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EFFECTIVENESS OF VIDEOCONFERENCING PHASE 1: PRE-PILOT TEST REPORT

Final Report

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16. Abstract

This phase of the project entailed research into the impacts experienced by other organizations that have deployed videoconferencing technology (VCT).

Clearly, the study shows that videoconferencing offers much promise for communications between geographically remote parties. There is little doubt that the use of videoconferencing (particularly with features such as shared documents, whiteboard, etc.) will increase as the technology improves and bandwidth limitations are overcome. Additional usage for VCT is sure to develop, as the use of the technology becomes more commonplace.

Field interviews and observations provided an insight to how this VCT really helped the companies and organizations to reduce travel costs and enhance effective and efficient use of time.

The “Buyers’ Guide” has been designed in an effort to provide a future user of VCT with a useful methodology for buying videoconferencing equipment, either room system units or desktop units. The researcher believes that this report provides the necessary background tools to make educated purchasing decisions.

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EXECUTIVE SUMMARY

This project is to explore the effectiveness of videoconferencing and to determine if videoconferencing technology can reduce travel costs and enhance effective and efficient use of staff time. This project was divided into two phases. Phase 1 began on February 10, 1998 to entail research into the impacts experienced by other organizations that have deployed videoconferencing technology (VCT) for internal use. Given the low budget for this phase of the project, the organizations and companies with Videoconferencing Technology, which have been studied, are all located in the Tucson area near where the student researcher is attending the University of Arizona. A mail survey has been conducted of the transportation departments all over the country and the results have been analyzed.

Perhaps the most concrete result of this phase is that the researcher has successfully tested Videoconferencing Technology capability among the local sites. Both intensive tests and extensive tests that have been conducted have verified the potential uses and benefits of Videoconferencing Technology for ADOT -- a would-be Videoconferencing Technology user.

Clearly, the study shows that videoconferencing offers much promise for communications between geographically remote parties. There is little doubt that the use of videoconferencing (particularly with features such as shared documents, whiteboard, etc.) will increase as the technology improves and bandwidth limitations are overcome. Additional usage for Videoconferencing Technology is sure to develop, as the use of the technology becomes more commonplace.

Groups in Tucson can now videoconference with people at sites on the public networks. This dramatically increases the flexibility of development groups in Tucson to include people who are unable to travel in the decision-making processes. More people who used to be unable to attend the meetings can now attend the meetings and get more information. Additionally these tests have yielded the following principles about running Videoconferencing Technology:

- Participants find voice and picture switching distracting with slow transmission speed and low quality hardware.
- Participants should choreograph and direct the meeting more explicitly than in face-to-face meetings.
- Organizers should limit Videoconferencing Technology meetings to two hours or less.
- Participants must prepare more carefully and completely for Videoconferencing Technology meetings.
- Videoconferencing Technology can be used for local meetings, not just long distance meetings.
- Videoconferencing Technology can not only be used for meetings, but employee training or other educational purposes.

Field interviews and observations provided an insight to how this Videoconferencing Technology really helped the companies and organizations to reduce travel costs and enhance effective and efficient use of time. Also those key points directly from those Videoconferencing Technology field experts help us understand:

- What is the most important feature in this Videoconferencing Technology business?
- Why Videoconferencing Technology benefits can usually exceed the costs?

Market research revealed that two years ago vendors were less than supportive to their customers and manufacturers are less than forthcoming about their future commitment to their products. But now they are supportive, and most products are upgradeable. The “Buyers’ Guide” has been designed in an effort to provide a future user of Videoconferencing Technology with a useful methodology for buying videoconferencing equipment, either room system units or desktop units. The researcher believes that both ‘Chapter 6 and Appendix C’ provide the necessary background tools to make educated purchasing decisions.

1.Introduction and Objectives

U.S. corporations invest billions of dollars in workplace meetings and training annually. There is considerable interest in identifying a certain technology, which might lead to more efficient or effective meetings or training. This study used qualitative methods such as interviews and observations (Appendix A) and quantitative analysis to determine the responses of the people to the videoconferencing technology (VCT) used by several corporations in Tucson, Arizona.

Adult workplace meetings and training account for a sizeable proportion of the formal conferencing and teaching activities, which occur in the United States. Estimates of the number of people who receive formal corporate meeting and training annually range from 14 million to 35 million, at a cost of $30 -- $60 billion (Eurich, 1990). With these numbers of people and costs involved, companies and organizations are obviously interested in improving both the effectiveness and efficiency of these programs. One of the ways companies and organizations have sought to improve effectiveness, efficiency, or both, is through the use of videoconferencing technology.

The current status of Videoconferencing Technology is complex. Systems vary by image quality (e.g. compression speed and refresh rates), by subject focus (e.g. small group-6 to 10 people, big group-10 to 30 people or individual), by network requirement (e.g. ISDN, 56 KBPS switch, etc.), by computer platform (e.g. proprietary vs. standard), by control (e.g. local or remote), and by use of complementary media (e.g. audio application sharing). Add the market's volatile rate of change in with these variables, potential users face an awesome task: deciding which configuration fits their needs best today and in the next few years.

The decision is further complicated for potential users by the many other factors, such as network availability of the local area, budget availability, etc. Establishing process and data baselines may require a substantially different set of tools; discussions, participants, and deliverables than do the evaluation and selection of improvement alternatives, or the development of information systems. Research conducted by Meader (1995), as well as other research in the field, suggests that both technical and social factors have potentially large impacts on the success of Videoconferencing Technology. To explore the range of feasible solutions to support Videoconferencing Technology meetings, it is necessary to get hands on experience with several different kinds of Videoconferencing Technology systems.

1.1. Objectives of the Study

The goal of this study is to explore the effectiveness of videoconferencing. The objectives of Phase 1 are mainly 1) to establish a reliable estimate of videoconferencing costs experienced by other agencies, 2) to establish a reliable estimate of videoconferencing benefits experienced by other agencies, 3) to calculate a benefit/cost ratio experienced by other agencies, 4) to develop one or more tools with which to measure the usage of videoconferencing in phase 2 of the

project. The researcher did this in five ways. First, he tested intensively the room system of Videoconferencing Technology with several actual working meetings and classes. Second, he evaluated the opinions of over 15 site technicians or managers and over 60 Videoconferencing Technology participants when asked various questions about Videoconferencing Technology and Videoconferencing Technology meetings. Third, he analyzed the existing research literature on Videoconferencing Technology to extract predictions on the future use of Videoconferencing Technology and multimedia conferencing systems. Fourth, he analyzed survey responses from other state DOTs that have experience with Videoconferencing Technology. Finally, he conducted a market survey of existing Videoconferencing Technology systems and provided some guidelines for future buyers.

2. Videoconferencing Technology Basics

Videoconferencing systems are an emerging technology that has not yet converged to a standard set of configurations, nor gained wide support in organizations. Before discussing the problems in this environment, let us look at the brief description of this medium.

2.1 Real Time Video

Real time videoconferencing systems embody a wide spectrum of systems and capabilities. They range from digital to analog, from room-sized to desktop, from high bandwidth and compression ratios to low. They also come coupled with different applications or sometimes none at all. The analyses in this paper try to evaluate the entire spectrum. That is, the field studies and literature review encompasses virtually every kind of video-conferencing system that has been studied or used in the last 20 years. Finn, Sellen & Wilbur (1997) and Rosen (1996) provide a recent review of videoconferencing system capabilities.

The critical feature of real-time video is the ability to see and be seen, and the nonverbal cues that constitute group interaction. Of these nonverbal cues, video (by itself) can provide access to kinetic, proxemic, and personal appearance cues. Kinetic cues include gaze, facial expression, posturing, gesturing, and head nods. Proxemic cues provide spatial relationship information such as conversational distance between two communicators, position and "pecking order" of people in remote work sites (e.g. who is sitting next to whom). Personal appearance cues include body type, skin color, grooming (e.g. hairstyle), and adornment (e.g. dress, cosmetics, jewelry). Individuals can also manipulate video with lighting and perspective (e.g. low angle, close-up). Kinetic, proxemic and personal appearance cues have been shown to affect the way listeners/viewers interpret the group process during a meeting. In particular, such visual cues have been shown to help establish (or prevent) rapport and trust as well as to help group members manage conversations. These in turn help the group with persuasion and conflict resolution (Burgoon, Buller & Woodall, 1996). Aside from nonverbal cues, video systems can also provide access to remote, non-electronic data such as real-time pictures of broken machinery or workspaces.

2.2 Real Time Audio

Real time audio systems have been a part of distributed work for a long time, typically in the form of speakerphones. However, new developments in Internet digital voice as well as improvements in audio systems coupled with videoconferencing systems increase the design opportunities for distributed groups.

Audio systems provide verbal cues (word content) as well as two nonverbal cues: vocal cues and a redundant channel, in some systems, for proxemic cues. Vocal cues, such as voice inflection, tone, pauses, and back-channel cues have been shown to affect interpretation (such as the raising of suspicions to the indication of understanding) and conversation management and control, such as floor gaining and holding (Burgoon, Buller & Woodall, 1996). Some audio

system designs provide proxemic cues that enable listeners to perceive a virtual space for speakers (Olson, Olson & Meader, 1997).

2.3 Real-Time Shared Applications

Shared applications among work groups have received the most research attention in the recent past. Systems such as Lotus Notes, Ventana's Group Systems, and other real-time computer conferencing systems offer distributed groups the ability to develop work objects, conduct on-line problem solving and make group decisions independent of visual or auditory cues. More recently, desktop multimedia conferencing systems such as Intel's ProShare and Vtel's PC-based technology have offered shared office automation tools for videoconferencing.

Shared applications provide a limited redundant channel for verbal cues (word content without vocalic cues). But they also provide a medium for displaying and editing electronically stored visual and audio data, and work objects such as documents, drawings, models, spreadsheets, and simulations. Shared applications do not typically provide kinetic, proxemic, personal appearance cues.

Shared applications have limitations that affect distributed work group process and performance. Applications do not always provide the functionality and performance a group requires, nor are networks and applications always compatible across distributed sites.

2.4 Actual Conferencing Configurations

A *Video + Audio + Application* configuration typically includes desktop multimedia conferencing systems like Intel's ProShare with users working across all three media, where the shared computer application is integrated into the videoconferencing system. It could also include room-sized videoconferencing systems, such as PictureTel's (with external PC), Vtel's products, with an independent shared application running on a separate data network.

A *Video + Audio* configuration includes videoconferencing systems, but could be a room-sized system that supports groups of people at different sites, or it could be a desktop system that supports two individuals working together without a shared application. An example of the latter is the AT&T Videophone.

An *Audio + Application* configuration includes any shared application supported with any audio system (e.g. telephone), including the use of a videoconferencing system's document camera or simply a fax machine used in real-time mode.

3. Tests of VCT Capabilities with Actual Working Meetings

In order to exclusively explore the Videoconferencing Technology impacts experienced by other agencies, the researcher selected one Videoconferencing Technology site with CLI's (now Vtel's) earlier product as his first testing site, trying to find some problems because the previous research has indicated that earlier products tended to cause more problems. After this intensive test, the researcher further tested five other sites with different Videoconferencing Technology units from different manufacturers, trying to find out 1) whether it is true the old models cause more problems, 2) how much the later products have been improved, 3) whether the reaction from the participants to this technology with new products is the same as that with old ones.

3.1 Lists of VCT Sites and Their General Information

There are over 20 videoconferencing sites in Tucson. Here are just some of related sites:

#1
Address: Tucson Medical Center
Person in charge: Jerry Freund
Tel: 520-324-5080
Room Size: two rooms for around 10 people, one for 25-30 people
Product Info: CLI's product with codec, imux and two 27" colors monitors.
Capability: two-way audio and two-way video
Can be updated: Yes
Add-ons: document camera
Vendor: Norstan
Networks Interface Supported: ISDN
Transmission Speed: 128kbps-384
H.320support: yes
Year installed: 1991
Price when bought: $250,000.00 for 3 sets

#2
Address: 310 S. William Blvd. Suite 300, Tucson, AZ 85711
Person in charge: Jack DeJong
Tel: 520-745-2270
Room Size: around 10 people
Product Info: CLI's product, Using computer processor, and software driven**.**
Capability: two-way audio, two-way video
Add-ons: document camera
Vendor: VTel
Networks Interface Supported: ISDN
Transmission Speed: 128kbps
H.320 support: Yes

Year installed: Nov. 1995
Price when bought: $30,000.00

#3
Address: KUAT, University of Arizona
Person in charge: Jack Parris
Tel: 520-621-1500
Room Size: around 10 people
Product Info: PictureTel ‘s Venue 2000, one unit with one monitor (can be converted to two monitors)
Capability: two-way audio, two-way video
Can be updated: Yes
Add-ons: document camera
Vendor: Darcom in Phoenix
Networks Interface Supported: ISDN
Transmission Speed: 128kbps-384kbps
H.320 support: Yes
Year installed: 1992
Price when bought: $85,000.00

#4
Address: Business School, University of Arizona
Person in charge: Mellisa Glyn
Tel: 520-621-1536
Room Size: 25 people
Product Info: PictureTel’s Venue 2000, dual color monitor
Capability: two-way audio, two-way video
Can be updated: Yes
Add-ons: document camera
Vendor: View Tech
Networks Interface Supported: ISDN
Transmission Speed: 128kbps-384kbps
H.320 support: Yes
Year installed: August 1997
Price when bought: $38,000.00

#5
Address: 333 E. Wetmore
Person in charge: Paul Sopka
Tel: 520-696-1382
Room Size: 10 people
Product Info: PictureTel’s Venue 2000 with two 35” monitors and codec
Capability: two-way audio, two-way video
Add-ons: document camera

Vendor: Lucent
Networks Interface Supported: T 1
Transmission Speed: 112kbps-336kbps
H.320 support: Yes
Year installed: June 1996
Price when bought: $50,000.00

#6
Address: 9000 South Rita Road
Person in charge: Luis Newell
Tel: 520-799-2912
Room Size: one for 15, another one for 30 or more
Product Info: PictureTel's Concord 4500, dual colors monitors
Capability: two-way audio, two-way video
Can be updated: Yes
Add-ons: document camera
Vendor: PictureTel
Networks Interface Supported: T 1
Transmission Speed: 112kbps-336kbps
H.320 support: Yes
Year installed: 1996
Price when bought: $40,000.00

#7
Address: 3820 South Palo Verde
Person in charge: Oscar Paredes,Jr.
Tel: 520-573-4047
Room Size: around 10 people
Product Info: PictureTel's SwiftSite and Concord 4500, Venue 2000 with extra voice tracking system.
Capability: two-way audio, two-way video
Add-ons: document camera
Vendor: PictureTel
Networks Interface Supported: ISDN, T1
Transmission Speed: 112kbps, 128kbps, 336kbps, 384kbps
H.320 support: Yes
Year installed: 1996
Price when bought: Samples

#8
Address: 401 w. Bonita Ave.
Person in charge: Mark Handy
Tel: 520-523-0904
Room Size: 20 people
Product Info: Tandberg's product, two 54" color monitor, and main switchboard

Capability: two-way audio, two-way video
Add-ons: none
Vendor: no particular vendor
Networks Interface Supported: ISDN, T 1
Transmission Speed: 112kbps, 128kbps, 336kbps, 384kbps
H.320 support: Yes
Year installed: 1992
Price when bought: Do not know

3.2 Intensive Test of VCT Capability with DESCIM Groups

With the help of Professor David K. Meader, MIS department, University of Arizona, the researcher conducted an intensive test of CLI's Videoconferencing Technology system with DESCIM groups in Room 214, McClelland Building.

DESCIM Groups are groups of professors and researchers from different universities all over the world. They meet periodically in Tucson to work out requirements for new information systems and more recently, to develop configuration boards. Typically, 20-30 people fly to Tucson to work for a few days. Based on the conversations with both DESCIM management and DESCIM team participants, five areas have been identified where Videoconferencing Technology provides opportunities for adding value to DESCIM teamwork. These areas include, but may not be limited to, Pre-meeting Videoconferencing Technology, Kick-off Videoconferencing Technology, Remote Expert Videoconferencing Technology, Post-meeting Videoconferencing Technology, and DESCIM Management Communication. The following sections provide details as to how these areas may benefit from Videoconferencing Technology.

3.2.1 Pre-Meeting Videoconferencing Technology

A current problem perceived by a number of participants in DESCIM groups is that DESCIM mismanages the preparation of group participants. Verbal and written comments collected from a large number of people indicate that participants get very short notice (a few days) of a meeting in Tucson. The short notice leads to abrupt changes in participants' work, social and family lives. The short notice helps create animosity towards the work effort. This animosity can only have negative impacts on both the work and the "buy-in" to that work. A comment that is more expressive than others, but represents -- to some extent--many of the comments is:

"Prior to (4 days before the meeting) I had little to no knowledge of DESCIM. On that day my command was informed of this conference and I was informed that I would be going, whether I wanted to or not … Because of the short notice, our travel office did not get an airline flight I could take so I am coming off (many) hours of driving and (too few) hours' sleep."

Videoconferencing Technology could be used by DESCIM as an effective method to better prepare participants for upcoming meetings. A pre-meeting with all participants could address what the goals of the week will be, answer questions about materials that will need to be brought, and other issues. Clearly, this problem is broader in scope than Videoconferencing Technology, but assuming that other types of planning can be managed better, Videoconferencing Technology promises to offer benefits because a visual channel helps establish trust and rapport.

Another area that offers potential for Videoconferencing Technology is pre-meeting planning among DESCIM team leaders and facilitators. Currently, pre-planning is often done the day before a weeklong meeting, and requires travel by either the team leader and/or facilitator. While the researcher did not get a chance to conduct a pre-planning session via Videoconferencing Technology, it seems likely that some pre-planning can be done effectively by Videoconferencing Technology, especially if data application sharing is made available.

3.2.2 Kick-off Videoconferencing Technology

Perhaps related to the problem of pre-meeting preparation, team participants often arrive in Tucson with little understanding of why they are there, what is expected of them, and how they are to proceed. The kick-off Videoconferencing Technology allows a key leader to address these issues to the group in Tucson without having to travel. The procedure for the kick-off Videoconferencing Technology is to speak to the group just after it has assembled on the first day of the meeting. The goals, on the part of the speaker, are to explain the objectives of the week, and to answer questions about orientation and focus. The researcher conducted a kick-off Videoconferencing Technology for the Air Quality group in March 1998; the results of that session are included in the next section --- 3.3.1 Session 1-Kick-off.

3.2.3 Remote Expert Videoconferencing Technology

Occasionally, people who should be at a DESCIM meeting can not be there. They can't get away for the week, they are needed only for a small portion of time or there is no workstation available for them. The Remote Expert Videoconferencing Technology would allow a key participant or a technical expert who is not at the Tucson meeting to participate in the work at critical times. For example, one or more people from the site could participate. While the researcher did not conduct a remote expert Videoconferencing Technology, comments from the participants in the meeting that he assessed generally agreed, without prompting, that including remote experts through a Videoconferencing Technology would have a positive impact on the work. For some participants, Remote Expert Videoconferencing Technology would also reduce the disruption in work schedules and reduce the costs incurred by traveling to Tucson.

3.2.4 Post Meeting Videoconferencing Technology

Another problem facing DESCIM is getting "buy-in" from people at remote sites who did not attend the Tucson meetings and, as a result, don't understand the process and rationale that group went through to arrive at their conclusions. A Post Meeting Videoconferencing

Technology would allow the Tucson group -- in its entirety -- to report the results of their week to one or more people at the end of their week. The researcher did not have an opportunity to conduct a Post Meeting Videoconferencing Technology, but see this as a potentially valuable way to address the problem of "buy-in" at remote sites.

3.2.5 DESCIM Management Communication

During the course of this study, DESCIM management used Videoconferencing Technology between Edgewood, DESCIM HQ, and WES when individuals could not travel, or when the meeting did not justify travel. DESCIM management has also used Videoconferencing Technology effectively to meet with outside groups who wished for a briefing of DESCIM activities. The researcher conducted a meeting between DESCIM management and HQUSACE DC in March 1998, the results of that session are included in next Section – 3.3.3 Session 3-Reporting.

3.3 Tests Conducted and Results

Since February 15, 1998, the researcher has observed three intensive meetings and 10 extensive meetings. The following sections describe the results of these meetings.

3.3.1 Session 1-Kick-Off

On February 20, 1998, the DESCIM Director, Mr. Warren Meekins, kicked off an Air-Quality integration meeting. He communicated via Videoconferencing Technology from the Edge System, Inc. office in Alexandria, Virginia, while a group of 25 people were in Tucson. The objective of this session was to orient the Tucson group as to the context of their task, and to focus them on the week's work. The Videoconferencing Technology was conducted via ISDN (running effectively at 128kbps). In Tucson, the CLI roll-about was used, with the video image projected on two 8-foot screens and the audio signal sent through the room speakers. In Alexandria, the Target Technology system was used. The two systems worked by virtue of the H. 320 standard.

The meeting was held at 9:00am Tucson time on the first day of the group's week. While a few administrative issues were dealt with before the Videoconferencing Technology, the conference was the first activity in which the Tucson group engaged. The meeting went on for 20 minutes with Mr. Meekins explaining his overview of the DESCIM work in general, and the Air-Quality project, in particular. He explained the objectives of the group's imminent work, and then took six questions. Several of the questions had to do with the value of the imminent work and the links to other development activities.

After the questions had been answered, the Videoconferencing Technology link was closed and questionnaires were distributed to all the Tucson group members. The goals of the questionnaire were to assess the value o f the kickoff meeting, the quality of the technology for

conducting such meetings, and the degree to which Mr. Meekins was able to meet the original goals: namely to orient and focus the group. The results of the questionnaire are presented below.

Overall, participants perceived the Videoconferencing Technology to be "about the same" as face-to-face with respect to an index that included ability to see, hear, ask questions, and follow the conversation, as well as the ability to communicate with the remote speaker and its comparability with meeting in person. Interestingly, when asked how adequate and useful the Videoconferencing Technology was, given that it was impossible for the Director to travel to Tucson, participants perceived the Videoconferencing Technology to be "very useful".

For all individual items in the index mentioned above, the difference between "compared to face-to-face" and "given that a face-to-face is impossible", was significant, (94% positive answer). This indicates that people are more likely to rate the Videoconferencing Technology session as useful when "face-to-face is impossible" when compared to face-to-face". This suggests not only that the ISDN Videoconferencing Technology was perceived as better than expected, but that DESCIM team members have a reasonably high tolerance for situations when certain people can only attend via Videoconferencing Technology.

