYSIS

**Table 8. MEANS AND STANDARD DEVIATIONS OF QUESTIONNAIRE ITEMS**

<i>question</i>	<i>mean</i>	<i>std. dev.</i>
1.To what extent did the telecommunications affect your opportunity to ask questions?(1-very little, 7-a great deal)	3.78	1.83
2.To what extent did you feel comfortable with the lack of nonverbal feedback from the instructor?(1-very uncomfortable, 7-totally comfortable)	4.30	1.14
3.How did teleteaching affect your willingness to ask questions?(1-very encouraged, 7-very discouraged)	4.43	1.61
4.Were the teleteaching sessions more or less organized than the traditional sessions?(1-a great deal more organized, 7-a great deal less organized)	4.39	1.03
5.How was class time spent in the teleteaching sessions compared to the traditional sessions?(1-much less effective, 7-much more effective)	3.60	1.07
6.How dominant was the instructor in the teleteaching sessions compared to the traditional sessions?(1-much more dominant, 7-much less dominant)	4.78	0.99
7.How did the class structure affect the cohesion of the students in the class?(1-much more cohesive, 7-much less cohesive)	2.60	1.15
8.How valuable was the use of the graphics on the monitor screen used by the professor?(1-very effective, 7-very ineffective)	4.21	1.50
9.How clear was the voice transmission with the telecommunication system?(1-very clear, 7-unclear)	2.21	1.20
10.Did you feel more or less stimulated in class as a result of teleteaching?(1-more stimulated, 7-less stimulated)	3.34	1.55
11.How comfortable were you with the system the first time you used it?(1-very comfortable, 7-very uncomfortable)	4.13	1.84
12.Did you become more or less comfortable with the system after it was used several times(1-great deal more comfortable, 7-very uncomfortable)	2.52	1.53
13.How would you rate the overall effectiveness of teleteaching compared to the traditional approach as a learning tool?(1-very effective, very ineffective)	3.08	1.62

Table 9. REGRESSION ANALYSIS (QUESTION 13 AS INDEPENDENT VARIABLE)

<i>question item</i>	<i>R-squared</i>
1	.17
2	.49
3	.18
4	.18
5	.00
6	.02
7	.00
8	.20
9	.01
10	.01
11	.01
12	.22



## APPENDIX B. NAVY TRAINING COSTS

Training Category	FY 1981	FY1982	FY1983	FY1984	FY1985	FY1986 (est)
Recruit Training	332.3	320.6	262.7	291.7	494.4	526.0
Specialized Skill Training	1074.7	1182.7	1195.0	1567.4	2097.2	2252.9
Flight training	672.5	731.1	747.7	746.3	906.8	945.8
Officer acquisition	163.3	179.0	187.6	204.4	253.7	258.6
Health Care Training	111.4	115.4	111.0	120.5	151.3	167.3
Professional Education and Training	78.5	84.2	93.7	101.4	152.5	153.7
Educational Deveopment Programs	49.2	55.7	65.5	66.1	76.6	83.4
Training Support	400.6	522.6	504.8	639.1	803.3	1,013.1
Base Support	542.3	547.8	559.8	605.2	751.8	706.0
PCS Travel	135.2	196.0	198.9	163.0	138.6	168.3
Total	3,560.0	3,935.1	3,926.7	4,505.1	5,826.2	6,275.1
(Millions of FY1986 Dollars)						

Figure 10. Navy Training Costs

## APPENDIX C. OTHER SOURCES FOR VIDEOCONFERENCE RESEARCH

In addition to the list of references provided, more information about teletraining can be gathered from [Ref. 19: p. 184]:

Integrated Computer Systems  
5800 Hanum Avenue  
P.O. Box 3614  
Culver City, CA 90231-3614  
(Call 800-421-8166; 800-352-8251 in California)

or,

Telelearning Systems, Inc.  
5050 Beach Street  
San Francisco, CA 94133  
(Call 800-225-3276)

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