Judging from the percentage of positive answers in the survey, DESCIM team members understood the arguments and points made by Mr. Meekins. Additionally, participants found it reasonably easy to interpret what he meant and were not confused about what was going on at the far end. 90% of the respondents indicated that they understood at least 95% of the content of the meeting. These perceptions are important because previous research has indicated that technology mediated communication often causes confusion and misinterpretation. It appears, in this situation, that is not the case.

Since the purpose of the "kickoff" session was to orient and focus the group on their task, the survey asked questions about how well Videoconferencing Technology accomplished this purpose. In general, DESCIM team members felt the Videoconferencing Technology session had little negative impact on this goal. On average, they felt 95% clear about what they were going to do after the meeting. During the informal conversations between the researcher and the participants, the researcher found that most participants felt:

- Comfortable with what they were doing
- Clear about what they were to accomplish during the week
- In agreement with what they were doing during the week
- Understood their individual roles in what they were doing during the week

Finally, the researcher had interviews with five participants to assess whether factors such as experience with videoconferencing meetings or familiarity with either Mr. Meekins or other members had an impact on the responses. The researcher found several interesting relationships. First, people who reported more Videoconferencing Technology usage tended to have more familiarity with both Mr. Meekins and with the others in the room, suggesting that Videoconferencing Technology may have an impact on social networks and familiarity. It was

not determined where people became familiar with Mr. Meekins or others, so this can not be concluded confidently. Second, those with more experience using speakerphones tended to find the session more useful. No relationship existed for those with experience using Videoconferencing Technology. This may suggest that people who are used to only speakerphones found the added video channel a useful enhancement. Third, the researcher found no relationship among a variety of other factors. Of particular interest was the lack of relationship between familiarity (with Mr. Meekins or others) and ability to see, hear, ask, follow, or communicate.

There were a few other relationship: People who were experienced speakerphone users reported understanding Mr. Meekins' arguments and points better, suggesting that a higher comfort level with listening to mediated audio pays off in Videoconferencing Technology session. Older participants reported being more comfortable with what they were to accomplish during the week.

3.3.2 Session 2-Debriefing

On March 10, 1998 a multipoint working session was held between a group of five in Tucson, a group of three in Edgewood, and a group of three at DESCIM HQ in Hoffman. The objective of the meeting was to brief DESCIM management on a development plan. For the first twenty minutes, the Tucson group presented their work and their recommendations, using a PowerPoint presentation. For the next forty minutes, there was an interchange among the Tucson team and both other teams. From a neutral observer's viewpoint. There seemed to be issues regarding scope assumptions, documentation version control, policy issues and logistical issues.

Participants seemed to dislike the video-switching feature, whereby the last speaker's image remains on the screen. For a substantial, contiguous portion of the meeting, only one group image was viewed in Tucson, while for another substantial contiguous portion, only the other group image was viewed in Tucson. It is not clear if that had an impact on the Tucson group's presentation. But it is clear that participants found the voice switching and half-duplex voice channel (e.g. only one person can talk at a time) distracting. An example of this is when a speaker at one end would be making point with which a person at the other end disagreed. From a neutral observer's viewpoint, this clearly frustrated the local person, who wished to correct an erroneous assumption made by the speaker. Instead, without this information, the speaker continued on for a minute or so because his channel switched off any signal from the remote location. Clearly, in a face-to-face setting, the speaker would have stopped earlier and inquired what the other was trying to say. From this, and similar episodes, the voice switching and half-duplex audio channel appear to be a serious hindrance to "natural" argument and intensive discussion.

Of particular interest in this session was the Tucson group's ability to make a PowerPoint presentation via Videoconferencing Technology. Because it has not yet determined how to make a PC input to the CLI equipment, the team member just directed the document camera onto his notebook computer and ran a PowerPoint presentation. Participants at the other two sites

commented that it was mostly visible, with smaller type data becoming increasingly less visible. Finally, the team and the researcher concluded that anything less than 24 point was illegible.

3.3.3 Session 3-Reporting

On March 27, 1998, a point-to-point session was held between DESCIM management, who were in Tucson, and an Army group at HQUSACE DC, going through the MCU at Edgewood. The topic of the meeting was to assess the potential integration of DESCIM development efforts with other, non-DESCIM development efforts. In particular, at issue was the need for the Army group, chartered with evaluating information systems, to include DESCIM projects in their evaluations. One participant characterized this meeting as "contentious," which is an important kind of meeting to study.

In Tucson, the DESCIM managers were seated together, using the CLI roll-about system. All three managers were on the screen at all times. At HQUSACE DC, seven people were present in what looked to be a dedicated Videoconferencing Technology room. Someone off-screen was controlling the camera and would typically, as speakers changed, redirect the camera to the speaker. At no time were all seven people on the screen at once. From Tucson's viewpoint, the lighting at the other end was adequate, but facial expressions were difficult to read. In Tucson, because of the close overhead spotlights in the room, the DESCIM managers' faces were well lit. There was no information on how the people at the other end viewed the image from Tucson.

Results from interviews with DESCIM managers following the session indicated several issues. First, once again the voice-switching feature of current Videoconferencing Technology systems presented problems. In this experience, the automatic muting feature at the other end cut off the speech of Tucson speakers. In one estimate, up to 30 seconds of speech at a time was lost -- resulting in unnecessary confusion among people at the other end. The participants at the other end addressed this by quieting down, but participants expressed a desire to overcome this feature. Second, participants in Tucson felt uncomfortable with the occasional practice of having the speaker off-camera. However, they did not call attention to that fact, and in one instance let the other end continue on for about 7 minutes. Even during the discussion, that speaker never appeared on the screen. This suggests that technology chauffeurs need to be vigilant in directing the camera. More importantly, it may indicate reluctance on the part of Videoconferencing Technology participants to interrupt and direct the camera. While it was unclear what the status differences were in this meeting (it appeared to be mostly peers), it seems likely that a subordinate may be reluctant to ask a superior to use the technology better.

3.3.4 Extensive Tests of Videoconferencing Technology Capability

With the problems found during the intensive test in mind, the researcher observed and tested five other sessions at five other different sites in extensive way.

3.3.4.1 Session 4

At 11:00am, April 2nd, 1998, the researcher tested one interview session with Management Recruiter Tucson. There CLI's roll-about system was used, but with a modem, computer processor and software driven operation, in other words, this product does not have codec. Network interface support was ISDN with a transmission speed of 128kbps for both audio and video. (The same configuration as in the intensive test). Their primary purpose in using Videoconferencing Technology is to help companies to internationally recruit employees. They interviewed the applicants and recorded the tape for the employers to review or the employer might send a person to interview the applicant through Videoconferencing Technology. The ultimate purpose is to save money.

The researcher had an agreement with the field manager to observe the session, but by the time he was there the vice-president of the company did not allow the researcher to sit in the conference room for observation due to the privacy with their client. But after that the researcher was able to test the equipment with a manager of this company in Sedona. An informal interview was conducted to ask several questions, specifically concerning the problems found in the intensive test. Both the manager in Tucson and in Sedona agreed that voice and video switching was distracting. Also due to the slow speed of transmission, about 30 seconds of voice and video delay was very clear. They told the researcher that their clients were very happy with their results. Usually recruiting one person needs a round trip airline ticket. This may cost hundreds or even thousands of dollars. Videoconferencing Technology, in contrast, costs around $100 per interview. Also with the limitation of the recruiting budget, usually only a few applicants can be interviewed, and even if they were not happy with the applicant, because of the budget they had to choose among these interviewed people. Now with Videoconferencing Technology they can interview many more applicants. Since they usually interview one person at a time and do not involve much image or movement, both managers felt satisfied with their equipment and this technology.

3.3.4.2 Session 5

3:00pm -- 5:00pm April 6, 1998, the researcher observed a videoconferencing meeting in Tucson Medical Center. The West Conference Room can hold 12 people. CLI' s roll-about system with one unit of dual color monitors, operated through codec, IMUX and T1 networks with the flexibility of switching from 2 channels to 6 channels depending on their own needs. Five people attended the meeting. The main purpose of this meeting was to prepare a lecture for an upcoming class that would be taught by a professor in the University of Utah. After this meeting, the researcher was able to talk to the participants about their reaction to this technology, particularly their feedback about the problems exposed from the intensive test. According what they told the researcher, if they used 336kbps, there was almost no voice and picture distraction, unless they forgot to redirect the camera. In other words, someone in the room needs to control the buttons, which can control either this end or the far end. Also they have three different size rooms that are networked inside, which means that they can move this unit to each of the three rooms to meet their needs.

3.3.4.3 Session 6

4:00pm April 8,1998, the researcher observed one of the KUAT videoconferencing meeting. KUAT has four Videoconferencing Technology rooms, Room 205 in Harvill Hall Building is used to hold executive meetings and originate the lessons. This room is equipped with PictureTel's Venue 2000, one unit, one color monitor (but could be add one more monitor), sometimes operated through ISDN 6 channels with 384kbps, sometimes 2 channels 128kbps for reducing the cost. Typically, every Wednesday this semester, from 4:00pm, classes have been televised through 128kbps. To solve the voice distraction, PictureTel has an ability to separate the audio and video transmission, in other words, audio and video do not share 128kbps, which dedicates to video only to improve the video image quality. Also Picture Tel uses remote control to control the menu buttons, so it is easy to redirect the camera, (unlike CLI's model the control board was connected by wire and almost fixed, not easy to pass around and redirect the camera and causes distraction).

3.3.4.4 Session 7

April 10, 1998, the researcher visited Business School, University of Arizona; they just bought one of PicturTel's Venue 2000, one unit with two 27" color monitors, and roll-about system. The researcher was unable to observe its operation, but Mellisa Glyn told him that this system was bought to replace the old CLI's model. And it is much better in terms of the picture quality and voice quality even if it runs through 128kbps, because this product separates the audio and video transmission channel.

3.3.4.5 Session 8

April 13, 1998, the researcher visited Pima Community College and Northern Arizona University, Tucson Campus. NAU uses Tandberg products operated through main switched board. Since there is little similarity to the regular conferencing meeting systems, the researcher did not put much efforts to investigate Tandberg's products, but survey questionnaire from all the students are positive about this technology in terms of ability to understand the arguments and points made by the professor in Flagstaff. Pima Community College has public networks, microwave dish system and satellite systems, all are operated through a main switch, just like a TV station. Again there is little similarity to the room conferencing system. Consequently, it is the reseaercher's opinion that it is not worth spending more time to investigate. Also, they do not have the exact product brand name. The whole system is different pieces of components put together.

3.3.4.6 Session 9

April 14, 1998, the researcher tested another PictureTel's Venue 2000, one unit with one 35" color monitor, operating over a T1 line. The room at Health Partner, holds around 10 people. This technology is heavily used, at least 6 hours a day, as the technician said, and mainly point-to-point to Phoenix. At 3:05pm the researcher and the technician were sitting in the room and

dialed to the Phoenix site, just for testing, but there happened to be four people there at the Phoenix site, waiting to have a meeting with the people in Tucson. The researcher took this chance to talk to the other end about this technology, they replied that this technology is so convenient. To have a meeting, they do not have to leave the building, even the floor. Before either people in Tucson drove to Phoenix or people in Phoenix drove to Tucson, wasting a lot of time to have a one or two hour meeting. Also they said if they wanted to cancel the meeting or reschedule, it is so easy to handle. When asked about no one showing up at one site, they said it was not a big deal, just couple of minutes to walk back to the office. This kind of thing had happened before, maybe the leader of the meeting could not attend the meeting or the main speaker had something else to do. Overall, they are very satisfied with this technology, especially the document sharing feature through the document camera. The whole big team can work together on one project, or edit the report, or analyze something, very effectively and efficiently. Before, they had to mail back and forth and it took long time to decide one thing.

3.3.4.7 Session 10

11:00 -- 12:30, April 16, 1998, the researcher visited IBM in Tucson, because he learned that IBM has PictureTel's new product -- Concord 4500, which solve the voice and video image distraction problems. But due to the privacy policy, the researcher didn't have the chance to observe the operation, but had the chances to talk to people after the meeting. Most of young people the researcher interviewed were happy with this technology. First, they said they did not have chances to attend some of the most important meetings, before usually, supervisors or managers went to have a meeting and came back to have another meeting to pass on the information, But now they can directly attend the meeting. "Especially when some highly technical matters are being discussed, you need to hear the real engineer", they said.

The researcher had a chance to test this new product in Norstan Showroom. Basically, Concord 4500 has a feature called Limelight -- it is a voice tracking system, connected to the camera to direct the camera by the voice, in other words, where there is a speaking voice, the camera will automatically focus the zoom, with the echo elimination feature this works great.

3.4 Lessons Learned from the Tests

The lessons are 1) that groups in Tucson can now videoconferencing with people at remote areas, 2) that more people in Tucson can now attend more meetings, 3) that time and cost have been saved for some other use. This dramatically increases the flexibility of groups in Tucson to include people who are unable to travel to Tucson or people who are unable to leave Tucson in the decision-making processes. The following principles about these Videoconferencing Technology systems have been identified from the above tests:

1. Participants find voice switching distracting. Voice switching occurs in two ways. First, systems give preference to signals from the local source, meaning that any substantial noise near a microphone will cut off incoming voice signal and the local system will try to transmit that noise. The noise could be a voice, but is often pencil tapping, keyboard typing, side

conversations, back-channel cues (e.g. “uh-huh”, “okay’), body shifting, door closing, etc. Muting the microphone can minimize the effect of incidental noises, but often the microphone is out of reach of the participant making muting inconvenient. Participants could also try to be quiet, but such an effort seems to be difficult and constraining over long periods of time.

A better solution is to use systems with full duplex, unswitched voice, which means the audio channels will carry all signals regardless of the source. Some systems allow this, such as PictureTel’s echo elimination four way microphone, but the CLI system used by Business School, by Management Recruiter Tucson, by TMC did not.

2. Participants find picture-switching distracting. Picture-switching distraction occurs in multipoint conferences. Or more people joined the discussion at the meeting, where one site will view the video signal from the remote site that last spoke -- or made the last incident noise (Videoconferencing Technology systems couple audio and video signal -- if it is going to send an audio signal it will simultaneously send the video signal). In fact, one of the more distracting aspects of picture switching is when two participants are conversing but an incident noise from another site switches the video signal away from the conversation.

Picture switching also has a curious effect. If two sites are doing most of the talking, a third site will never appear to either of the two sites. The researcher suspects this may have subtle yet important effects on inclusion of all participants. That is, if one group never really appears on the screen, then the presentation may ignore their interests. PicturTel products has a pre-set option, let the system switch the sites automatically and re-set the system if you do not want to.

Picture switching is common among existing Videoconferencing Technology systems, but new systems will likely offer an option to have all sites on screen at all times. This will require either larger screens to accommodate multiple windows (one site per window) or separate monitors for each site. Note that as the number of windows on a monitor of a given size increases the resolution of facial expression decreases.

3. Participants should choreograph and direct the meeting more explicitly than in face-to-face meetings. In face-to-face meetings, no one thinks to say “get in view”, “speak more clearly”, “stop making noise”, “ get better lighting so I can see your face.” In Videoconferencing Technology meetings, these comments need to be made with a shared understanding that such interruptions are part of a Videoconferencing Technology meeting. For example, in Session 3 described above, the speaker conversed for over 7 minutes without ever appearing on the screen. To fix this, we not only need to have a new product with a voice tracking feature, but also participants need to interrupt and ask for a better presentation. This leads to a better quality meeting.

4. Limit Videoconferencing Technology meetings to an hour to two hours. It seems that many participants tire after an hour or so of conducting a Videoconferencing Technology meeting, although it is unclear why. It may be the effort required to keep quiet to avoid voice and picture switching, the effort of managing views, the effort of sitting still, the effort of conducting

a meeting without expressive flexibility (such as a white board). In any case, participants should be sensitive to this potential time constraint, and either try to shorten the meeting, or take breaks.

5 Participants must prepare more carefully and completely for a Videoconferencing Technology meeting. In face-to-face meetings, confusion and potentially conflicting ideas can be worked out more readily. Such working out of ideas and agendas becomes harder when attempted with voice switching and limited time constraints. In Session 2, the Tucson group had a good PowerPoint presentation that lead to a productive conversation after it was presented. In contrast, some sessions, like Session 1, were not as well prepared, resulting in a less influential Videoconferencing Technology meeting.

6. Data and application sharing may be the "killer app" for Videoconferencing Technology. Given the communication barriers present in existing Videoconferencing Technology systems (e.g. voice switching, lighting of the room, etc.), groups who have a shared focus on either data or applications will likely find Videoconferencing Technology meetings more productive and more sensible. This difference was clear between Session 2 and Session 3. Clearly these were different kinds of meetings, but had the participants in Session 3 had access to shared graphics about different systems, about different data sources, about different missions and charters, the researcher's belief is that the meeting would have been less confusing. The confusion in Session 3 and other sessions was caused both by the nature of the meeting, but also by the extreme voice switching problems experienced.

3.4.1 Education

As stated at the very beginning of this study, U.S. corporations invest billions of dollars in workplace employee training annually. One of the two major findings in this study is that Videoconferencing Technology offers promise for employee training. Most of the companies and organizations agreed that when they installed Videoconferencing Technology, their primary purpose was for the meetings and conferences. But in fact most of the time Videoconferencing Technology is contributing to education and employee training. Now they have found:

Guest instructors or trainers do not have to be paid a lot to come to the premises in order to deliver his or her lessons. As found in the extensive test, the Tucson Medical Center no longer pays a professor to come to Tucson to give a lecture. This saves the following costs 1) round trip air fare, 2) wages for travel time, 3) lodging and food, 4) car rental, 5) other expenses. The NAU Tucson campus does not have to have the instructors come from Flagstaff to give lessons.

Institutions and organizations in Tucson do not have to send their instructors or experts out to deliver new information. Pima Community College has classes in Douglas, Nogalas and other small towns televised from Tucson. KUAT, in Tucson, televises their lessons from University of Arizona. IBM's Tucson office televises their training sessions in Tucson.

More people can get more training. Those working full time have a chance to finish their education and get a degree without leaving town. Pima Community College, Northern Arizona University and the University of Arizona have helped thousands of people get higher education

without leaving their routine jobs.

Organization and Business employees do not have to travel to another city or even another floor of their building to get training. Health Partners trains their employees within each building, while the instructors may be in Phoenix or some where else in the country. IBM trains their employees within each local office which could be in Asia, in Europe or somewhere else in the world by those experts in New York, or California.

4. Quantitative Analysis of VCT Survey Questionnaire

A total 65 valid survey questionnaire forms have been analyzed. Three major points have been looked at, 1) Benefits of Videoconferencing Technology, 2) Effectiveness of Videoconferencing Technology and 3) Chances to Attend Meetings without Videoconferencing Technology.

4.1 Survey Sample Information

SAS programming analysis on "Study on Effectiveness of Videoconferencing", for more information about variables and codes, please refer to Appendix E.

Subject Occupation Category

OCCUPATION	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Employee	30	46.2	30	46.2
Mid-manager	27	41.5	57	87.7
Top-manager	8	12.3	65	100.0

Among 65 valid participants, there are 30 ordinary employees, 46.2% of the sample population. 27 mid-level managers take 41.5% of the sample population. 8 Top-level managers are 12.3% of the sample population. This variable has been designed to look at response difference among different levels of people.

The following table shows the marital status of the sample. Previous research indicates that marital status could affect participants' responses. But here this study does not explore these differences due to the unbalance of the sample size of each category. (single = 11, married = 40 and other (separated, widow and divorced) = 14). Further study can be done in the future.

Subject Marital Status

MSTATUS	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Single	11	16.9	11	16.9
Married	40	61.5	51	78.5
Other	14	21.5	65	100.0

Sex of Subject

GENDER	Frequency	Percent	Cumulative Frequency	Cumulative Percent
Male	33	50.8	33	50.8
Female	32	49.2	65	100.0

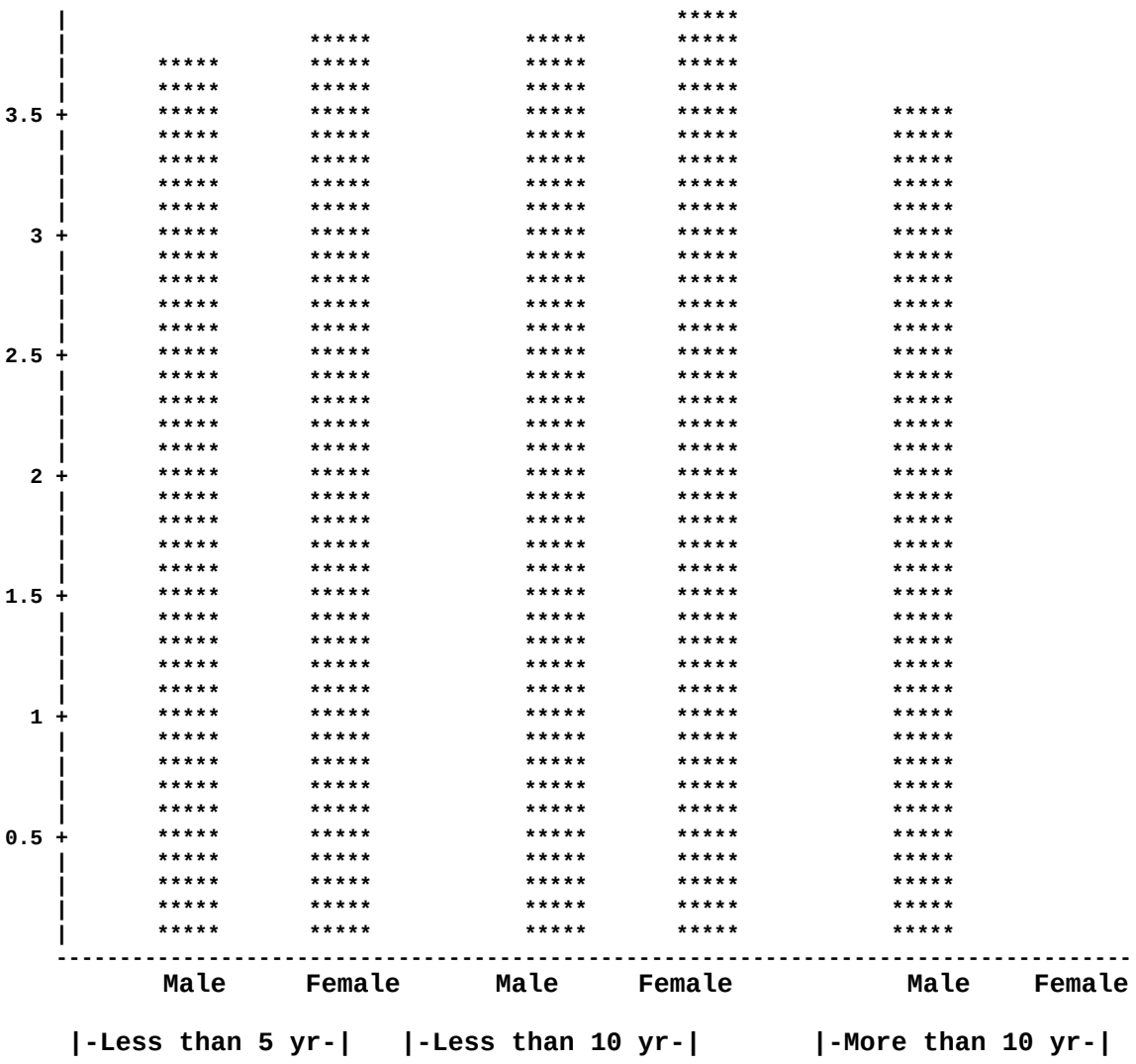
No previous research has been conducted to find out whether there is difference between male and female in response to Videoconferencing Technology. This study has been designed to explain this. But it failed to find significant difference between male participants and female participants in response to Videoconferencing Technology in this study.

Subject years of experiences with VCT

YEXP	Frequency	Percent	Cumulative Frequency	Cumulative Percent
less than 5 yr.	31	47.7	31	47.7
less than 10 yr.	30	46.2	61	93.8
more than 10 yr.	4	6.2	65	100.0

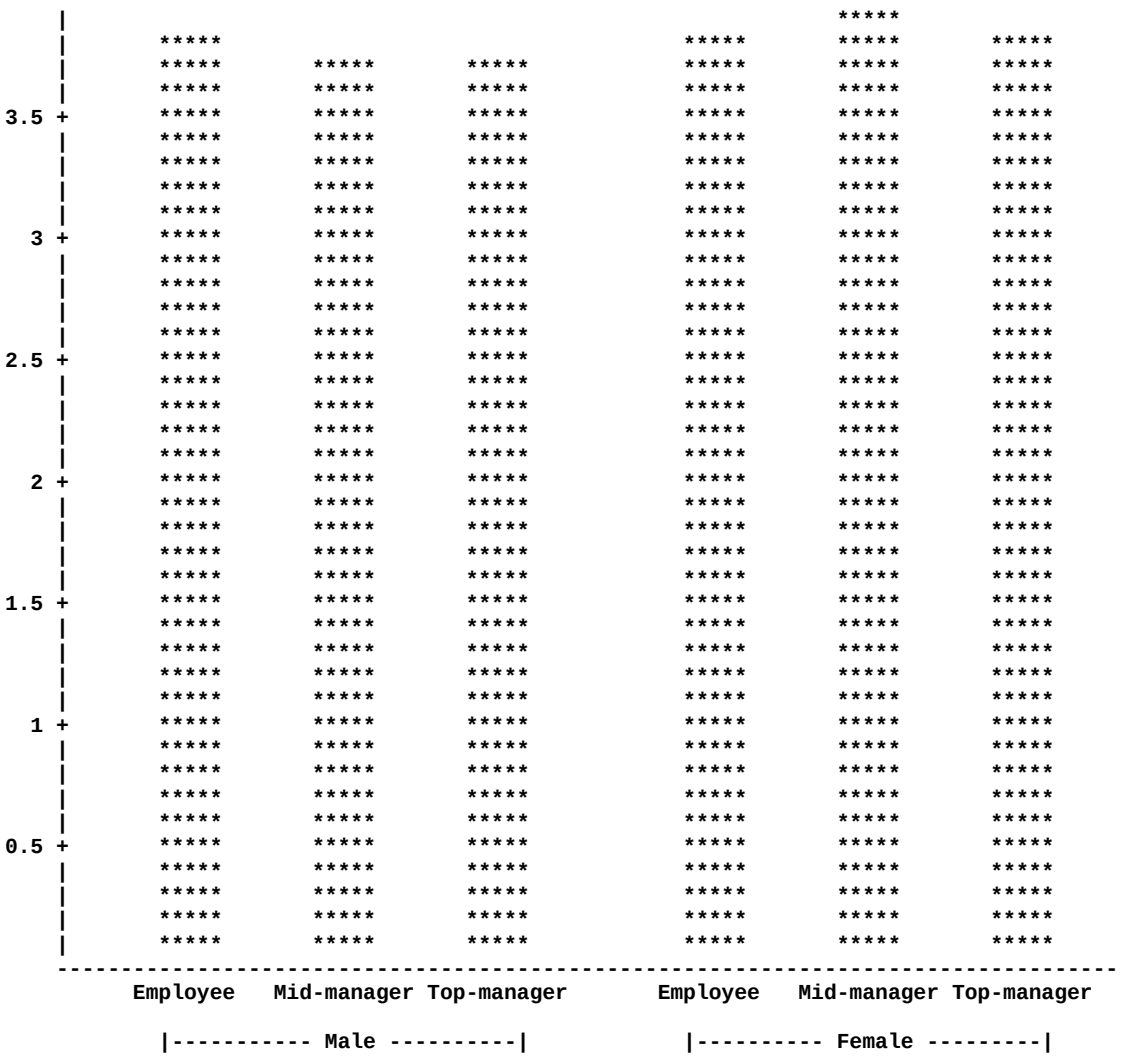
Participants' years of experiences with Videoconferencing Technology have been designed in this study to explore whether this variable affects the responses. The above table shows that 31 subjects have less than 5 years of experiences with Videoconferencing Technology, 30 have less than 10, 4 have more than 10 years of experiences with Videoconferencing Technology.

4.2 VCT Benefits Mean Comparison between Males and Females within Years of Experiences with VCT (SAS Bar Chart Computer Output):



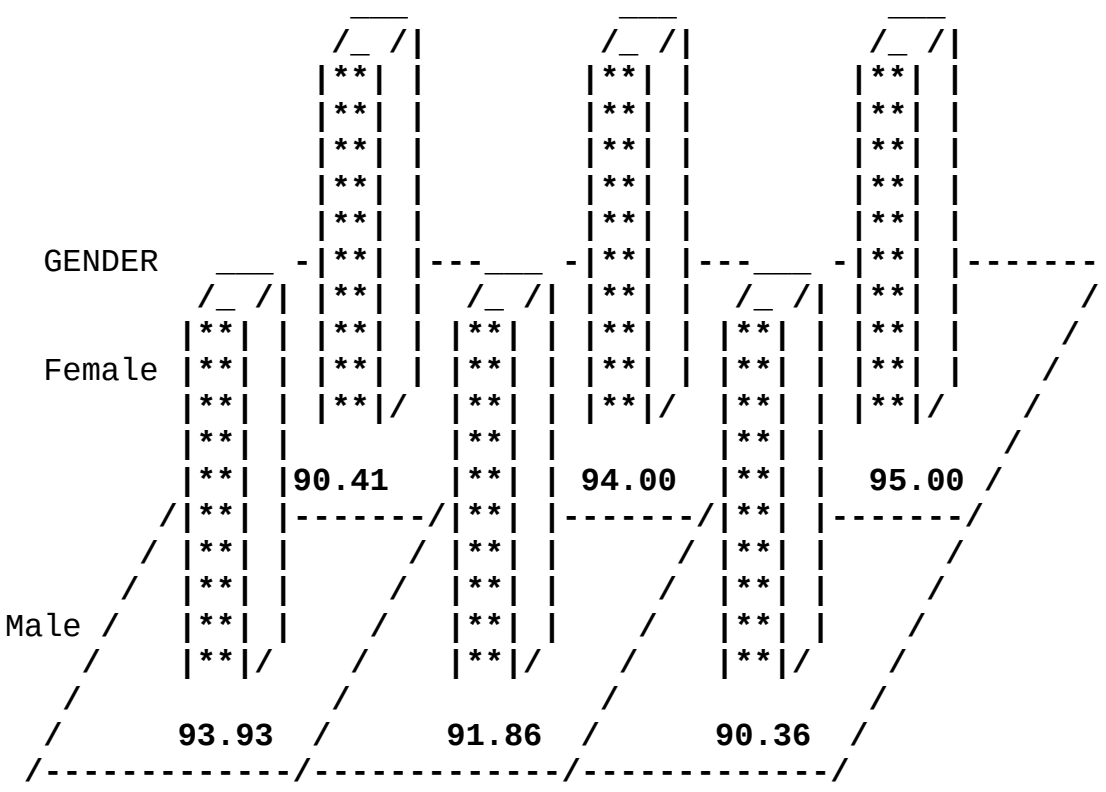
Just look at the computer output – bar chart, we can conclude that no significant differences have been found between male and female with same years of experiences with Videoconferencing Technology in response to Videoconferencing Technology benefits.

4.3 VCT Benefit Mean Comparison among Occupation Categories within Gender (SAS Bar Chart Computer Output):



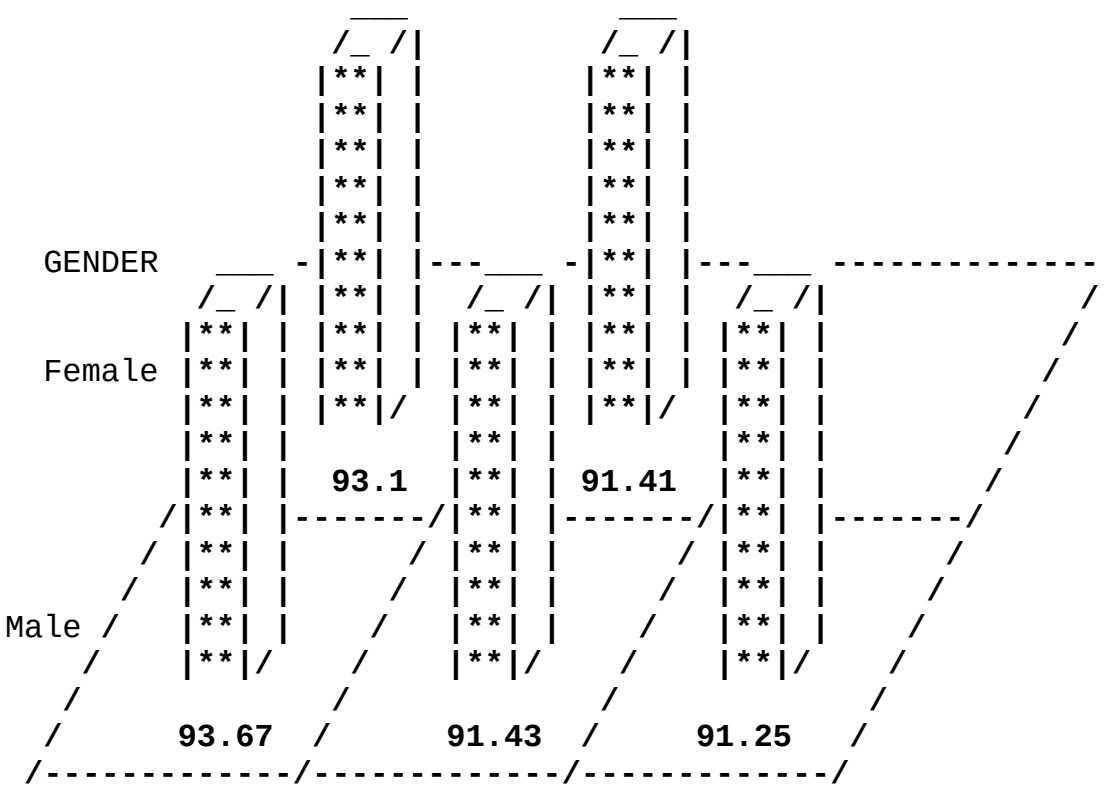
The computer output shows that no significant differences exist among three different groups of occupational people, either in male group or in female group in response to the benefits of Videoconferencing Technology.

4.4 VCT Effectiveness Mean Comparison among Occupation Categories Grouped by Gender (SAS Computer Block Chart Output):



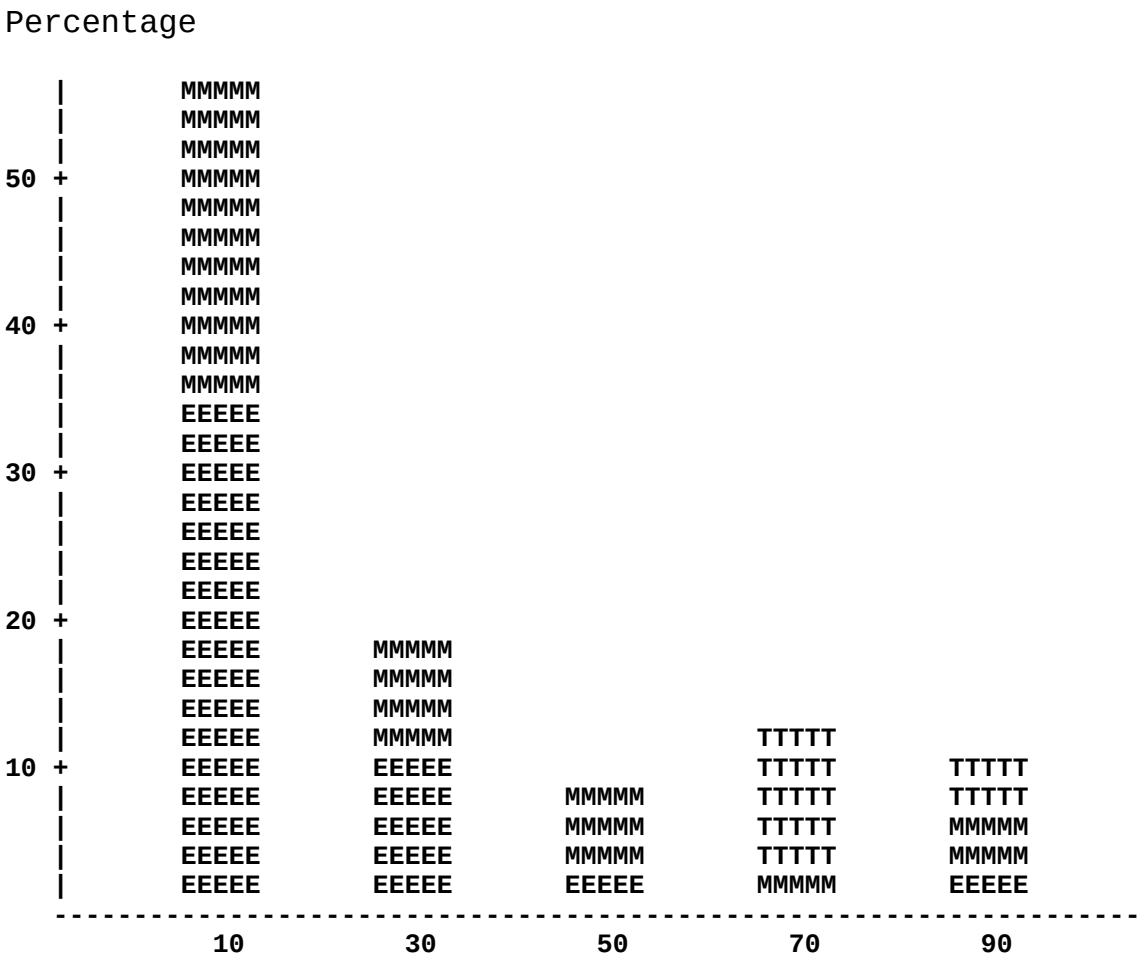
Item 6 and 7 were designed to ask about the effectiveness of Videoconferencing Technology. The above computer output shows that six groups of participants (occupation category grouped by gender) each gave over 90% positive answer to the effectiveness of Videoconferencing Technology.

4.5 VCT Effectiveness Mean Comparison among Years of Experiences Grouped by Gender (SAS Computer Block Chart Output):



Analysis has been done to look at the comparison among three groups of participants with different years of experiences with Videoconferencing Technology, grouped by gender. Again no significant difference has been found among these groups, instead each gave over 90% positive answer to the effectiveness of Videoconferencing Technology.

4.6 Chances to Attend Meetings without VCT (SAS Computer Output Chart):



In the previous chapters, we have known that one of the benefits Videoconferencing Technology offers is that more people can have chances to attend meetings. Item 8 was designed to find out the chances to attend meetings without Videoconferencing Technology. From the above Symbol chart, we can see that most of the participants could not attend meetings without Videoconferencing Technology available.

4.7 Evaluating Costs and Savings

The most widely recognized benefits of videoconferencing are the time and cost savings that result when people in different places no longer have to travel in order to meet together. But for how long can we get the investment back? The following worksheets can help us to estimate the cost of Videoconferencing Technology meetings and travel meetings:

Travelling Meeting Cost Estimation

Salaries	Meeting time and travel time for all participants	$
Benefits	35%-50% of salary.(Check With personnel department	$
Per Diem		$
Travel Cost	Mileage	$
	Tolls	$
	Parking	$
	Airfare	$
	Rental cars/taxi	$
	Food	$
	Lodging	$
Room charge	Cost of hotel meeting Room (if applicable)	$
Total		$

VCT Meeting Cost Estimation

Salaries	Meeting time for all Participants, plus travel Time to VCT meeting sites If other than the office	$
Benefits, Taxes	Use the same percentage as for travel meeting	$
Per Diem		$
Travel Costs (to VCT Sites, If other Than office	Mileage Tolls Parking Airfare Rental cars/taxi Food Lodging	$ $ $ $ $ $ $
Network Access	Cost to hook up to your carrier	$
Network Usage	Long distance phone charges Usage fee for public Switched network	$ $
Room Charge	Total cost per hour for any public rooms,times Length of meeting	$
Total Cost		$

4.8 Actual Meetings Costs Comparison

May 25,1998. Pima Community College, Room 109
Technology Equipment Purchasing Conference
35 participants from different companies and organizations in Tucson area
Time: 9:00am – 12:00pm (3 hours)
Network: ISDN (128kbps)
Equipment: PictureTel's venue 2000, model 30, one 32" color monitor
Each participant paid $13.00 for attending the meeting (35 * 13 = 455).
Videoconferencing Technology Meeting (point-to-multipoint) originated from Chicago.
Wages/per hour = $25
Meeting time cost: 3 hours * 35 * 25 = $2625
Travel time cost: maximum 2 hours * 35 * 25 = $1750
Benefits, taxes = 40% of Salary = 0.40 * $4375 = $1750
Travel cost to the site:0.31 * 100 miles = 31 *35 = $1085
Room rent charge = $150
Local phone charge = none
Long distance charge = $0.60/per minute/per channel * 2 * 180 = $216
MCU charge = $55/per hour /per site * 3 = $165
Total = 2625 + 1750 + 1750 +1085 + 150 +216 + 165 = $7741

If every participant went to Chicago to have this 3-hour meeting just for one day, no overnight scheduled:
Wages/per hour = $25
Meeting time cost: 3 hours * 35 * 25 = $2625
Travel time cost: 8 hours * 35 * 25 = $7000
Benefits, taxes = 40% of salary = 0.40 * $9625 = $3850
Travel cost = airfare($300 * 35) + car rental or taxi ($50 * 35) + Food ($20 * 35) + Parking ($10 * 35) + mileage($0.31 * 200miles * 35) + others($20 * 35) = $10500 + $1750 + $700 + $350 + $2170 + $700 = $16170
Total =$2625 + $7000 + $3850 + $16170 = $29645
Savings/meeting = $29645-$7741 = $21,904
This organization has 8 meetings every year. With Videoconferencing Technology just **savings come to $21904 * 8 = $175,232**

June 11, 1998, University of Arizona, Speech and Hearing Building, Room 201
Arizona Information Technology Conference
10 participants in Tucson and 15 in Phoenix attended this Videoconferencing Technology conference to discuss the future of Information Technology in Arizona State.
Time: 1:00pm – 3:00pm (2 hours0
Network: ISDN (128kbps)
Equipment: CLI's Old model with computer processor and software driven, one monitor

Videoconferencing Technology Meeting: Point-to-point (originated from Phoenix, but discussion in nature, two way video and two way audio
Wages/per hour = $25
Meeting time cost = 2 hours * $25 * 10 = $500
Travel time cost = 1 hour * $25 * 10 = $250
Benefits, taxes = 0.4 * $750 = $300
Travel cost to Videoconferencing Technology site = mileage (0.31 * 80 * 10) + parking ($3 * 10) = $240 + $30 = $270
Network usage cost: none
Room charge: $100
Total = $500 + $250 + $300 + $270 + $100 = $1420

If these 10 people went to Phoenix to have this 2 hours meeting (assuming everyone would have time to attend):

Wages/per hour = $25
Meeting time cost: 2 hours * $25 * 10 = $500
Travel time cost: 6 hours * $25 * 10 = $1500
Benefits, taxes = 0.4 * $1250 = $500
Travel cost = mileage (0.31 * 300 * 10) + parking ($5 * 10) + food ($15 * 10) + other ($10 * 10) = $930
Total cost = 500 + 1500 + 500 + 930 = $3430
Savings/meeting = $3430-$1420 = $2,010.00
12 meetings a year will **save $2010 * 12 = $24,120.00**

4.9 Analysis Summary

As it is believed that one of the most recognized benefits of Videoconferencing Technology is the time and cost-savings that result when people in different places no longer have to travel in order to meet together. But the strategic advantages of videoconferencing go far beyond travel-related dollars. One important thing must be pointed out here is that time and productivity benefits are of greater long-term benefits than the money saved from reduced travel. Six strategic advantages can be gained:

1. The typical overnight business trip costs more than travelling, room and board; there is also the hidden cost of lost productive time. In spite of notebook computers and in-flight phones, the value of useful time lost during travel can still be more than twice the cost of the trip. Add to this the wear and tear of traveling early in the morning or after a full day at the office, being away from home, jet lag, fatigue and stress of too many trips to too many places in too short a time. Given the travel schedules of many of today's managers and executives, it is a wonder we are in any shape to work at all. Videoconferencing Technology will not keep you off the road completely, but it will result in less time spent traveling and more productive time in your office.

2. Through videoconferencing, people in separate locations feel more like part of a team. Senior executives can make more frequent appearances to remote constituents, and people at all levels of the organization can contribute to meetings they otherwise might not attend.
3. Videoconferencing Technology offers many opportunities for more productive relationships with customers and suppliers.
4. Videoconferencing Technology can help you get the information you need from key experts or stakeholders, so you can make more timely, better-informed decisions.
5. Through Videoconferencing Technology, collaboration on multilocation projects becomes easier and ideas are shared more freely. The number of delays caused by poor communication can often be significantly reduced.
6. Videoconferencing Technology is a tool for competitive success in virtually any area of your organization because it enables you to do more with fewer resources in less time.

5. Interview Data Category System

The researcher interviewed total 15 technicians and site managers during the past two months, also nearly 40 Videoconferencing Technology meeting participants. To categorize these interviews, the researcher has found the following main points:

5.1 Overall Opinion about Videoconferencing Technology

All the interviewed technicians or managers are satisfied with this technology. No one complains, even those who have older models and have voice and image distractions are happy because the benefits are more than expected. Specifically, to cite some original comments:

Luis Newell, (IBM): *"The benefits are tremendous, I have been with this technology for over 10 years, I never heard any one complain about this technology. All are positive. To name a few: 1) Travelling to meetings costs a fortune and put the work behind, 2) Most people should attend these meetings, but they could not, now any one can, what is more, some just need to attend part of the meeting, they can work up until the time they just walk in. It is tremendous…." … " If you are familiar with the speaker, then it is almost the same as face-to-face".*

Phil (Management Recruiter Sedona): *"I do not think any one can evaluate this technology in dollars. It is not just how much money or time is saved, a lot of factors people ignored, like travel stress, depression, energy and unpredicted accidents, etc. Now, going to a meeting is just like being at home. I heard some one say every time he was told to go to a meeting, he would be nervous. This kind of benefit can not be evaluated. I think this technology is awesome…."*

Paul Sokpa (Health Parterner): *"I think this technology will eventually replace most meetings, it so convenient. We use Videoconferencing Technology at least 6 hours a day, mostly to have meetings with people in Phoenix, point to point, by different departments. Just from this, imagine that all the meetings held face-to-face, either people travelling from Phoenix to Tucson or from Tucson to Phoenix. You can calculate the costs, it is huge. Besides, Videoconferencing Technology is not only for meetings, but for employee training too…"*

5.2 Important Feature in Videoconferencing Technology

Networks are more important than hardware.

Jerry Freund (TMC): "*Remember, John, a lot of people think hardware is most important, it is not, in fact, networks are very important. We have a few problems, all came from networks. Of course there were also a couple of times the hardware went wrong, but usually something that could be fixed in a matter of minutes. But when networks went wrong, it is not even hours, but maybe days to fix. One time, the USWest ISDN failed. You can do nothing about it…"*

Mark Handy (NAU) *" My experience is that networks are more important. I do not have problems with hardware so far... You have to know how much data you will transfer, and what speed you need, not just now, in the next few years…."*

5.3 Future Videoconferencing Technology

Jerry Freund (TMC): "*If I am the one to buy Videoconferencing Technology, I will consider, first, the products must be upgradeable, we have one that is not upgradeable, we have to throw it away to change to a new one. It is a loss. Second, look at your company in the next 5 years how much data will be dealt with, do not just look at this year or next year…."*

Jack Parrise (KUAT): "*You can never catch the development of the technology, but have a very good look at this technology and your company, get as good products as possible, of course, the money you have now is important. Also talking about the money, you have to educate those upper level people, because some people control the money, but they do not know the value. I am one of the leaders here, so usually it is easy to get the money to update our equipment…"*

Paul Sokpa (Health Parterner): "*If you taste the technology, I think every one will like it, you just look at ours, now almost every one cannot stay away from this, it is so convenient. At first I was the one to push this technology, now every one benefits, of course mainly the company benefits. Recently our boss in Phoenix called me -- " I want to buy more, we just bought four sets of PictureTel's SwiftSite. By this time you do not have to apply for the budget…"*

5.4 Survey of Other State Transportation Departments

A mail survey was conducted by ADOT research center, to gather information from Departments of Transportation in other states. The survey had 7 questions. Here is the summary of the survey:

1. Have you had any experience with videoconferencing? # valid answers: 27
   78% Yes (proceed to question #2)
   22% No (skip to question #6)

2. If you have had experience with videoconferencing, how would you rate the ability to see, hear, understand and communication with persons on the other end of the video connection? # Valid answers: 21

Excellent	9	43%
Good	10	48%
Fair	2	9%
poor	0	
impossible	0	

3. If you have had experience with videoconferencing, how would you rate the comparability with meeting in-person? # Valid answers: 19

____much better	0	
____better	1	5%
____about the same	11	58%
____worse	7	37%
____much worse	0	

4. If you have had experience with videoconferencing, how would you rate the trade-off of reduced travel time and cost vs. the videoconferencing experience? Valid answers: 20

_____a worthwhile trade-off	20	100%
____ not a worthwhile trade-off	0	

5. Does your organization already own videoconferencing equipment? Valid answers: 22

____Yes	11	50%
____No	11	50%

6. If your organization does not (or did not) already own videoconferencing equipment and you had to make the decision on whether to invest in videoconferencing would you…(Valid answers: 21)

definitely pursue full, organization-wide implementation of video technology	6	29%
definitely pursue a more limited implementation to test video technology	6	29%
maybe pursue a limited implementation to test video technology	7	33%
probably not pursue implementation to test video technology	2	9%
definitely not pursue implementation of video technology		

7. Would you provide a brief reason for the answer you gave in question #6
The last open-ended question brings a lot of information. Overall experience has been good. To cite a few:

Those having Videoconferencing Technology:

Dohn S. Beard (Illinois): "*Our overall experience with videoconferencing has been good. It allows us to hold prompt meetings to discuss issues that may need immediate attention as well as providing us with the opportunity to schedule contract negotiations, civil rights hearings, etc. without requiring the participants to travel."*

Joe T. Baker (Louisiana): "*We have made a decision to build an Education and Training Facility on the LSU campus with videoconferencing capabilities. This will substantially reduce travel costs for students from our 9 DOTD districts, and additionally increase the scope of training we can make available. We would both broadcast and downlink from this facility, however, specific equipment/technologies have not been selected at this time."*

Scott Bennett (Arkansas): " *.. and that travel time and cost are actually reduced."*

Those that do not have Videoconferencing Technology:

Travis Dubois (Maine): “No real need at this time, state is small…”

Dave Snider (Missouri): “We have had a 3 months trial … Our experience was excellent… We are in the process of completing and installing this equipment in all 10 district offices.”

6. Buyer's Guide

This chapter tries to offer some suggestions to those would-be Videoconferencing Technology users – like ADOT. Since Videoconferencing Technology is still evolving, the following description is just based on today's market and on those general standards set by the ITU (International Teleconference Union).

6.1 Types of Videoconferencing Technology

Before you decide to purchase any Videoconferencing Technology equipment, you must first of all have in mind what types of videoconferences you will have in the next 5 years:

- *Multipoint-to-Multipoint*: Both audio and video transmissions are two-way among multiple sites, although you can hear and see only one other site at a time.

- *Point-to-Multipoint:* Video is one-way: it originates at one site and is received at multiple sites. Audio is two-way: all sites can hear each other.

- *Point-to-Point:* Some systems can hook up with only one other site at a time. Video for this type of system may be one-way. However, if you use a system with multipoint capability for a two-site meeting, that conference also is called point-to-point and both audio and video will be two-way.

6.2 Videoconferencing Technology Networks

The second thing you have to consider before you decide to buy Videoconferencing Technology equipment is the network, not only the availability, but what kind of networks are available and the bandwidth.

Wide Area Networks

Traditional videoconferencing takes place over wide-area networks (WANs) provided by long-distance carriers such as AT&T, MCI and U.S. Sprint. If one person is on the Sprint WAN, but the other is with AT&T, their conference may have to be scheduled several days in advance while one network makes arrangements to connect the system to the other network and equipment.

Fortunately, switched access digital networks are becoming the norm. With switched access, you can connect to any WAN as easily as making a long-distance telephone call, regardless of carrier. The most widely used types of switched access are switched 56 and ISDN.

Bandwidth, measured in bits per second, determines how much information can flow between sites. Wider bandwidths provide clearer pictures and smoother on-screen motion. Most WAN videoconferencing systems combine two 56k or 64k channels for 112k or 128k bandwidths, which is not wide enough to meet today's multimedia conferences based on the investigation done in this study.

Desktop Networks

A desktop system may operate within a local network (LAN) of linked computers within your department or organization and/or be connected to a WAN. For example, you might work on a spreadsheet with someone in Marketing via the LAN within your Phoenix office. Then, you and this other person might join a videoconference with others in another city from your desks, via a WAN link. Computer-based videoconferencing technology is evolving rapidly. Asynchronous Transfer Mode (ATM) is a new type of network capable of carrying voice, video and computer data. It promises to improve the quality and flexibility of desktop videoconferencing connections. Use the following to check which vendor provides what kind of desktop system:

The desktop system can connect to:

Other computers throughout the organization
Other computers in the same department
The conference room system
A WAN

6.3 Videoconferencing Technology Standards

The standards for videoconferencing systems are still evolving, but the standards that do exist are good enough to allow for a reasonable level of interoperability. The key standard is the International Telecommunication Union's (ITU) H.320 specification. H.320 is really a suite of standards that allows ISDN-based videoconferencing systems to inter-operate—and it's somewhat of a moving target. For example, while vendors only need to comply with the existing H.261 compression standard to be considered H.320 compliant, the emerging H.263 standard, which is optional, improves significantly upon H.261.

The H.320 specification also provides for varying pixel resolution at a given bandwidth. Full Common Intermediate Format (FCIF) provides a resolution of 352 x 288 pixels while Quarter Common Intermediate Format (QCIF) provides a resolution of 176 x 144 pixels. Two other key ITU standards, G.722 and G.728, govern audio quality. G.722 specifies the use of 64 KBPS of bandwidth to provide an audio range of 50 Hz to 7 kHz. G.728 compromises audio quality 50 Hz to 3.4 kHz a bit by using only 16 KBPS of bandwidth.

While H.320, G.722 and G.728 are well established, the emerging T.120 standards, which facilitate the exchange of data over a videoconference link, have generated considerable interest recently. Once systems conform to T.120, we will be able to perform such functions as exchange

of graphics images, real-time on-screen annotation, file transfer, application sharing and in-band faxing. While many of these features are available from vendors today, the implementations are proprietary. Like H.320, T.120 is a suite of standards.

More information about the standards for Videoconferencing Technology is available in Appendix F. This point just reminds you to look at the compliant standards first before you talk to a certain vendor about the specific features. If the system or equipment does not comply with standards, you may experience compatibility problems either within your system and peripherals or in your connections to systems at other sites.

6.4 Specific Features Check List

6.4.1 Codec

At the heart of any modern videoconferencing system is a device called a codec. As its name implies, the codec is responsible for the encoding, decoding, compression and decompression of audio and video signals. All other things being equal (for example, the quality of the cameras), the better the codec implementation, the better your audio and video signal will be when a given amount of network bandwidth is available. The codec functions can be implemented in software--using general-purpose CPUs, in hardware using digital signal processors (DSPs), or some combination of the two. Different unit has different numbers of processors of different sizes, which determine the speed of data processing and display different audio and video quality.

The major determining factor for a system's price is the sophistication of the codec design. Use the following to check this device:

1) What make and model codec does the vendor provide?
2) Does the codec use CPU, DSP or both?
3) How many processors does it have?
4) What is the model or speed of the processors?

Price range with different kinds of codec: _____

6.4.2 Cameras

Camera capability and placement determine what video images you can transmit to other sites.

A room system usually has one camera in a fixed position to capture a group shot, while others pan, tilt or zoom for details. **An auxiliary camera** in the rear of the room can focus on a white board or flip chart. Room systems often use **presets**, programmable camera positions that you store and select with the touch of a button. **Voice-activated cameras** are linked to microphones to focus automatically on whoever is speaking. Room systems also have a **document camera** positioned over the table to transmit video images of documents or objects.

Desktop system cameras are mounted on the monitor or on the desk. They are designed to frame one or two people and may have a limited range of focus. Since documents and graphics are transmitted directly from the computer, there is no need for a document camera with a desktop system. Use the following to make your decision:

What kind of camera(s) do you need?

___Room,
___ Auxiliary,
___ Voice-activated,
___ Document

Can the vendor provide what you need?

Price range with different kinds of camera (s): _____

How many presets can you program?

How large a page can the document camera accommodate?

What other imaging capabilities do you need?

___ Touch-sensitive screen: draw directly on the screen with your finger
___ Freeze-frame: capture video frames as:
___ Bit-mapped graphics
___Slides
___Retrieve & display presentation files & bit-mapped graphics
___People at different sites can manipulate graphics.

6.4.3 Audio Systems

While the immediate appeal of videoconferencing is the addition of a video image to voice communication, audio quality is more important than image quality. It is better to lose video and still have clear sound than to lose audio and have to complete your meeting with hand-scribbled notes shoved under the document camera!

If you are using a desktop system in an open-office environment, a headphone or headset rather than desktop microphone or speakerphone will help screen out ambient noise. Use the following to check off the types of microphones that the vendor provides with the system:

Room System

- Ceiling microphone
- Table microphone
- Lapel microphone (wired) or wireless

Desktop System

- Microphone built into the system
- Table microphone
- Speakerphone
- Headset
- Regular telephone connection
- Other microphone

Price range with different kinds of microphone: _____

6.4.4 Monitors

Room systems usually use a live monitor to display the image coming in from other sites, and a preview monitor to display the outgoing video. The preview monitor can be used to check an image or graphic before transmitting to other sites. Sometimes a separated graphics monitor is part of the system.

Portable systems have one or two monitors. With single-monitor systems, the preview image appears as a small window in the corner of the incoming line image, which uses the full height and width of the screen.

Desktop systems use the computer monitor. Two or more windows display different kinds of information, such as a system document and image transmitted from the camera at the other end. Use the following to select the right equipment:

- How many monitors are provided with the system?
- What size monitor do you need?

`Price range with different monitors: _____

6.4.5 Peripherals

A wide range of peripheral equipment can be connected to videoconferencing systems to expand imaging and other capabilities. Check off the peripheral equipment that is incorporated in the videoconferencing system provided by a certain vendor:

- Personal computer linked to room or portable system
- High-resolution graphics camera: when you need more detailed than the document camera provides
- Flatbed scanner (color or monochrome): send the image of a hard copy original at higher resolution than with the document camera
- Fax machine: send a hard copy image to remote sites during your meeting
- Laser printer: produce hard copy of images received through the system
- Electronic whiteboard
- Audio recorder
- Video recorder and player (with different features)

Price range with different peripherals: _____

6.4.6 Inverse Multiplexer

An inverse multiplexer combines several phone channels for greater bandwidth, which means greater capacity and higher resolution audio and video quality. Your receiving sites must also have inverse multiplexers with matching capabilities. During this study, since 112 KBPS (two switched 56) or 128 KBPS (one ISDN line, with two 64 KBPS channels) cannot support full motion video, we need higher bandwidth. Inverse multiplexers can help us combine more channels. Check whether the equipment provides inverse multiplexer with the system.

- Does the equipment come with an Inverse Multiplexer built in?
- If yes, how many channels can it combine?
- If no, how much does an external one cost?
- For how much total bandwidth?

Price range with different kinds of inverse multiplexer: _____

6.4.7 System Control Unit

The control unit is the all-important keypad that puts you in the pilot's seat. It enables you to:

- Dial up your remote sites
- Select and control cameras
- Select incoming video from among remote sites
- Control who has got the microphone
- Adjust audio volume
- Switch to peripherals such as fax machine, VCR, etc.

Check:

- Does the system have a Control Unit?
- How many functions does it have?

Price range with a certain kind of control unit: _____

6.4.8 Bridge/MCU

The multipoint control unit (MCU) usually referred to as the bridge, enables you to connect to more than one other site at a time. The bridge for your system may be on-site, or it may be located at your long-distance carrier.

Some bridges allow you to add one or more audio-only participants via a regular phone call. They won't receive or transmit any video images, but the rest of you will be able to hear them, and they will be able to hear you.

In 5 to 10 years, an MUC may be added to save more money, so from the beginning you have to take this into consideration when you decide to buy any Videoconferencing Technology equipment so that by the time you want to add a MCU your equipment is still compatible. Use the following to check off MCU:

- Does the MCU have the same brand name as the other equipment?
- Does the vendor provide MCU rental service?
- How many remote sites can you link up at one time?
- What connecting arrangements does the bridge support?
- Meet-me: other sites call me
- Dial-out: your bridge calls other sites
- Hybrid: meet-me and dial-out combines
- Can frequently connected sites be speed-dialed?
- Can you add or drop a site after the conference has begun/
- Can you add voice-only participants?
- Which switching modes do you have?
- Director control: one person with a control unit controls the switching.
- Voice-activation; the audio signal activates the video signal switch. In other words, whoever's speaking is seen on screen at the receive sites. (The send site continues to see their most recent received image.)
- Rotation; the video image cycles through the sites displaying each one in turn.
- Self-selection: someone wishing to become the send site pushes a button to signal the MCU to switch the video source to his/her location.

Price range of different service of MCU: _____
Price range of different MCU: _____

6.5 Recommendation

6.5.1 Vendor Interviewing Guide

1) Would you please tell me why your company is better than others as a Videoconferencing Technology vendor?
2) Which product do you recommend to us since you represent more than one manufacturer?
3) Would you please enumerate the advantages and disadvantages?

6.5.2 Vendors' Responses to Interviews

USWC:

Person Listed: Bill Meador
Tel: 602 – 604-4642
Person interviewed: Mike Jones
Tel: 602 – 604 – 4696
Knowledge Rank: #4 = a little knowledge about VCT equipment

1) Unique Service: Full service package, both network and equipment
2) No recommendation is given, between VTel and PictureTel products.
3) None

AVR:

Person Listed: Jim Klein

Tel: 602 – 277 – 4723

Person Interviewed: Jill

Tel: 602 – 277 – 4723

Knowledge Rank: #3 = knowledgeable about VCT equipment

1) Unique Service: Rental Service is provided.
   - $225/per day with codec speed of 128kbps, $75/per hour with a technician
   - $199/per month (lease at least 48 moths) with codec speed of 128kbps, one 27" monitor
   - $299/per month (lease at least 48 months) with codec speed of up to 512kbps, one 27" monitor

2) Recommend "3m" and "PictureTel"

   Advantages of "3m"
   - Less cost
   - Meets ITU standards

   Disadvantage of "3m"
   - Small market share
   - Unpredictable future

   Advantages of "PictureTel"
   - Higher standard and quality
   - Good future support
   - Large market share

   Disadvantage of "PictureTel"
   - More expensive

EIS:

Person listed: Ginger Mattox

Tel: 602 – 303 – 0885

Person Interviewed: J. Clay Boothe

Tel: 602 – 303 – 0889

Knowledge Rank: #2 = more knowledgeable about VCT equipment.

1) 40 years of service experiences
2) Recommend 'PictureTel'

   Advantages of 'PictureTel'
   - Cutting Edge of VCT
   - Higher standard, better quality

   Disadvantages of 'PictureTel'
   - Too big company, hard to get hold of
   - More expensive

Multimedia Telsys:

Person Listed: Thomas

Tel: 602 – 894 – 9225

Person Interviewed: Thomas

Tel: 602 – 894 – 9225

Knowledge Rank: #2 = more knowledgeable about VCT equipment.

1) Only company to represent Tandberg
2) Recommend 'Tandberg'

Advantages of 'Tandberg'

- Software driven
- Mpex technology, automatically adjust the channels of both in/out

Disadvantages of 'Tandberg'

- new company, small market share

Norstan Communications:

Person Listed: Mike Jensen

Tel: 602 – 267 – 3297

Person Interviewed: Robb Baillargeon

Tel: 602 – 267 – 3192

Tel: 1-800 – ITS – SREE

Knowledge Rank: #1 = most knowledgeable about VCT equipment

1) Only Norstan has call center set up specifically dedicated to VCT service 24 hours a day
2) Recommend 'VTel'

Advantages of 'VTel'

- PC based, Easy to use
- Codec has more ability, can be used to design presentation package and file sharing easily through codec (PictureTel needs extra hardware to do this)
- LAN and WAN connection is easier by just adding a card
- Longest history in VCT (CLI and VTel together)
- Upgradeable through software, save money in the future
- Inverse Multiplexer is built in with flexibility to remove if necessary.

Disadvantages of 'VTel'

- PC based, need a little more knowledge to operate

6.5.3 Points of Investigation During Study

6.5.3.1 PictureTel Venue 2000 Model 50 and up

Advantages:

- Top quality sound
- Largest manufacturer of videoconferencing equipment so far
- Largest market share so far
- Reliable
- Have been in the business the longer than any of the other companies

Disadvantages:

- Application sharing (file creating and sharing) requires a separate PC
- Most expensive videoconferencing equipment reviewed
- May be hard to trouble shoot
- Rapid evolving of PC based videoconferencing will challenge PictureTel if they do not change now.
- Upgrading is a little harder

6.5.3.2 Vtel TC 2000 and up

Advantages:

- PC based – already capable of doing application sharing
- Integrated product – components act as one piece of equipment
- Very friendly user interface
- Sending and receiving files by just “drag and drop” with the “mouse”
- Easy to do presentations
- Has the greatest potential for the future, especially for training applications
- Have been in the business longest
- Since it is PC based already, the future is the best
- Easily upgradeable

Disadvantages:

- Need to have a working knowledge of Windows 95
- The knowledge level of a person operating this equipment must be slightly higher than with other vendors’ equipment
- Additional training may be needed for videoconferencing site coordinators to ensure PC back-up/recovery and other housekeeping is done properly

6.5.3.3 ISDN Rates:

1) Ameritech Team Data
   Tel: 1 – 800 – 832 – 6328
   Charge: Install $156.50 monthly $83.37
   (Local usage charge is negotiable.)
2) Bell South
   Tel: 1 – 800 – 858 –9413
   Charges: Install $58.00 monthly $93.60
   (Local usage charge is negotiable.)
3) Southwestern Bell
   Tel: 1 – 713 – 567 – 4246
   Charges: Install $78.60 monthly $57.96 (2-year contract)
4) US West
   Tel: 1 – 800 – 898 – 9675
   Charges: Install $140.00 monthly $75.00
   (None for up to certain hours per month, 3 cents per minute thereafter per channel)
5) Pacific Bell
   Tel: 1 – 800 – 472 – 4736
   Charges: Install $159.75 (waived with 2 year contract) monthly $24.50
   Usage charges: 3.33 cents for first minute and 1.05 cents for each additional minute per channel

6.5.4 Recommendation

Investigation shows that ISDN lines are only available in Phoenix, Tucson and Flagstaff. Due to the limited budget of this project, three advanced-room systems and some desktop sites in these three areas are strongly recommended for the coming year pilot test, which is adequate for evaluation purposes. (To bring T1 or Switched 56 into the networks requires extra components, which cost extra money).

US West is recommended to install the ISDN lines connections for their lower price:

$140.00 to install one ISDN line
$75.00 monthly to cover 200 hours per month usage for one line
$0.03 per minute per channel there after

Norstan communication is recommended as a vendor for:

- Unique services provided
- Strong technical team locally available
- Has its own MCU service provided
- Representing Vtel product

Vtel product is recommended over PictureTel:

- PC – based videoconferencing will eventually take the lead
- Greatest advantage of file creation and file sharing
- Friendly user interface
- Integrated product – components act as one piece of equipment
- Easy to do presentation
- Has the greatest potential for training

7. Literature Review

7.1 Literature Review Objectives

The objectives of this investigation were to determine, to the extent possible, the present state of the people's thoughts regarding the questions of what has happened and what will happen to videoconferencing technology, the costs and benefits.

The researcher's objective at this stage is to assist ADOT decision-makers contemplating use of this technology. This is not meant to be a detailed technical review of hardware, software, and protocols (though these subjects are considered where it is believed they will add value.) Rather, the researcher approached this from a social theoretical perspective; a review at a higher level of abstraction to inform the judgement as to the direction of development and deployment of videoconferencing technology in the near future. Simply put, what appears to work, what doesn't, and what might work when the technology catches up.

From the research point of view, these thoughts and reactions to the technology from people are the main data source, the researcher does not think that simply quantitative methods, the numbers, can fully account for values and benefits experienced by Videoconferencing Technology users. The literature review just gives us a quick look at what happened before in this field.

7.2 Literature Review Process

The approach has been to bound an extremely large area of inquiry by judicious trimming of possible sources and then to be as thorough as possible in combing those sources for relevant research. As a first cut towards extracting relevant research a list of leading journals was compiled. Brainstorming sessions as well as analysis of the sources cited by the original sources expanded the list. Additionally, a variety of electronic sources (web pages) were identified and used both as source material themselves and as pointers to printed materials. The ADOT librarian, Mary Silva, provided a list of useful information. From these sources, the researcher established a list of target journals. Extensive use was also made of the various bibliographic databases at the University of Arizona to conduct keyword, author, and subject searches in appropriate Boolean combinations.

7.2.1 Source Listings

The relevant databases (based on their potential referencing of the target journals and/or presumed content) were:

Expanded Academic Index-multi-disciplinary
Expanded Academic Index-ASAP-multi-disciplinary, fulltext
Current Contents
Eric Database-education (education technology)

PsycINFO Database-psychology
INSPEC Database-physics, electronics, computers
ABI inform (Ovid)-business 1995, 1996
WWW via Alta Vista search engine

The following journals were also surveyed:
Administrative Science Quarterly
Behavior and Information Technology
Communications of the ACM
Human communication research
Human Communications Research
Human Computer Interaction
Information Systems Research
Journal of Communications
Journal of Decision Sciences
Journal of Decision Support Systems
Journal of Information Systems
Journal of Information System Management
Journal of Management
Journal of Management Information Systems
Journal of Management Science
Journal of Nonverbal Behavior (communications)
Journal of Organization and Administrative Sciences
Journal of Organizational behavior and Human Decision Processes
Journal of Organizational Dynamics
Journal of Organizational Science
Journal of Small Group Research
MIS Quarterly

7.3 Results of Literature Review

The last 15 years of research on videoconferencing, across a variety of disciplines and research settings, found that most of these studies were cross-sectional, with insight drawn from "one time" experiences. A few studies investigated the effects over time. Nearly all studies compare face-to-face with Videoconferencing Technology, which limits our ability to say whether "video + audio + data" is substantially better than just "audio + data". Clearly, current technology can not approximate face-to-face interaction -- at the very least the narrow scope of a camera lens limits the ability of remote participants to "take in" the entire meeting environment and all the participants. So studies that compare face-to-face with Videoconferencing Technology help only marginally.

The overall conclusion is one of dissonance. On the one hand, the research shows a limited value of a video channel to most kinds of interaction given the availability of other

media, such as audio. Over a broad set of measures, distributed groups interacting with video behave and perform similarly to groups with only audio. On the other hand, the market for videoconferencing was $1.1 billion in 1995, $1.6 billion in 1996, $2.3 billion in 1997, with expected compound growth rates of nearly 50% (data from the Gartner Group, cited in Compression Labs, Inc.)

If, as previous research suggests, video has little value regarding behavior and performance, why is the market so big and growing so fast?

We can not completely address that question here, but we can draw some tentative conclusions about this paradox and most particularly about some "best bets" on when to use video.

The following review does not address the appropriateness of distributed work; but given that distributed work must occur, where does the addition of video (over data and audio conferencing) make a difference?

Information below summarizes the results the researcher got from the research literature. There are no hard and fast rules that can be suggested. However, these dimensions have some empirical support. The good news is that while video seems to have little impact on many behaviors, little research suggests that it actually hurts. Obviously, if the technology doesn't work, or if voice switching annoys people it may have negative impacts, but the marginal detriment to a distributed meeting, where groups must use some form of technology mediation, is probably not substantial.

7.3.1 Behavior and Performance Differences

Information below, summarizes the probable impacts of video on behavior and performance.

1. Familiarity. When group members are unfamiliar with each other, video tends to enable them to become familiar faster. In some groups, participants often find themselves working with people they have never met, or perhaps met only through reputation. In such situations, video may enable such groups to develop cohesion as a team faster. If group members are familiar with each other, the need for video drops and an audio + data mediation appears to be sufficient for both task and social support. Again, as with all these conclusions, we assume that a meeting must take place.

2. Trust. Even if group members are familiar with each other, they may not trust each other across a variety of dimensions. In a system design task, designers and clients may not trust each other's sincerity, competence, reliability or confidentiality. Evidence suggests that communication partners can detect deception and other personality traits germane to trust by attending to nonverbal cues provided, somewhat, through video. If group members trust each other, then an audio mediation appears to be sufficient for detecting nuances in conversation (i.e. shifts in trust as a discussion unfolds).

3. Task Traits. Much of the video research (as well as small group communication research, in general) has studied the effects media have on different kinds of tasks. Classifying a task is difficult work for many reasons, not the least of which is that they can change dramatically during the course of a meeting. However, past research suggests that video has effects on tasks characterized by opinion sharing and creation, rather than simply fact sharing; by conflict, negotiation and otherwise asymmetrical goals, rather than by cooperation and symmetrical goals; by ill-structured problems requiring exploration of different perspectives, rather than well-structured problems requiring the application of routine procedures; and by the need for visual data, rather than a lack of such a need. Distributed meeting organizers who can predict the general tenor of a meeting along these dimensions can better assess the value of including video in the mediation.

4. Signal Quality. Poor signal quality tends to dampen enthusiasm for videoconferencing by making it harder to conduct the meeting. Poor signal quality can range from low refresh rates (e.g. less than 15 frames per second), to voice switching, to signal lag between video and audio, to narrow band audio. All of these qualities reduce the ability of meeting participants to have smooth discussions. This heightens frustration -- eventually curtailing the discussion. High signal quality, on the other hand, can reduce the communication effort and enable longer, more natural discussions. However, even with relative high quality, some evidence suggests a ceiling effect, a point after which enthusiasm wanes and communication winds down.

5. First Impressions. A fair number of studies suggest that people believe they make better impressions -- both as they perceive others and are perceived by others -- when they can see others through a video medium. However, research results are mixed about the actual accuracy of those impressions. For example, some people can manage -- through charisma or control of nonverbal cues -- the impression others form of them.

6. Local Bandwidth Availability. Real time video communication requires a substantial bandwidth to work effectively. If a distributed meeting has limited bandwidth, then performance of audio media and data applications will suffer when meeting organizers add video to the mix if all three media must share that bandwidth. Several popular desktop Videoconferencing Technology systems work over LANs, which make this concern particularly relevant. Of course, if organizers run video on dedicated media, then this issue becomes number 4 above -- signal quality.

7. Visual Data Format. If visual data such as graphs, documents, drawing, etc. are unavailable in electronic form, and only available in physical (e.g. paper) form, then video becomes very useful through a document camera. However, research seems to strongly indicate that such representation pales in comparison to electronic representation, either through a “Read Only” mode via PC screens or through interactive “Read-Write” modes.

8. Conversation Formality. Studies suggest that people engage in more informal conversations with video connections than with audio only connections. Formal conversations are characterized as having few interruptions, little overlapping speech, long speaker turns, fewer speaker turns,

and formal hand over of speaker turns. Often, formal conversations create a sluggish mood that dampens spontaneity. Spontaneity occurs, apparently, because listeners predict what speakers are about to say, and begin their turn before the speakers are done. Conversational formality typically correlates positively to conversation focus.

9. Conversation Focus. Research has found that people working through an audio only channel tend to focus more narrowly on the task and less on social conversation. Video groups tend to have wider scope in their conversation, touching on more subjects, and affording more conversation to the development and maintenance of relationships among participants. If groups need to build better relationships then these research results suggest video can serve that need better than audio only.

10. Single Leadership. In video mediated conversations, normal leadership patterns emerge, which means one person typically emerges as the single leader. In audio only groups, leadership is often diffused and shifting among group members. The research on the effectiveness of assigned leadership in video or audio only meetings is spare, so any conclusions about that are doubly tentative. But it seems that remote groups can prove problematic for assigned leaders, in that coalitions seem to form at local sites rather than across remote sites. This could mean that single leaders trying to attain some level of cohesion among all participants might face serious limitations. Simply put, the effectiveness of a remote assigned leader may be subverted by the coalition-forming tendency of the people at the remote site. An example of this was somewhat evident in the "kickoff" experiment described in a previous section of this report. Through the reading of the Tucson participants' responses, it appears that they were less impressed with the Director's encouragement and more attentive to their colleagues in Tucson.

11. Group Social Support. Research shows that people conversing over a video channel tend to engage in more relationship building and social conversation than groups in audio only conversations. This point is related to number 4 above. For some tasks, establishing, reaffirming, and growing relationships among distributed participants is paramount, or at least very important. Related to #1 and #2 above, if the group wishes to learn to trust each other, then much the social conversation should be encouraged both procedurally, and technically -- through a video channel.

12. Conversational Difficulty. When a given conversation promises difficulties -- regardless of medium -- it would seem prudent to try video rather than rely on just audio. Conversations can become difficult for a variety of reasons: highly diverse members, confusing agenda, low morale and commitment, etc. While no research directly studies the effect of video in difficult conversations (except related to task type, as discussed above), it seems that difficult conversations need a full range of cues in order to maintain focus and pace. Good facilitation, for instance, requires different cues at different times. To limit those cues by arbitrarily eliminating the video channel -- given the context described in this section -- seems unwise.

13. Technical Delivery. Anecdotal evidence suggests that videoconferencing has not yet reached "plug and play" status, with easy connections across a variety of situations. In fact, complications do arise: cross platform connections fail despite each station supporting the same standard, lines

drop in mid session, poor lighting makes meeting participants look hideous, people need to run around to get at the microphone that has a limited range, camera shots fail to focus on the speaker, etc, these all have little to do with signal quality *per se*, and much to do with the technical infrastructure and meeting choreography. Poor technical delivery can reduce meeting effectiveness by creating delays, bad impressions, unnatural movement, and loss of attention. To the extent that meeting organizers can't plan for and ensure a high quality of technical delivery, video may prove more of a hindrance than support.

14. Emergent Role Differentiation. Some studies show that members of different groups will create their own roles while communicating via audio only. Video groups tend to adopt more prescribed roles. This could have implications on the creativity of the group. If meeting organizers desire novel and innovative approaches and solutions, then audio only may encourage the kind of novel perspective taking required for such innovation. If meeting organizers wish to retain tight control over who deals with what, then perhaps video is a better way to go.

7.3.2 Perceptual Differences

Several studies have found that while visual and audio channels elicit similar behavior and performance among distributed groups, the perceptions of the distributed group members differ significantly between the two conditions. The following results come from self-report questionnaires that participants complete following use of a visual channel, audio channel, or both.

1. Engagement. Distributed groups communicating via video tend to want to engage themselves in conversation more than those communicating via audio only. That is, they feel more part of the conversation and feel like they contribute more to the conversation. While no behavioral or performance differences are typically found, this finding could mean that group members commit to and take ownership of a solution more readily if they have used video, as opposed to audio only.

2. Persuading Others. People feel the video channel enables them to persuade remote conversation partners to their point of view better than people who use audio only. No data exists on the long-term effects of this perceived ability. Short term (e.g. extent to which participants changed their original position) suggest this perception is unjustified across many situations. For example, one study found that people with a strong case that they believed in persuaded others to their point of view better in audio only conditions, but that difference went away when they had a strong case in which they did not believe in. That is, neither audio nor video could hide the lack of commitment in the person's desire to persuade.

3. Resolving Disagreements. Similarly, people feel the video channel enables them to resolve disagreements with remote conversation partners better than audio only. No data exists suggesting that this feeling is justified across all situations.

4. Simulating Face-to-face Environment. Compared to audio only conditions, most people using video say conversations feel more like face-to-face, but they also feel face-to-face is significantly different from video. Research has recently undergone a direction change that de-

emphasizes comparison between face-to-face and distributed environments, and emphasizes the unique quality of distributed work as a valid work environment in its own right. We have used all available research in that vein to develop this report.

5. Face Time. In some organizational cultures, people feel that the access to and amount of time spent in face to face conversation with a supervisor often determines career advancement. In such environments, people will probably prefer video to no meeting at all, but they will likely always prefer physical co-presence.

6 & 7. Satisfaction with the Process and Outcome. Typically, people who use visual channels tend to feel more satisfied with the task process and outcome than people who use audio only channels do. Even though performance and behavior seem unaffected, the beliefs meeting participants form may be sufficient reason for organizers to choose to use video.

8. Peripheral Participation. Some evidence suggests that video encourages more people to monitor a meetings proceedings and then contribute from the periphery of the work. An example for DESCIM groups might be that a remote expert in D.C. is monitoring the proceedings of the Tucson group as he or she works at his or her desk, keeping one ear tuned to the discussion. As a subject or disagreement or point of confusion arises, the expert can then jump in. The point is that peripheral participation by a remote expert means that he or she continues to do other work while halfway listening in via an open link.

7.3.3 Conclusions on the Future of Videoconferencing

Despite the apparent contradictions in the "visual channel vs. audio only channel" research (that is, there are perceptual, but few behavioral and performance differences) we can draw a set of tentative conclusions about the likely directions that future use of videoconferencing will take. Applying this information is not easy. It requires a meeting organizer to carefully balance the often-conflicting requirements described above. Ultimately, at least at the present time, the question of the value of Videoconferencing Technology has two answers, both relying heavily on a subjective judgment about what's important.

If meeting organizers perceive a compelling need to include remote participants in real time, and those people would not otherwise participate, then Videoconferencing Technology is often a viable support technology.

However, if computers and audio conferencing can satisfy those needs, then Videoconferencing Technology is probably less valuable, more complicated and a higher risk at this time.

If remote participants need to be included in real time, and organizers believe that Videoconferencing Technology will serve that purpose best, then technology support staff must ensure seamless, reliable, integrated video/audio/data capabilities. Otherwise the attempt may hinder a project's progress.

8. Conclusions

From the findings of this phase, it can be concluded that, with the continuing improvement of its quality, Videoconferencing Technology is developing and becoming accepted by more and more companies and organizations. Clearly, Videoconferencing Technology offers two major contributions to today's business world: 1) Communications between geographically remote parties and 2) employee training inside companies and organizations. Because of its tremendous savings of time and money, companies and organizations install this technology to enhance effective and efficient use of their time and money. There is little doubt that the use of videoconferencing will increase as the technology improves and bandwidth limitations are overcome.

The most concrete result of this study is from an operational point of view. The researcher has not only successfully tested Videoconferencing Technology capability among several sites, but explored its potentiality and concluded that Videoconferencing Technology would play an important role in the future business of departments of transportation. These tests of Videoconferencing Technology that have been conducted have verified the potential uses and benefits of Videoconferencing Technology for these local agencies. Additional usage for Videoconferencing Technology is sure to develop, as the use of the technology becomes more common place. The participants' responses and other states' survey results attest to the benefits of this technology and to the fact that current and planned uses of this technology are consistent with other recent studies on this topic. There will be a greater use of Videoconferencing Technology that will change how, when, and where meetings are held and employees learn (American society for Training and Development, 1994). It is predicted that in the future more companies and organizations will utilize Videoconferencing Technology and other multimedia technologies and individualized performance support systems to provide flexible training opportunities to workers when desktop systems are improved.

It can also be concluded from the findings that there are differences in the use of this technology among businesses and organizations of various sizes, and these differences are likely to continue in future years. Generally, large organizations will find tremendous savings with Videoconferencing Technology, and will easily find the money to install it. Also those states which are large or widely separated geographically from locations which they frequently do business have a stronger tendency to install Videoconferencing Technology than those which are close to each other.

From the survey responses, it can be concluded that Videoconferencing Technology especially benefits the majority of ordinary people. Those who used to have no or little chance to attend meetings or have no or little chance to have further training can now get most opportunities, which will further improve employee quality and eventually benefit the business and organization.

It was determined by the participants that vendor support is very important in this technology, in other words, establishing a good vendor service relationship and choosing a strong service vendor is as important as buying high quality equipment.

Market research revealed that new products are coming out and the vendors are becoming more supportive. System configurations vary, but tend to be more functional. The researcher concludes that current video quality is poor at ISDN (128kbps) speed, but it is much better if three ISDN lines or equivalent are installed.

It can be concluded that a lack of financial resources is the major barrier to implementing Videoconferencing Technology in training efforts. Lack of compatibility between systems, lack of executive support, lack of technical support and lack of technology skills are also significant barriers. However, from this study, there does not appear to be a lack of employees' interest in using this technology or a general lack of support for training efforts.

Finally, the researcher concludes that too little attention is paid by both vendors and participants to the social impacts of Videoconferencing Technology communication, and that problems with trust building, group cohesion, and message misinterpretation becoming more pronounced with Videoconferencing Technology. Such problems warrant an active role for both technology chauffeurs and group facilitators.

Appendix A:Letter of Consent and Interview Guide

Effectiveness of Videoconferencing Technology Research Informed Consent Statement

You are invited to participate in a research study entitled "Effectiveness of Videoconferencing" Technology (VCT). The purpose of the study is to determine the responses to Videoconferencing Technology used in local companies or organizations with the ultimate aim of reducing costs and enhancing effective and efficient use of staff time.

The primary research method used will be structured interviews with about 50 participants at different levels in the study. Interviews with some participants will be audiotaped and later transcribed to permit more thorough analysis. The audiotapes and transcriptions will be used for research purposes only. Only the researcher or research team members will have access to these materials. If you wish, you may review your own audiotape and transcript. If you withdraw from the study prior to its completion, your audiotape and transcript will be returned to you or destroyed.

The initial interview should take no more than half an hour of your time. It is possible that we will request a follow-up interview at a later time. This will take no more than fifteen minutes.

In addition, we may observe some conference or class sessions and examine existing documents such as conference guides and course evaluation forms.

Your participation in this study will not entail any known risks. The potential benefit is the improvement of conferencing and employee training in the corporation.

Every effort will be made to keep your identity confidential. Your name will not appear in the study report, or in any written materials associated with this study. We will make no written references that could link you to the study (e.g. the name and date of the conference). Data from the study will be physically secured, and made available only to the immediate researcher.

If you have any questions about the study, you may contact the researcher:

Zhang Jian-xiang (John)
1601 E. Broadway
Tucson, AZ 85719
Tel: (520) 792-9117
E-mail: zhangj@u.arizona.edu

Your participation in the study is voluntary. You may decline to participate. If you consent to participate, you may withdraw from the study at any time without penalty. If you withdraw prior to the completion of the study, your data will be returned to you or destroyed.

By signing this form, you indicate your agreement with the following statement:

"I have read and understand the above information. I have received a copy of this form. I agree to participate in this study. If interviewed, I consent to have my interview audiotaped."

Participant's signature_____ Date_____

Investigator's signature_____ Date_____

Interview Guide ------ Technician

Name:
Company:
Address:
Tel:
E-mail:

1. Please tell me something about your videoconferencing equipment:
    a) Brand Name
    b) Unit components
    c) Add-ons
    d) Picture Quality
    e) Network Used / Required
    f) Year Installed
    g) Vendor
    h) Manufacture
    i) Price when you bought
2. Could you give me your overall rate in percentage of the satisfaction with your system?
3. How about the technical support from your vendor?
4. How often do you use your equipment?
5. Could you tell me some specifics of your hardware? Why you chose this one? What is its unique feature?
6. How about your networks?
7. Based on your experience, What is the most important feature in this technology?
8. What system or technical capability would you like to have in the next 3-5 years?
9. Do you feel videoconferencing benefits exceed the costs? Name specific benefits, please.
10. Would you recommend what you have to others? Why?
11. From your experiences, is there any advise you would give to a company or organization who is considering the use of videoconferencing technology? E.g. buy or rent, etc.
12. Please tell me something I did not mention and ask you , but you think they are very important in concerning videoconferencing technology.

Appendix B: Evaluation Tools

Survey Questionnaire

We are investigating the effectiveness of Videoconferencing Technology (Videoconferencing Technology). Please take couple of minutes to fill this questionnaire for us. Thank you for your help. (Please check or circle the letter corresponding to your choice).

Company: _____
Name: _____if you do not mind.
You are ____(male), _____(female).
You are ____(married), _____(single) or ____(other)
Years of your experiences with Videoconferencing Technology: _____.

1. How is your ability to see, hear, ask questions and follow conversations in Videoconferencing Technology compared with face-to-face (FTF) meetings?

a) Much better than FTF
b) Better than FTF
c) About the same as FTF
d) Worse than FTF
e) Much worse than FTF

2. How is your ability to communicate with the remote speaker in Videoconferencing Technology compared with FTF meetings?

a) Much better than FTF
b) Better than FTF
c) About the same as FTF
d) Worse than FTF
e) Much worse than FTF

3. Its comparability in information acquisition with meeting in person is _____.

a) Much better
b) Better
c) About the same
d) Worse
e) Much worse

4. The time and money required with Videoconferencing Technology is ____ without it.

a) A lot more than
b) More than
c) About the same as
d) Less than
e) A lot less than

5. Overall, how useful do you believe the Videoconferencing Technology is?

a) Always useful
b) Sometimes useful
c) Occasionally useful
d) Seldom useful
e) Never useful

6. The percentage of the knowledge you got from the remote speaker is _____%.

7. The percentage of how clear you are about what you are going to do after the meeting is _____%.

8. The percentage of your chances to attend the meeting without Videoconferencing Technology is _____%.

9. How long could you stay comfortable without break?

One hour
Two hours
Three hours
Four hours

10.What makes you more comfortable with Videoconferencing Technology?

a) Having a table
b) Having a chair
c) Having telephone available
d) Having fax available
e) Having one monitor
f) Having two monitors
g) Availability of refreshments
h) Having comfortable temperature

11.Could you list some problems you have experienced as a Videoconferencing Technology meeting participant?

12. Could you tell us your future expectation from Videoconferencing Technology?

Travelling Meeting Cost Estimation

Salaries	Meeting time and travel time for all participants	
Benefits	35%-50% of salary. (Check With personnel department	
Per Diem		
Travel	Mileage Tolls Parking Airfare Rental cars/taxi Food Lodging	
Room Charge	Cost of hotel meeting Room (if applicable)	
Total		

VCT Meeting Cost Estimation

Salaries	meeting time for all Participants, plus travel Time to VCT meeting sites If other than the office	
Benefits	use the same percentage as for travel meeting	
Per Diem		
Travel Costs (to VCT Sites, Other	Mileage Tolls Parking Airfare Rental cars/taxi Food Lodging	
Network Access	Cost to hook up to your carrier	
Network Usage	Long distance phone charges Usage fee for public switched network	
Room Charge	Cost/hour times length of meeting	
Total Cost		

Appendix C: SAS Data Analysis Information

ADOT 'Effectiveness of Videoconferencing' Questionnaire Codebook
Data file name: vct.dat
Date of creation: 07/10/98
Name: Zhang Jian-xiang (John)
E-mail: zhangj@research.u.arizona.edu

Number of records/per case = 1

Variables	Type	Record	Column	Description and code
ID	F	1	1-3	Subject ID
Rec	F	1	5	Record ID
Ocucat	F	1	7	Subject occupation category coded: 1 = ordinary employee 2 = mid-level manager 3 = top-level manager
Date	F	1	9-14	Date of this form filled (mmddyy)
mstatus	F	1	16	Subject marital status coded: 1 = single 2 = married 3 = other(sep/wid/div)
gender	F	1	18	Subject sex coded: 1 = male 2 = female
yexp	F	1	20	Subject years of experiences with VCT,coded: 1 = less than 5 years 2 = 5 and more, but less than 10 years 3 = 10 years and above
resp1-resp5	F	1	22-26	Subject response to item1 to item5 of the questionnaire, compared to face-to-face(FTF) meeting,coded: 5 = much better than FTF

```
                                                    4 = better than FTF
                                                    3 = about the same as FTF
                                                    2 = worse than FTF
                                                    1 = much worse than FTF

resp6-resp7  F       1          28-33    Subject response to item6 and item7
                                           of the questionnaire,(percentage)

resp8        F       1          35-37    Subject response to item8
                                           (percentage)



options nocenter;

/*****************************************************************/
/*                                                               */
/*                Effectiveness of Videoconferencing             */
/*                                                               */
/*                     Project SPR-465                         */
/*                                                               */
/*                Arizona Transportation Department              */
/*                                                               */
/*                   Research         Center                    */
/*                                                               */
/*                John Semmens, John Zhang                       */
/*                                                               */
/*                02/98 ------------ 08/98                      */
/*                                                               */
/*****************************************************************/

title 'A Study on Effectiveness of Videoconferencing';

data report1;

  infile 'vct.dat' missover;
  input id 1 -3 rec 5 ocucat 7 date 9-14 mstatus 16 gender 18 yexp 20
        @22 (resp1-resp5) (1.) @28 (resp6-resp7) (3.) resp8 35-37;

resp = mean(of resp1-resp5);
effect = mean(of resp6-resp7);



label
     ocucat = 'Subject Occupation Category'
     mstatus = 'Subject Marital Status'
     gender = 'Sex of Subject'
     yexp = 'Subject years of experiences with VCT'
     resp = 'VCT Benifit'
     effect = 'VCT Effectiveness';
```

```
proc format;
      value ocufmt  1 = ‘Employee’
                    2 = ‘Mid-manager’
                    3 = ‘Top-manager’;
      value mstatfmt 1 = ‘Single’
                     2 = ‘Married’
                     3 = ‘Other’;
     value genfmt 1 = ‘Male’
                  2 = ‘Female’;
     value yexpfmt 1 = ‘less than 5 yrs’
                   2 = ‘less than 10 yrs’
                   3 = ‘more than 10 yrs’;

proc means;
   var resp1-resp5 resp6-resp7 resp8;

proc freq;
  tables ocucat mstatus gender yexp;
  format ocucat ocufmt. mstatus mstatfmt. gender genfmt. yexp yexpfmt.;

proc chart;
title ‘VCT Benifit’;
      vbar gender/group = yexp type = mean sumvar = resp discrete;
      format gender genfmt. yexp yexpfmt.;

proc chart;
title ‘VCT Benifit’;
    vbar ocucat/group = gender type = mean sumvar = resp discrete;
    format ocucat ocufmt. gender genfmt.;

proc chart;
title ‘VCT Effectiveness’;
    block ocucat / group = gender sumvar = effect type = mean discrete;
    format ocucat ocufmt. gender genfmt.;

proc chart;
title ‘VCT Effectiveness’;
     block yexp / group = gender sumvar = effect type = mean discrete;
     format yexp yexpfmt. gender genfmt.;

proc chart;
title ‘Chances to Attend Meetings without VCT’;
   vbar resp8 /subgroup = ocucat type=pct midpoints=10 to 100 by 20;
   format ocucat ocufmt.;

proc chart;
title ‘Chances to Attend Meetings without VCT’;
     pie ocucat / sumvar = resp8 type = pct;
     format ocucat ocufmt.;

run;
endsas;
```

Appendix D: Multimedia Teleconferencing Standards

T.120

Multimedia teleconferencing. The T.120 standards address Real Time Data Conferencing (Audiographics), the H.320 standards address ISDN Videoconferencing, the H.323 standard addresses Video (Audiovisual) communication on Local Area Networks, and the H.324 standard addresses High Quality Video and Audio Compression over POTS modem connections.

Each of these standards has been developed in accordance with the process described above. As of October 1996, each standard has been ratified by the ITU, however standards are not static. The IMTC expects to continue to contribute, through its members, to the future enhancement of the standards to incorporate new functionality and capabilities.

T.120 Overview

The T.120 standards cover the document conferencing (data sharing) portion of a multimedia teleconference. The recommendations specify how to efficiently and reliably distribute files and graphical information in real-time during a multipoint multimedia meeting. The objective is to assure interoperability between terminals without either participant assuming prior knowledge of the other system; permit data sharing among participants in a multimedia teleconference, including white board image sharing, graphic display information, and image exchange; and, specify infrastructure protocols for audiographic or audiovisual applications.

The T.120 series governs the audiographic portion of the H.320, H.323, and H.324 series and operates either within these or by itself. The T.120 suite consists of a series of recommendations, which are summarized, along with their current ITU status in Table 1.

Table 1: ITU T.120 Standard

Recommendation	Description	ITU Status(as of Oct. '96)
T.120	Data protocols for multimedia conferencing: This provides an overview of the T.120 series.	Ratified
T.121	Generic Application Template: This provides a guide for Development of T.120 application protocols.	Ratified

T.122	Multipoint Communication Service (MCS) Service Description: This describes the multi-port services available to developers	Ratified
T.123	Protocol stacks for audiographic and audiovisual teleconference applications: This specifies transport protocols for a range of networks.	Ratified
T.124	Generic Conference Control (GCC): This defines the application protocol supporting reservations and basic conference control services for multipoint teleconferences.	Ratified
T.125	Multipoint Communication Service (MCS) Protocol specification: This specifies the data transmission protocol for multipoint services.	Ratified
T.126	Multipoint still image and annotation protocal: This defines collaborative data sharing, including "white board" image sharing, graphic display information, and image exchange in a multipoint conference.	Ratified
T.127	Multipoint Binary File Transfer Protocol: This defines a method for applications to transmit files in a multipoint conference.	Ratified
T.130	Real time architecture for multimedia conferencing: Provides an overview description of how T.120 data conferencing works in conjunction with H.320 videoconferencing.	Draft
T.131	Network-specific mappings: Defines how real time audio and video	

	streams should be transported across different networks (i.e. ISDN, LAN, ATM) when used in conjunction with T.120 data conferencing.	
T.132	Real time link management: Defines how real time audio and video streams may be created and routed between various multimedia conferencing endpoints	
T.133	Audio visual control services: Defines how to control the source and link devices associated with real time information streams.	
T.RES	Reservation Services: This is an overview document which specifies how terminals, MCUs, and reservation systems need to interact, and defines the interfaces between each of these elements.	
T.Share	Application Sharing Protocol: This defines how participants in a T.120 conference can share local applications such that other conference participants can see the image of the shared application, and use the mouse and keyboard to take control of the shared application as if it were running locally.	Draft
T.TUD	User Reservation: This describes how to transport a user-defined bitstream between various endpoints in a T.120 data conference.	

As noted in Table 1, the core T.120 standards are ratified. This includes the Application or Upper Level Layers (T.126, T.127) and the Infrastructure or Lower Level Layers (T.122/125, T.123, T.124).

Work on the other recommendations continues in the ITU. Within IMTC, the Multipoint/Multiparty activity group, and API and Protocols activity group are coordinating submissions. Additionally, the T.120 Interoperability activity group is coordinating and

implementing test sessions to verify the interworking of products and services based on these standards.

H.320

Multimedia Teleconferencing Standards

The ITU-T T.120, H.320, H.323, and H.324 standards comprise the core technologies for multimedia teleconferencing. The T.120 standards address Real Time Data Conferencing (Audiographics), the H.320 standards address ISDN Videoconferencing, the H.323 standard addresses Video (Audiovisual) communication on Local Area Networks, and the H.324 standard addresses High Quality Video and Audio Compression over POTS modem connections.

Each of these standards has been developed in accordance with the process described above. As of October 1996, each standard has been ratified by the ITU, however standards are not static. The IMTC expects to continue to contribute, through its members, to the future enhancement of the standards to incorporate new functionality and capabilities.

H.320 Overview

The H.320-series governs the basic video-telephony concepts of audio, video and graphical communications by specifying requirements for processing audio and video information. It provides common formats for compatible audio/video inputs and outputs, and protocols that allow a multimedia terminal to utilize the communications links and synchronization of audio and video signals.

Like the other multimedia teleconferencing standards, H.320 applies to multipoint and point-to-point sessions. The H.320 suite addresses videoconferencing over circuit switched services like ISDN or Switched-56. The components of the H.320 standard are summarized in Table 1.

Table 1: Multimedia Teleconferencing Standards

Standard	Description	Status (October 1996)
H.320	H.320 is an “umbrella” standard that covers audio, video, videoconferencing, graphics, and multipoint.	Ratified
H.221	Frame structure for a 64 to 1920 Kbps channel in audiovisual teleservices.	Ratified
H.230	Recommendations in Force	

H.320-	Narrow-band Visual Telephone Systems and Terminal Equipment
H.221 -	Frame Structure for a 64 to 1920 kbit/s Channel in Audiovisual Teleservices
H.242 -	System for Establishing Communication Between Audiovisual Terminals Using Digital Channels up to 2 Mbit/s
H.261 -	Video Codecs For Audiovisual Services at Px64 Kbps
HTML	
Other Formats	
H.230 -	Frame-synchronous Control and Indication Signals for Audiovisual Systems
H.231 -	Multipoint Control Unit for Audiovisual Systems Using Digital Channels up to 2 Mbit/s
H.243 -	System for Establishing Communication Between Three or More Audiovisual Terminals Using Digital Channels up to 2 Mbit/s
G.711 -	Pulse Code Modulation (PCM) of Voice Frequencies •G.722-7 kHz Audio-coding Within 64 kbit/s
G.728 -	Coding of Speech at 16 kbit/s Using Low-delay Code Excited Linear Prediction
Draft Recommendations	
PictureTel	H.324 Archive-H.324, “Visual Telephone Terminals over GSTN”, includes:
H.263 -	Video Coding For Low Bitrate Communication

HTML	
MS-Word	
H.324 -	Visual Telephone Terminals over GSTN
H.245 -	Control of Communications Between Multimedia Terminals
H.223 -	Multiplexing Protocols for Low Bitrate Multimedia Terminals
G.723 -	Dual Rate Speech Coder for Multimedia Telecommunications Transmitting at 6.4 and 5.3 kbit/s
H.321 -	Visual Telephone Terminals over ATM
H.322 -	Visual Telephone Terminals over Guaranteed Quality of Service LANs
H.323 -	Visual Telephone Terminals over Non-Guaranteed Quality of Service LANs

H.323

Multimedia Teleconferencing Standards

The ITU-T T.120, H.320, H.323, and H.324 standards comprise the core technologies for multimedia teleconferencing. The T.120 standards address Real Time Data Conferencing (Audiographics), the H.320 standards address ISDN Videoconferencing, the H.323 standard addresses Video (Audiovisual) communication on Local Area Networks, and the H.324 standard addresses High Quality Video and Audio Compression over POTS modem connections.

Each of these standards has been developed in accordance with the process described above. As of October 1996, each standard has been ratified by the ITU, however standards are not static. The IMTC expects to continue to contribute, through its members, to the future enhancement of the standards to incorporate new functionality and capabilities.

H.323 Overview

The H.323 standard is an extension of H.320, which addresses videoconferencing over ISDN and other circuit switched networks and services. Since H.320 was ratified, in 1990, corporations have increasingly implemented Local Area Networks (LANs) and LAN gateways to the Wide Area Network (WAN). H.323 is a logical and necessary extension of the H.320

standard to include Corporate Intranets and packet-switched networks generally. Because it is based on the Real-Time Protocol (RTP/RTCP) from the IETF, H.323 can also be applied to video over the Internet.

In common with the other ITU multimedia teleconferencing standard, H.323 applies to multipoint and point-to-point sessions. The components of the standard are summarized in Table 1.

Table 1: Components of H.323

Recommendation	Description	Status(as of Oct. `96)
H.225	Specifies messages for call control including signaling, registration and admissions, and packetization/ synchronization of media streams	Ratified
H.245	Specifies messages for opening and closing channels for media streams, and other commands, requests and indications.	Ratified
H.261	Video codec for audiovisual services at P x 64 Kbps.	Ratified
H.263	Specifies a new video codec for video over POTS.	Ratified
G.711	Audio codec,3.1 KHz at 48, 56, and 64 Kbps (normal telephony).	Ratified
G.722	Audio Codec, 7 KHz at 48, 56, and 64 Kbps.	Ratified
G.728	Audio Codec, 3.1 KHz at 16 Kbps.	Ratified
G.723	Audio Codec, for 5.3 and 6.3 Kbps modesRatifiedG.729Audio Codec	Ratified

With the ratification of these core components, and the range of networks H.323 can be applied to, products and services based on H.323 are beginning to appear. As a result, interoperability is beginning to assume critical importance.

The IMTC is addressing this concern through its activity groups. Specifically, IMTC's Corporate Network Conferencing activity group conducted the first industry-wide H.323

interoperability test session in October 1996. Additional sessions were held in December 1996 and February 1997, with more sessions scheduled throughout 1997. This group is also coordinating with IMTC's POTS and H.320 Interoperability activity groups, to extend this testing to H.324 and H.320 products also.

H.324

Multimedia Teleconferencing Standards

The ITU-T T.120, H.320, H.323, and H.324 standards comprise the core technologies for multimedia teleconferencing. The T.120 standards address Real Time Data Conferencing (Audiographics), the H.320 standards address ISDN Videoconferencing, the H.323 standard addresses Video (Audiovisual) communication on Local Area Networks, and the H.324 standard addresses High Quality Video and Audio Compression over POTS modem connections.
Each of these standards has been developed in accordance with the process described above. As of October 1996, each standard has been ratified by the ITU, however standards are not static. The IMTC expects to continue to contribute, through its members, to the future enhancement of the standards to incorporate new functionality and capabilities.

H.324 Overview

H.324 addresses and specifies a common method for sharing video, data, and voice simultaneously using high-speed (V.34) modem connections over a single analog (POTS) telephone line. It also specifies interoperability under these conditions, so that videophones, for example, based on H.324 will be able to connect and conduct a multimedia session.

Of the three ITU standards that address videoconferencing-H.324, H.323 and H.320-H.324 has the broadest impact in the marketplace. That is because H.324 incorporates the most pervasive communications facility-POTS-installed today, on a global basis. For reference, H.320 specifies videoconferencing over circuit-switched media like ISDN and Switched 56, while H.323 extends H.320 video to corporate Intranets, LAN's and other packet-switched networks. As a result, H.324 based products are expected to be prominent in the mass market/retail segment, where PC's equipped with this capability are already available.

The H.324 suite consists of five recommendations: H.324, H.223, H.245, H.263 and G.723.1 (formally G.723). H.261 Video Compression and T.120 Data is also specified. Table 1 summarizes and briefly describes these recommendations and their status in the ITU.

Table 1

Recommendation	Description	Status (as of Oct. `96)
H.324	Defines a multimedia communication terminal operating over the Switched Telephone Network. It includes H.261, T.120, and V.34.	Ratified

H.263	Defines speech coding at rates less than 64 Kbps.	Ratified
H.223	Defines a Multiplexing protocol for low bitrate multimedia terminals.	Ratified
H.245	Defines control of communications between multimedia terminals.	Ratified
G.723	Defines speech coding for multimedia telecommunications transmitting at 5.3/6.3 Kbps.	Ratified

With the core standards ratified and the expected prevalence of H.324 products and services, the industry focus has shifted to interoperability of these products and services. Within IMTC, the POTS activity group held three H.324 interoperability test sessions in 1996, and one "virtual" test session, attended by vendors introducing H.324 products. The POTS activity group held another test session in January, 1997, as well as a "virtual" session February 26. More in-person and "virtual" test sessions are planned throughout 1997. In addition, this activity group is coordinating with IMTC's Corporate Network Conferencing and H.320 Interoperability activity groups, to extend interoperability testing to H.323 and H.320 products also.

Appendix E: Survey Responses from Other States

Alabama

responded to survey: Yes

name: Danny Turner

title of respondent: Mgr--Telecommunications

organization: Alabama DOT

address: 1409 Coliseum Blvd.

city: Montgomery

state: Alabama

zip code: 36130

phone: 334-242-6048 FAX 262-8041

e-mail: turnerd@dot.state.al.us

experience with videoconferencing: Yes

quality of videoconferencing: good

comparability with in-person meetings: about the same

is videconferencing worthwhile: Yes

do you own videoconferencing equipment: Yes

recommendation on videoconferencing: definitely pursue limited implementation

comments: cost argues for a limited deployment

Alaska

responded to survey: Yes

name: Nancy Slagle

title of respondent: Admin Services

organization: Alaska DOT

address: 3132 Channel Dr.

city: Juneau

state: Alaska

zip code: 99801-7898

phone: 907-465-3911

e-mail: nancy-slagle@dot.state.ak.us

experience with videoconferencing: Yes

quality of videoconferencing: good

comparability with in-person meetings: about the same

is videconferencing worthwhile: Yes

do you own videoconferencing equipment: No

recommendation on videoconferencing: probably not pursue implementation

comments: currently use sites at governor's office and universities

Arizona

responded to survey: Yes

name: John Semmens

title of respondent: Project Manager, Research Center

organization: Arizona DOT

address: 1130 N. 22 Ave

city: Phoenix

state: Arizona

zip code: 85009

phone: 602-407-3137 FAX 602-256-6367

e-mail: jsemmens@dot.state.az.us

experience with videoconferencing: No

quality of videoconferencing:

comparability with in-person meetings:

is videconferencing worthwhile:

do you own videoconferencing equipment: No

recommendation on videoconferencing: definitely pursue limited implementation

comments: currently undertaking a pilot study

Arkansas

responded to survey: Yes

name: Scott Bennett

title of respondent: Planning & Research

organization: Arkansas DOT

address: P.O. Box 2261

city: Little Rock

state: Arkansas

zip code: 72203

phone: 501-569-2201 FAX 569-2400

e-mail:

experience with videoconferencing: Yes

quality of videoconferencing: fair

comparability with in-person meetings: worse

is videconferencing worthwhile: Yes

do you own videoconferencing equipment: No

recommendation on videoconferencing: maybe pursue limited implementation

comments: need to be sure that frequency of use & travel savings exceed cost

California

responded to survey: No

name: James van Loben Sels

title of respondent: Director

organization: California DOT

address: 1120 N Street

city: Sacramento

state: California

zip code: 94273-0001

phone: 916-654-5368 FAX 654-6608

e-mail:

experience with videoconferencing:

quality of videoconferencing:

comparability with in-person meetings:

is videconferencing worthwhile:

do you own videoconferencing equipment:

recommendation on videoconferencing:

comments:

Colorado

responded to survey: No

name: Guillermo Vidal

title of respondent: Director

organization: Colorado DOT

address: 4201 E. Arkansas Ave.

city: Denver

state: Colorado

zip code: 80222

phone: 303-757-9469 FAX 757-9149

e-mail:

experience with videoconferencing:

quality of videoconferencing:

comparability with in-person meetings:

is videconferencing worthwhile:

do you own videoconferencing equipment:

recommendation on videoconferencing:

comments:

Connecticut

responded to survey: Yes

name: Joseph Kanachovski

title of respondent: Staff Development

organization: Connecticut DOT

address: P.O. Box 317546

city: Newington

state: Connecticut

zip code: 06131-7546

phone: 860-594-3600 FAX 594-3008

e-mail: joseph.kanachovski@po.state.ct.us

experience with videoconferencing: No

quality of videoconferencing:

comparability with in-person meetings:

is videconferencing worthwhile:

do you own videoconferencing equipment:

recommendation on videoconferencing: maybe pursue limited implementation

comments: small state, most trips less than one hour drive, may be useful for out-of-state meetings

Delaware

responded to survey: No

name: Anne Canby

title of respondent: Secretary

organization: Delaware DOT

address: P.O. Box 778

city: Dover

state: Delaware

zip code: 19903

phone: 302-739-3056 FAX 739-4329

e-mail:

experience with videoconferencing:

quality of videoconferencing:

comparability with in-person meetings:

is videconferencing worthwhile:

do you own videoconferencing equipment:

recommendation on videoconferencing:

comments:

Florida

responded to survey: Yes

name: Hubert Broome

title of respondent: Mgr. Engineering/CADD

organization: Florida DOT

address: 605 Suwanee St.

city: Tallahassee

state: Florida

zip code: 32399-0450

phone: 850-414-0138 FAX 277-3403

e-mail: elwin.broome@dot.state.fl.us

experience with videoconferencing: No

quality of videoconferencing:

comparability with in-person meetings:

is videconferencing worthwhile:

do you own videoconferencing equipment:

recommendation on videoconferencing: maybe pursue limited implementation

comments: currently use "liveboard" units w/o video, only one of 8 districts interested in videoconferencing

Georgia

responded to survey: No

name: Wayne Shackelford

title of respondent: Commissioner

organization: Georgia DOT

address: 2 Capitol Square

city: Atlanta

state: Georgia

zip code: 30334

phone: 404-656-0610 FAX 656-3507

e-mail:

experience with videoconferencing:

quality of videoconferencing:

comparability with in-person meetings:

is videconferencing worthwhile:

do you own videoconferencing equipment:

recommendation on videoconferencing:

comments:

Hawaii

responded to survey: Yes

name: Marilyn Kali

title of respondent:

organization: Hawaii DOT

address: 869 Punchbowl St.

city: Honolulu

state: Hawaii

zip code: 96813-5097

phone: 808-587-2160 FAX 587-2167

e-mail: mkali@hula.net

experience with videoconferencing: No

quality of videoconferencing:

comparability with in-person meetings:

is videconferencing worthwhile:

do you own videoconferencing equipment:

recommendation on videoconferencing: probably not pursue implementation

comments: another state agency has videoconferencing, HiDOT rarely uses it

Idaho

responded to survey: No

name: Dwight Bower

title of respondent: Director

organization: Idaho DOT

address: P.O. Box 7129

city: Boise

state: Idaho

zip code: 83707

phone: 208-334-8203 FAX 334-3858

e-mail:

experience with videoconferencing:

quality of videoconferencing:

comparability with in-person meetings:

is videconferencing worthwhile:

do you own videoconferencing equipment:

recommendation on videoconferencing:

comments:

Illinois

responded to survey: Yes

name: Dohn Beard

title of respondent: Information Processing

organization: Illinois DOT

address: 2300 S. Dirksen Pkwy

city: Springfield

state: Illinois

zip code: 62764

phone: 217-785-2400 FAX 782-6828

e-mail: beardds@nt.dot.state.il.us

experience with videoconferencing: Yes

quality of videoconferencing: good

comparability with in-person meetings: worse

is videconferencing worthwhile: Yes

do you own videoconferencing equipment: Yes

recommendation on videoconferencing: definitely pursue full implementation

comments: experience has been good

Indiana

responded to survey: No

name: Stanley Smith

title of respondent: Commissioner

organization: Indiana DOT

address: 100 N. Senate Ave.

city: Indianapolis

state: Indiana

zip code: 46204-2249

phone: 317-232-2380 FAX 232-0238

e-mail:

experience with videoconferencing:

quality of videoconferencing:

comparability with in-person meetings:

is videconferencing worthwhile:

do you own videoconferencing equipment:

recommendation on videoconferencing:

comments:

Iowa

responded to survey: Yes

name: Dave Cook

title of respondent: Data Services

organization: Iowa DOT

address: 800 Lincoln Way

city: Ames

state: Iowa

zip code: 50010

phone: 515-239-1771 FAX 239-1639

e-mail: dcook@iadot.e-mail.com

experience with videoconferencing: Yes

quality of videoconferencing: good

comparability with in-person meetings: about the same

is videconferencing worthwhile: Yes

do you own videoconferencing equipment: Yes

recommendation on videoconferencing: definitely pursue limited implementation

comments: IaDOT has 7 videoconference sites

Kansas

responded to survey: No

name: Dean Carlson

title of respondent: Secretary

organization: Kansas DOT

address: 915 Harrison

city: Topeka

state: Kansas

zip code: 66612-1568

phone: 913-296-2252 FAX 296-1095

e-mail:

experience with videoconferencing:

quality of videoconferencing:

comparability with in-person meetings:

is videconferencing worthwhile:

do you own videoconferencing equipment:

recommendation on videoconferencing:

comments:

Kentucky

responded to survey: Yes

name: John Sacksteder

title of respondent: Director--Hwy Design

organization: Kentucky DOT

address: State Office Bldg., High & Clifton St.

city: Frankfort

state: Kentucky

zip code: 40622

phone: 502-564-3280 FAX 564-4809

e-mail: jsacksted@mail.kytc.state.ky.us

experience with videoconferencing: Yes

quality of videoconferencing: excellent

comparability with in-person meetings: about the same

is videconferencing worthwhile: Yes

do you own videoconferencing equipment: No

recommendation on videoconferencing: definitely pursue full implementation

comments: currently rents use @ $50-75/hr., long term, though, agency will need its own

Louisiana

responded to survey: Yes

name: Joe Baker

title of respondent: Director

organization: Louisiana DOT

address: P.O. Box 94245

city: Baton Rouge

state: Louisiana

zip code: 70804-9245

phone: 504-767-9131 FAX 379-1851

e-mail: jbaker@dotdmail.dotd.state.la.us

experience with videoconferencing: Yes

quality of videoconferencing: good

comparability with in-person meetings: worse

is videconferencing worthwhile: Yes

do you own videoconferencing equipment: No

recommendation on videoconferencing: definitely pursue full implementation

comments: building a facility on the LSU campus for training

Louisiana

responded to survey: Yes

name: Frank Bourgeois

title of respondent: Public Affairs Director

organization: Louisiana DOT

address: P.O. Box 94245

city: Baton Rouge

state: Louisiana

zip code: 70804-9245

phone: 504-379-1202 FAX 379-1851

e-mail: mbourgeo@dotdmail.dotd.state.la.us

experience with videoconferencing: No

quality of videoconferencing:

comparability with in-person meetings:

is videconferencing worthwhile:

do you own videoconferencing equipment:

recommendation on videoconferencing: probably not pursue implementation

comments: too costly (Sher Creel, La. Transportation Research Council 504-767-9145)

Maine

responded to survey: Yes

name: Travis Dubois

title of respondent: EA II

organization: Maine DOT

address: State House Station 16

city: Augusta

state: Maine

zip code: 04333-0016

phone: 207-287-5665 FAX 287-2896

e-mail: travis.dubois@state.me.us

experience with videoconferencing: No

quality of videoconferencing:

comparability with in-person meetings:

is videconferencing worthwhile:

do you own videoconferencing equipment:

recommendation on videoconferencing: probably not pursue implementation

comments: state is small, travel cost low, videoconferencing w/ outside state available via governor's office

Maryland

responded to survey: Yes

name: Alisoun Moore

title of respondent: Information Officer

organization: Maryland DOT

address: P.O. Box 8755

city: Baltimore

state: Maryland

zip code: 21240-0755

phone: 410-865-1040 FAX 859-7615

e-mail: amoore@sha.state.md.us

experience with videoconferencing: Yes

quality of videoconferencing: good

comparability with in-person meetings: worse

is videconferencing worthwhile: Yes

do you own videoconferencing equipment: Yes

recommendation on videoconferencing:

comments:

Massachusetts

responded to survey: Yes

name: Nancy Logan

title of respondent: Executive Office

organization: Massachusetts DOT

address: 10 Park Plaza, Room 3510

city: Boston

state: Massachusetts

zip code: 02116-3973

phone: 617-973-7824 FAX523-6454

e-mail:

experience with videoconferencing: No

quality of videoconferencing:

comparability with in-person meetings:

is videconferencing worthwhile:

do you own videoconferencing equipment:

recommendation on videoconferencing: probably not pursue implementation

comments:

Michigan

responded to survey: No

name: Robert Welke

title of respondent: Director

organization: Michigan DOT

address: 425 W. Ottawa St.

city: Lansing

state: Michigan

zip code: 48913

phone: 517-373-0343 FAX 373-0167

e-mail:

experience with videoconferencing:

quality of videoconferencing:

comparability with in-person meetings:

is videconferencing worthwhile:

do you own videoconferencing equipment:

recommendation on videoconferencing:

comments:

Minnesota

responded to survey: Yes

name: Douglas Bjornberg

title of respondent: Division Admin Mgr

organization: Minnesota DOT

address: 395 John Ireland Blvd.

city: St. Paul

state: Minnesota

zip code: 55155

phone: 612-296-8176 FAX 297-3160

e-mail: bjor/dou@gwmntdom

experience with videoconferencing: Yes

quality of videoconferencing: good

comparability with in-person meetings: better

is videconferencing worthwhile: Yes

do you own videoconferencing equipment: Yes

recommendation on videoconferencing: definitely pursue full implementation

comments: two-site pilot was unsuccessful--too limited, 16 sites installed with goal of 3 hr/day usage = success

Mississippi

responded to survey: Yes

name: John Simpson

title of respondent:

organization: Mississippi DOT

address: 401 N. West St.

city: Jackson

state: Mississippi

zip code: 39215-1850

phone: 601-359-7422

e-mail: jsimpson@mdot.state.ms.us

experience with videoconferencing: Yes

quality of videoconferencing: fair

comparability with in-person meetings: about the same

is videconferencing worthwhile: Yes

do you own videoconferencing equipment: No

recommendation on videoconferencing: maybe pursue limited implementation

comments: too costly for a single state agency to fund

Missouri

responded to survey: Yes

name: Dave Snider

title of respondent: Asst. Chief Engineer

organization: Missouri DOT

address: P.O. Box 270

city: Jefferson City

state: Missouri

zip code: 65102

phone: 314-751-2856 FAX 526-4859

e-mail:

experience with videoconferencing: Yes

quality of videoconferencing: excellent

comparability with in-person meetings: about the same

is videconferencing worthwhile: Yes

do you own videoconferencing equipment: No

recommendation on videoconferencing: definitely pursue full implementation

comments: 3 month trial results excellent, a 10 district installation is planned, gets free connections via fiber-optics in ROW

Montana

responded to survey: Yes

name: Barbara Martin

title of respondent: Organizational Development

organization: Montana DOT

address: 2701 Prospect St.

city: Helena

state: Montana

zip code: 59620

phone: 406-444-6048 FAX 444-7643

e-mail: u5568@long.mdt.mt.gov

experience with videoconferencing: Yes

quality of videoconferencing: excellent

comparability with in-person meetings: about the same

is videconferencing worthwhile: Yes

do you own videoconferencing equipment: Yes

recommendation on videoconferencing: definitely pursue limited implementation

comments: equipment is expensive, people need time to get used to it, budget for dedicated personnel to support system

Nebraska

responded to survey: Yes

name: Don Robertson

title of respondent: Communication Division

organization: Nebraska DOT

address: 1500 Nebraska Highway 2

city: Lincoln

state: Nebraska

zip code: 68509-4759

phone: 402-479-4316 FAX 479-4325

e-mail: dor28009@vmhost.cdp.state.ne.us

experience with videoconferencing: Yes

quality of videoconferencing: excellent

comparability with in-person meetings: about the same

is videconferencing worthwhile: Yes

do you own videoconferencing equipment: No

recommendation on videoconferencing: definitely pursue limited implementation

comments: six month trial showed underutilization, scheduling was difficult w/ multipurpose site used for other types of meetings, unit was removed

Nevada

responded to survey: Yes

name: Richard Sheldrew

title of respondent: Communications Mgr.

organization: Nevada DOT

address: 1263 S. Stewart St.

city: Carson City

state: Nevada

zip code: 89712

phone: 702-888-7888 FAX 687-6781

e-mail:

experience with videoconferencing: Yes

quality of videoconferencing: excellent

comparability with in-person meetings: about the same

is videconferencing worthwhile: Yes

do you own videoconferencing equipment: Yes

recommendation on videoconferencing:

comments:

New Hampshire

responded to survey: Yes

name: Doug Scamman

title of respondent: Director of Admin

organization: New Hampshire DOT

address: P.O. Box 483

city: Concord

state: New Hampshire

zip code: 03301-0483

phone: 603-271-3734 FAX 271-3914

e-mail:

experience with videoconferencing: Yes

quality of videoconferencing: good

comparability with in-person meetings: about the same

is videconferencing worthwhile: Yes

do you own videoconferencing equipment: No

recommendation on videoconferencing: maybe pursue limited implementation

comments: multiple agencies need to be involved to share costs & benefits

New Jersey

responded to survey: Yes

name: Joseph Acerra

title of respondent: Facilities Mgmt

organization: New Jersey DOT

address: 1035 Parkway Ave., CN 600

city: Trenton

state: New Jersey

zip code: 08625

phone: 609-530-2062 FAX 530-3894

e-mail:

experience with videoconferencing: Yes

quality of videoconferencing: fair

comparability with in-person meetings: worse

is videconferencing worthwhile: Yes

do you own videoconferencing equipment: No

recommendation on videoconferencing: maybe pursue limited implementation

comments: initially limited to higher level communications of commissioners

New Mexico

responded to survey: Yes

name: Anne Stewart

title of respondent: Staff Development

organization: New Mexico DOT

address: P.O. Box 1149

city: Santa Fe

state: New Mexico

zip code: 87504

phone: 505-827-9880 FAX 827-3237

e-mail:

experience with videoconferencing: No

quality of videoconferencing:

comparability with in-person meetings:

is videconferencing worthwhile:

do you own videoconferencing equipment: No

recommendation on videoconferencing: definitely pursue limited implementation

comments: funds for a pilot test were set aside, but the pilot test has not yet been implemented

New York

responded to survey: Yes

name: Michael McCarthy

title of respondent: Budget & Finance

organization: New York DOT

address: 1220 Washington Ave.

city: Albany

state: New York

zip code: 12232

phone: 518-457-2787 FAX 457-4190

e-mail:

experience with videoconferencing: No

quality of videoconferencing:

comparability with in-person meetings:

is videconferencing worthwhile:

do you own videoconferencing equipment:

recommendation on videoconferencing: maybe pursue limited implementation

comments: trying to determine whether benefits would likely exceed costs

North Carolina

responded to survey: No

name: Garland Garrett

title of respondent: Secretary

organization: North Carolina DOT

address: 1 S. Wilmington St.

city: Raleigh

state: North Carolina

zip code: 27611

phone: 919-733-2031 FAX 733-9150

e-mail:

experience with videoconferencing:

quality of videoconferencing:

comparability with in-person meetings:

is videconferencing worthwhile:

do you own videoconferencing equipment:

recommendation on videoconferencing:

comments:

North Dakota

responded to survey: Yes

name: Gary Berreth

title of respondent: Director of Executive Services

organization: North Dakota DOT

address: 608 E. Boulevard Ave.

city: Bismarck

state: North Dakota

zip code: 58505-0700

phone: 701-328-4408 FAX 328-4545

e-mail: gberreth@state.nd.us

experience with videoconferencing: Yes

quality of videoconferencing: good

comparability with in-person meetings: about the same

is videconferencing worthwhile: Yes

do you own videoconferencing equipment: Yes

recommendation on videoconferencing: definitely pursue limited implementation

comments: currently participating w/ universities, investigating district office video connections

Ohio

responded to survey: No

name: Jerry Wray

title of respondent: Director

organization: Ohio DOT

address: 25 S. Front St.

city: Columbus

state: Ohio

zip code: 43215

phone: 614-644-7085 FAX 752-6416

e-mail:

experience with videoconferencing:

quality of videoconferencing:

comparability with in-person meetings:

is videconferencing worthwhile:

do you own videoconferencing equipment:

recommendation on videoconferencing:

comments:

Oklahoma

responded to survey: Yes

name: Cynthia White

title of respondent:

organization: Oklahoma DOT

address: 200 N. E. 21 St.

city: Oklahoma City

state: Oklahoma

zip code: 73105

phone: 405-521-4521 FAX 521-2524

e-mail: cynthia white/odot@fd9ns01.okladot.state.ok.us

experience with videoconferencing: Yes

quality of videoconferencing: good

comparability with in-person meetings: about the same

is videconferencing worthwhile: Yes

do you own videoconferencing equipment: No

recommendation on videoconferencing: definitely pursue limited implementation

comments: cost analysis shows sites pay for themselves in less than two years

Oregon

responded to survey: Yes

name: Michael Topik

title of respondent:

organization: Oregon DOT

address: Capitol & Center Sts.

city: Salem

state: Oregon

zip code: 97310

phone: 503-986-3238 FAX 373-7376

e-mail: michael.j.topik@odot.state.or.us

experience with videoconferencing: Yes

quality of videoconferencing: good

comparability with in-person meetings: about the same

is videconferencing worthwhile: Yes

do you own videoconferencing equipment: Yes

recommendation on videoconferencing: definitely pursue limited implementation

comments: organization-wide implementation would be too expensive

Pennsylvania

responded to survey: Yes

name: James Slaughter

title of respondent: BIS Application

organization: Pennsylvania DOT

address: Commonwealth & Forster Sts.

city: Harrisburg

state: Pennsylvania

zip code: 17120

phone: 717-783-8823 FAX 787-5491

e-mail: jslaugh@penndot.state.pa.us

experience with videoconferencing: Yes

quality of videoconferencing: excellent

comparability with in-person meetings: worse

is videconferencing worthwhile: Yes

do you own videoconferencing equipment: Yes

recommendation on videoconferencing: definitely pursue full implementation

comments: benefit/cost analsis for 14 site system showed recouped costs w/in 9 months from travel & time savings

Rhode Island

responded to survey: No

name: William Bundy

title of respondent: Director

organization: Rhode Island DOT

address: 2 Capitol Hill

city: Providence

state: Rhode Island

zip code: 02903

phone: 401-277-2023 FAX 277-6038

e-mail:

experience with videoconferencing:

quality of videoconferencing:

comparability with in-person meetings:

is videconferencing worthwhile:

do you own videoconferencing equipment:

recommendation on videoconferencing:

comments:

South Carolina

responded to survey: Yes

name: Reginald Hall

title of respondent: Asst. Deputy Director

organization: South Carolina DOT

address: P.O. Box 191

city: Columbia

state: South Carolina

zip code: 29202

phone: 803-737-1270 FAX 737-6385

e-mail:

experience with videoconferencing: Yes

quality of videoconferencing: excellent

comparability with in-person meetings: worse

is videconferencing worthwhile: Yes

do you own videoconferencing equipment: No

recommendation on videoconferencing: maybe pursue limited implementation

comments: rent educational television videoconferencing on an as needed basis

South Dakota

responded to survey: No

name: Ron Wheeler

title of respondent: Secretary

organization: South Dakota DOT

address: 700 E. Broadway Ave.

city: Pierre

state: South Dakota

zip code: 57501-2586

phone: 605-773-3174 FAX 773-3921

e-mail:

experience with videoconferencing:

quality of videoconferencing:

comparability with in-person meetings:

is videconferencing worthwhile:

do you own videoconferencing equipment:

recommendation on videoconferencing:

comments:

Tennessee

responded to survey: Yes

name: David Doyle

title of respondent: Information Officer

organization: Tennessee DOT

address: Fifth & Deaderick

city: Nashville

state: Tennessee

zip code: 37243-0349

phone: 615-741-3576 FAX 741-2508

e-mail: ddoyle@mail.state.tn.us

experience with videoconferencing: No

quality of videoconferencing:

comparability with in-person meetings:

is videconferencing worthwhile:

do you own videoconferencing equipment:

recommendation on videoconferencing: definitely pursue limited implementation

comments: $500,000 project to implement at six sites underway

Texas

responded to survey: Yes

name: Tom Orton

title of respondent: Manager Communicatio

organization: Texas DOT

address: 125 E. 11 St.

city: Austin

state: Texas

zip code: 78701-2483

phone: 512-465-7393 FAX 475-3072

e-mail: torton@mailgw.dot.state.tx.us

experience with videoconferencing: No

quality of videoconferencing:

comparability with in-person meetings:

is videconferencing worthwhile:

do you own videoconferencing equipment:

recommendation on videoconferencing: maybe pursue limited implementation

comments: cost is big concern

Utah

responded to survey: Yes

name: Neal Christensen

title of respondent: Director

organization: Admin Service, Utah DOT

address: 4501 S. 2700 West

city: Salt Lake City

state: Utah

zip code: 84119

phone: 801-965-4032 FAX 965-4338

e-mail: src0fs01.nchriste@state.utdotu2

experience with videoconferencing: Yes

quality of videoconferencing: excellent

comparability with in-person meetings: about the same

is videconferencing worthwhile: Yes

do you own videoconferencing equipment: Yes

recommendation on videoconferencing: definitely pursue full implementation

comments: saves time, saves $, meetings can be held when bad weather impedes travel

Vermont

responded to survey: Yes

name: Bruce Bender

title of respondent:

organization: Vermont DOT

address: 133 State St.

city: Montpelier

state: Vermont

zip code: 05633-5001

phone: 802-828-3984 FAX 828-2024

e-mail: bbender@dot.state.vt.us

experience with videoconferencing: Yes

quality of videoconferencing: good

comparability with in-person meetings: about the same

is videconferencing worthwhile: Yes

do you own videoconferencing equipment: No

recommendation on videoconferencing: definitely pursue limited implementation

comments: use the state's educational videoconferencing networ k

Virginia

responded to survey: Yes

name: Mike McAllister

title of respondent: Assistant Administrator

organization: Virginia DOT

address: 1201 E. Broad St.

city: Richmond

state: Virginia

zip code: 23219

phone: 804-371-6704 FAX 225-3659

e-mail:

experience with videoconferencing: Yes

quality of videoconferencing: good

comparability with in-person meetings: better

is videconferencing worthwhile: Yes

do you own videoconferencing equipment: No

recommendation on videoconferencing: definitely pursue full implementation

comments: cost effective & efficient

Washington

responded to survey: Yes

name: Sandee Eagan

title of respondent: Network Planner

organization: Washington DOT

address: 212 Maple Park

city: Olympia

state: Washington

zip code: 98504-7308

phone: 360-705-7577 FAX 705-6808

e-mail: eagans@wsdot.wa.gov

experience with videoconferencing: Yes

quality of videoconferencing: excellent

comparability with in-person meetings: about the same

is videconferencing worthwhile: Yes

do you own videoconferencing equipment: Yes

recommendation on videoconferencing: definitely pursue limited implementation

comments: equipment quickly becomes obsolete, a cautious imple mentation is prudent

West Virginia

responded to survey: Yes

name: Norman Roush

title of respondent: Deputy Commissioner

organization: West Virginia DOT

address: 1900 Kanawha Blvd. East

city: Charleston

state: West Virginia

zip code: 25305-0440

phone: 304-558-2804 FAX 558-1004

e-mail: nroush@mail.dot.state.wv.us

experience with videoconferencing: Yes

quality of videoconferencing: good

comparability with in-person meetings: worse

is videconferencing worthwhile: No

do you own videoconferencing equipment: No

recommendation on videoconferencing: maybe pursue limited implementation

comments: inadequate for meetings, okay for training

Wisconsin

responded to survey: Yes

name: Charles Thompson

title of respondent: Secretary

organization: Wisconsin DOT

address: 4802 Sheboygan Ave.

city: Madison

state: Wisconsin

zip code: 53707-7910

phone: 608-266-1114 FAX 266-9912

e-mail: cthomps6@mail.state.wi.us

experience with videoconferencing: Yes

quality of videoconferencing: excellent

comparability with in-person meetings: about the same

is videconferencing worthwhile: Yes

do you own videoconferencing equipment: Yes

recommendation on videoconferencing:

comments:

Wyoming

responded to survey: Yes

name: David Talley

title of respondent: Training Mgr.

organization: Wyoming DOT

address: P.O. Box 1708

city: Cheyenne

state: Wyoming

zip code: 82003-1708

phone: 307-777-4792 FAX 777-4163

e-mail: dtalle@missc.state.wy.us

experience with videoconferencing: Yes

quality of videoconferencing: good

comparability with in-person meetings: about the same

is videconferencing worthwhile: Yes

do you own videoconferencing equipment: Yes

recommendation on videoconferencing:

comments: feds funded a regional videoconferencing partnership w/ WY, ND,SD,MT,UT,CO, and several universities, best potential is for training, not cost-effective in short term

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Appendix G: Market Matrix Definitions

Vendor

Phone/Fax

Contact person

Indicates contact names in specific areas of the company.

Tech Support

Indicates if tech support is free, a toll call, or toll-free call.

Tech Support Hours

Indicates the hours that tech support is available.

Warranty

Indicates the duration of the warranty.

Product Name and Version

System supplied complete with

Details the specific hardware and software included with the product.

Host System/Operating System

Details the required operating system and the minimum system requirements for the computer.

List price for the specified number of users

Indicates the price of the system for the specified number of users.

Product System 9software (SW), hardware (HW)

Indicates whether the system includes SW, HW or both.

Operational Features

Maximum resolution for video frames

Indicates the number of frames per second (FPS). The standard NTSC television rate is 30 fps which is the requirement for full-motion video.

Frames per second (claimed) over specified medium

Indicates the frames per second (FPS) over the particular medium (e.g. 15 FPS (ISDN)).

H.320 Support/Compression Algorithm

The compression algorithm can be either standard or proprietary. H.320 is an International Telecommunications Union-Telecommunications Standards Section (ITU-T) group of standards that includes the H.261 video CODEC standard among several others. Systems that use H.320 standard can connect with each other and with high-end conference-room systems.

Maximum number of multipoint users

The maximum number of parties that can participate in a simultaneous video conference. To videoconference with more than two parties, a Multipoint Control Unit must be used either in house or through a conference service provider.

Audio Echo Cancellation

Audio echo cancellation eliminates echoing of the audio portion of the conference.

Simultaneous display of incoming and outgoing video

Indicates if the software allows the user to view both incoming and outgoing video at the same time.

Versions available to run video on: (compatibility/standards)

Indicates the transport methods that the system supports. The following provides a brief description of each transport method:

Ethernet

A 10-Mbps baseband local-area network specification developed jointly by Xerox, Intel, and Digital Equipment.

Token Ring

A medium access-control technique for ring LANs. A token circulates around the ring. A station may transmit data by seizing the token, inserting a packet onto the ring, and then retransmitting the token.

FDDI

Fiber Distributed Data interface; a LAN standard; the medium access control employed is

token ring; the medium specified is 100-Mbps optical fiber. The FDDI has three general areas of application: backend LANs, high-speed office LANs, and backbone LANs.

ISDN

Integrated Service Digital Network -- a set of digital transmission standards; enables simultaneous, high-speed transmission of voice, graphics, video and data over a single digital phone line, up to 27 times faster than a regular phone. There are two ISDN interfaces: the Basic Rate Interface (BRI) and the Primary Rate Interface (PRI).

The BRI consists of two 64 kbps bearer (B) channels and one separate 16 kbps Data (D) channel that caries signaling, call setup, control and caller information across the network (a.k.a. 2B + D connection); capable of transmitting digital information at speeds up to 128 kbps. BRI connections are used to connect small key systems, PBXs and individual terminals (e.g. desktop computer or workstations or room-sized video conferencing equipment) to a large PBX, or directly to a central office.

The PRI consists of twenty-three 64 kbps Bearer (B) channels and one 64 kbps Data (D) channels within the United States (a.k.a. 23B + D connection). It is equivalent in bandwidth to the North American Standard T-1 facility. PRIs are used to connect medium and large PBXs, as well as multiplexers and mainframes, to each other or a telephone company central ofice. They allow for n x 64 kbps bandwidth-on-demand applications such as video conferencing and LAN interconnection.

Analog Telephone Line

The regular telephone line (POTS = Plain Old Telephone System).

Leased Line

If the user can not get ISDN service, or if the user's company uses long-distance video conferencing so heavily that the per-minute ISDN charges are a major portion of the operating budget, a leased line may be more economical. Generally, such lines offer a cost advantage if they are in use more than six hours a day. The drawback of leased lines is that the user can connect only between the same end points. As the user's bandwidth requirements increase, leased lines become more and more economical.

Switched 56 Line

Switched 56 is used to extend the geographic coverage of domestic and international locations that do not have ISDN coverage. Switched 56 represents the most popular of the Switched Digital Services. It is a fast, yet cost-efficient, method of transferring data. The '56' of Switched stands for the fast data rate of 56 kbps per second. 'Switched' refers to your ability to dial and receive switched data calls just as you would with a voice telephone line. Once Switched 56 is installed, you simply dial another user Switched 56 number to transmit full duplex 56 kbps

digital data.

T1/Fractional T1

T-1 carrier provides a data rate of 1.544 Mbps and is capable of supporting the DS-1 multiplex transmission format (DS-1 transmission rate is used to provide both a voice and data service). The T-1 facility was first introduced by AT & T in 1960s. The most common external use (not part of the telephone network0 of T-1 facilities is for lesed dedicated transmission between customer premises. These facilities allow the customer to set up private networks to carry traffic troughout the organization. For users with substantial data transmission needs, the use of private T-1 networking is attractive for two reasons. First, T-1 permits simpler configurations than the use of a mix of lower-speed offerings, and second, T-1 transmission services are less expensive. Another use of T-1 is to provide high-speed access line to the public network (it is suggestive to use ISDN for this particular application). (W. Stallings, R. Van Slyke, Business Data Comunications, Second Addition, p. 200-201)

T3

Offering almost 30 times the capacity of T-1 lines, T-3 facilities are attractive for building backbone wide-area networks for high-volume users.

ATM

Asynchronous Transfer Mode, also known as cell relay. It is a packet-oriented transfer mode; it allows multiple logical connections to be multiplexed over a single physical interface. Cell relay is even more streamlined than frame relay in its functionality and can support data rates several orders of magnitude greater than frame relay can. (W. Stallings, R. Van Slyke, Business Data communications, Second Addition, p. 200-201)

Frame Relay

Frame relay provides a streamlined technique for wide-area packet switching. It is designed to work at access speeds up to 2 Mbps. (W. Stallings, R. Van Slyke, Business Data communications, Second Addition, p. 200-201)

Internet

Requires separate telephone line for audio transmission. The software only supports video and not audio transmiddion. Therefore, the user should pick up the telephone and call the other party as they look at each other's face on the screen.

Upgrade capabilities

Indicates the ability of the system to be upgraded.

Interoperable with other vendor's systems

Systems that support H.320 are able to operate with other vendor's systems.

Hardware

Video camera

Details of system's video camera.

Camera controls

Focus

Support for close focusing. There are three types of focus; fixed, automatic, and for manual adjustment. Focus control is very desirable.

Iris

Is the iris manual or electronic?

Zoom, Pan, Tilt

Are zoom, pan, and tilt controls provided by the software?

Movability (how is attached to the system)

Indicates how the camera is attached to the system.

Microphone

Provides details of the systems microphone.

Speakers

Provides details of the systems speakers.

Total number of boards per system

ISDN adapter card

Provides connectivity with the public switched telephone network

Video Overlay card

Enables the PC to display video on its monitor.

Coder/decoder comunications card

Enables the PC to video conference. A.k.a. CODEC, the system; it converts and compresses outgoing sound and pictures into a digital stream of data, while decompression incoming digital voice and video.

NT1

If the system uses ISDN for transport, then the system should supply an ISDN card and also an NT-1 (network terminator) interface between the card and the ISDN line. The NT-1 performs several functions, including providing termination and power for the ISDN line.

PC Bus types support

ISA, EISA, or N/A if the package is only software.

Software

Application links

Indicates if the software supports OLE links.

Background file transfer

Indicates if the software has the ability to transfer files over the system.

Bandwidth use indicators

Indicates if a bandwidt meter is provided so that the user can gauge the effect of video conferencing on LAN trafffic.

Call logging/chat

Indicates if the software allows the user to open a text chat window.

Captures and transmits still image

A snapshot capability lets the user send uncompressed still video images at high resolution.

Color controls

Refers to color accuracy; the software allows the user to adjust the brightness, contrst, saturation, and tint of the video images.

Connection Timer

The software provides a log that records the duration and cost of calls.

Control data rate

Indicates f the system allows for the control of data rates.

Control frame rate

Indicates if the system allows for adjustment of frame rate and image size in terms of resolution.

Frame rate adjustment range (claimed)

Indicates if the FPS can be adjusted.

Phone directory

Indicates if the system provides an address book for frequently called numbers.

Picture in picture

Indicates if the software can display an inset of what the user's camera sees.

Real-time application sharing

Indicates if the software enables conference participants to collaborate on projects using the same virtual spreadsheet or word processor.

Record audio/video to disk

Indicates if the software can record the video and/or audio of the meeting.

Screen sharing

Indicates if users can share a common screen. This differs from the whiteboard feature in that it lets the user show their guest party an open document in any application; the package may also allow the guest party to modify the remote document using its application's features.

Screen snapshot

Indicates if the software can take a snapshot of incoming video for later use.

Software name and version

Indicates the software name and version (either of the vendor that offers the hardware or the suggested other vendor's software.)

Video mail/audio mail

Indicates additional features of the software.

Video quality adjustment

Indicates if video quality is adjustable.

Video window size adjustment

Indicates if the window size is adjustble.

Whiteboard/ shared clipboard

Indicates if a whiteboard feature is available. The whiteboard allows participants at both ends of a conference to draw or scribble remarks on a shared blank screen.

Full/Half duplex audio

Indicates the audio type the system supports. With half-duplex, audio goes in only one direction at a time, triggered by who is speaking.

Security Feature

Indicates which of the following security features are included;

Privacy feature (video on hold)
Control file transfers
Control screen sharing
Control session recording
Control session start
Control snapshots
Pause (audio/video)

Appendix H: Matrix Results of Market Survey

PicTel

Vendor: PictureTel

Phone/fax: Tel: (800) 716 - 5245

Product Name and Version: PictureTel Live PCS 50

"Product Description: The PictureTel Live PCS 50 is simple to install and use. It provides very good quality video and audio at an aggressive per-seat cost and lets you hhok desktops to PictureTel room systems or other H. 320-compliant system." Pc magazine april 25. 1995.

System Supplied Complete With: Video/Audio Board with ISDN Bri
Color Camera
Headset
Cables
Conference Control Software
LiveShare Plus Data Collaboration software
Documentation

Host Systems/Operating System: 386 or higher microprocessor with VGA monitor; VGA with VESA Feature connector; Microsoft windows 3.1 or higher; 8MB memory, 20MB disk space; ISA or EISA Bus.

List Price: Retail price is $2,000 for each Live 50 unit; volume discounts are available.

Product System (SW, HW): HW/SW

Operational Features: Maximum Resolution for video
frames

Frames Per Second (claimed): 15 fps over public digital lines,

H. 320 Support/Compression Algorithm: Fully complies with H.320 (for video conferencing)

Maximum Number of Multipoint Users: point to point only

Additional I/O Capabilities: Audio echo cancellation

Simultaneous Display of incoming and Outgoing Video: yes

Versions Available to Run Video On

Ethernet: "LiveLAN" and "LiveManager"

Token Ring: No

FDDI: No

ISDN: Yes, Basic Rate IDN line

Analog Tel Line: No

Leased Line: No

Switched 56 Line: Yes

T1/Fractional T1: No

T3: No

E1: Yes

ATM: No

Frame Relay: No

Internet: Yes, requires separate tel. Line for audio transmission.

Upgrade Capabilities: Open architecture; allows for simple, quick and easy upgrades.

Interoperable with other vendor's systems: The CODEC complies with both the ISDN and H.320 standards for system interoperability.

Hardware

Video Camera

Camera Controls: One CSM unit

Focus:

Iris:
Zoom: Yes
Pan: Yes
Tilt:
Movability: On top of PC

Microphone: Headset

Speakers: Headset (optional speakerphone)

Total Number of Boards per System: The system requires two ISA slots

Codec: Combination video/audio codec

ISDN Adapter: Yes

NT1:

PC Bus Types Supported: ISA compatible PCs running Microsoft Window. So, you can work wih familiar Gus.

Software:

Freeze frame;

Frame capture:

Application links:

Audio sampling rate adjustment:

Background file transfer: Yes

Bandwidth use indicators:

Call logging/Chat: Yes

Captures and Transmits Still image:

Color Controls: Full contrast brightness, full color capacity

Connection Timer:

Control Data Rate:

Control Frame Rate:

Frame Rate Adjustment Range (claimed):

Phone Directory: Yes and on-screen dial pad

Picture in Picture:

Real-time Application Sharing: Yes

Record Audio to Disk:

Record Video to Disk:

Screen Sharing:

Screen Snapshot:

Software Name and Version:

Video Mail/Audio Mail:

Video Quality Adjustment:

Video Window Size Adjustment: Icon sized or full screen display

White board/Shared Clipboard: Yes

Full/Half Duplex Audio:

Workspace Tools:

Security Features

Privacy Feature (video on hold):
Control File Transfers:
Control Screen Sharing:
Control Session Recording:
Control Session Start:
Control Snapshots:
Pause (Audio/Video):
ProShare

Vendor: Intel Corporation

Phone/fax: Tel: (800) 538-3373 Fax: (800) 525-3019

Product Name and Version: ProShare Personal Conferencing

"The Intel Proshare video system 200 is a full-featured desktop system that lets you connect over ISDN phone line or LAN and take advantage of all document and application sharing capacities. You can even share video and voice with H.320-compliant room system, other desktop conferencing systems and multipoint control units." Intel Corporation.

System Supplied Complete With:
* a sleek monitor-top camera
* an audio headset with
    * built-in microphone
    * installation guide
* all the software to share documents and applications

Host Systems/Operating System:

* PC with intel 486 33 NHz CPU minimum (pentium processor or Intel DX 266 MHz processor recommended)
* 8 MBRAM minimum, 16 MB RAM recommended, plus 17 MB hard disk space inimum
* VGA display with 256 colors or higher (no feature connector required)
* 2 full-length ISA slots
* For ISDN use-NT-1 adapter, ISDN telephone service from local phone company
* For LAN/WAN use-Network interface card. Supported protocol stacks.

List Price:

Product System (SW, HW): HW/SW

Operational Features: Maximum Resolution for Video Frames

Frames Per Second (claimed):

H. 320 Support/Compression Algorithm: Yes

Maximum Number of Multipoint Users:

Additional I/O Capabilities:

Simultaneous Display of incoming and Outgoing Video:

Versions Available to Run Video On

Ethernet: Yes

Token Ring: Yes

FDDI: Yes

ISDN: Yes

Analog Tel Line: No

Leased Line: No

Switched 56 Line: No

T1/Fractional T1: Yes

T3: No

E1: No

ATM: No

Frame Relay: Yes

Internet: Requires separate tel.phone line for adio transmissison

Upgrade Capabilities

Interoperable with other vendor's systems: interoperability with existing industry standards such as h.320

Hardware:

Video Camera: a sleek desktop video camera

Camera Controls: monitor, color CDD camera

Focus;
Iris:
Zoom;
Pan:
Tilt:
Movability:

Microphone:

Speakers:

Total Number of Boards per System: Two full-length ISA cards

Codec:

ISDN Adapter:

NT1:

PC Bus Types Supported:

Software:

Freeze frame;

Frame capture:

Application links:

Audio sampling rate adjustment:

Background file transfer: Yes

Bandwidth use indicators: Yes

Call logging/Chat:

Captures and Transmits Still image:

Color Controls: Support all VGA and SVGA resolution and color modes

Connection Timer;

Control Data Rate: Yes

Control Frame Rate: Yes

Frame Rate Adjustment Range (claimed):

Phone Directory:

Picture in Picture: Yes,simultaneous local and remote video views

Realtime Application Sharing: Yes

Record Audio to Disk: Yes

Record Video to Disk: Yes

Screen Sharing: Yes

Screen Snapshot: Yes, up to 640 x 480

Software Name and Version: Intel Proshare personal Conferencing software

Video Mail/Audio Mail:

Video Quality Adjustment:

Video Window Size Adjustment: 160 x 120, 320 x 240

White board/Shared Clipboard: Yes

Full/Half Duplex Audio: Full-duplex video and audio

Workspace Tools: Pointing with mouse, etc.

Security Features

Privacy Feature (video on hold):
Control File Transfers:
Control Screen Sharing:
Control Session Recording:
Control Session Start:
Control Snapshots:
Pause (Audio/Video):

Vtel

Vendor: Vtel Enterprise

Phone/fax: (800) 299-8835

Product Name and Version: TC2000 Conferencing Room System

"The Team Conferencing "TC2000" is the system of choice for a wide variety of uses and installations, from work groups to lecture halls. The system's Smart Videoconferencing features permit LAN access and installation on large enterprise-wide networks for data and document exchange and for direct access to the internet."

System Supplied Complete With:

ITU-T Standards supported: h.320, G.711, G.722, G.728, h.221, H.230, h.242, H. 243, h. 261, H. 281

Intel pentium microprocessor, CD-ROM drive, modem, 3.5" floppy drive, hard drive, 16 MB RAM.

Host Systems/Operating System:

List Price:

Product System (SW, HW): HW/SW

Operational Features:

Frames Per Second (claimed): 30 fps

H. 320 Support/Compression Algorithm: Yes, ITU-T H. 261 (px64)
352 x 288 (FCIF)
176 x 144 (QCIF)

Maximum Number of Multipoint Users:

Additional I/O Capabilities: Audio inputs, 3 microphones, line level in, VCR audio (play) input. Audio outputs, line level out, VCR audio (record) output

Simultaneous Display of incoming and Outgoing Video: Yes

Versions Available to Run Video On:

Ethernet:

Token Ring:

FDDI:

ISDN: 3 ISDN lines

Analog Tel Line:

Leased Line: Yes

Switched 56 Line:

T1/Fractional T1: Yes

T3:

E1:

ATM:

Frame Relay;

Internet: Yes

Upgrade Capabilities: PC based, easy to upgrade

Hardware:

Video Camera: Presets, 6 local, 6 remote

Camera Controls: Up to 4 pan/tilt/zoom cameras

Focal length: 6 -- 64mm
Iris:
Zoom:
Pan: 100
Tilt: + 25
Movability:

Microphone: 3 microphones

Speakers:

Total Number of Boards per System;

Codec:

ISDN Adapter:

NT1:

PC Bus Types Supported:

Software: (More information on Room system, please see the next appendix)

Appendix I: Some Room System Products List

VTEL Products:

1) TC1000 Rollabout Conferencing System:

Key Features:

Audio/Video
- High-quality single-or dual-27" monitor system
- 128 kbps line rate
- Picture-in-Picture
- Still image capture
- Full-duplex with adaptive echo cancellation

Collaboration
- Drag-and-drop file transfer
- Single-button-launch application sharing
- LAN, WAN or internet capable
- Pen Pal Graphic slide presentation and annotation

Available Options
- SMART Board interactive electronic whiteboard
- CameraMan auto-tracking camera
- Multipoint chair control
- Smart View control software and document stand
- Integrated PC sound
- Phone add allows telephone-only participants (U.S./ Canada)
- T1 (1536 kbps) line rate
- Wireless keyboard and mouse
- Quad basic-rate interface (BRI) for transmission speeds up to 512 kbps
- Remote diagnostics
- VCR support
- QuickFrame (increases frame rate to 30 frames per second)

2) TC2000 Large Group Conferencing System:

Key Features:

Audio/Video
- High-quality single-or dual- 27" or 32' monitor system
- 512 kbps line rate

True 30-frames-per-second video
Picture-in-picture
Still image capture
Full-duplex with adaptive echo cancellation
VCR support

Collaboration
Drag-and-drop file transfer
Single-button-launch application sharing
LAN, WAN or Internet capable
Pen Pal Graphics slide presentation and annotation

Available Options
SMART Board interactive electronic whiteboard
CameraMan auto-tracking camera
Multipoint chair control
Ethernet LAN card
SmartView control software and document stand
Integrated PC sound
Phone add allows telephone-only participants (U.S./Canada)
T1 (1536 kbps) line rate
Wireless keyboard and mouse

LC5000 Advanced Smart Videoconferencing:

Key Features:

Audi/Video
High-quality dual-27" or 32" monitor system
T1 (1536 kbps) line rate
True 30-frame-per-second video
Picture-in-picture
Still image capture
Full-duplex with adaptive echo cancellation
VCR support
Integrated PC sound
SmartView control software and document stand
Phone add allows telephone only participants (U.S./Canada)

Collaboration
Drag-and-drop file transfer
Single-button-launch application sharing
LAN, WAN or Internet capable
Pen Pal Graphics slide presentation and annotation
Wireless keyboard and mouse

Available Options

SMART Board interactive electronic whiteboard
CameraMan auto-tracking camera
Multipoint chair control
Ethernet LAN card

Listing of Main Features

	TC1000	TC2000	LC5000
CPU Pentium	133MHz	133MHz	166MHz
CPU Memory	16MB	16MB	32MB
Line Rate	128 kbps	512 kbps	T1
Monitor	Single/Dual 27"	Single/Dual 27"/32"	Dual 27"/32"
Furniture	SmartCart	S	S
ESA Architecture	S	S	S
AppShare	S	S	S
Pen Pal Graphics	S	S	S
QuickFrame (30 fps)	O	S	S
VCR Support	O	S	S
Remote Diagnostics	O	S	S
SmartView	O	O	S
Document Stand	O	O	S
Phone Add(U.S and Canada)	O	O	S
Integrated PC Sound	O	O	S
Wireless keyboard And Mouse	O	O	S

S = Standard feature, O = Optional feature

PictureTel Products:

Venue - 2000 Model 30

Specifications:

Audio

PictureTel audio enhancements fully compatible with H.320 standards
Full Duplex Echo Cancellation
Suto noise suppression and auto gain control

Audio Performance

Narrowband (toll quality)

G.711	56 or 64	300 Hz-3.4 KHz
G.728	16	300 Hz-3.4 KHz

Wideband

G.722	48 or 56	50Hz-7.0 KHz
PT724*	24	50Hz-7.0 KHz

high quality audio and video for pictureTel to PictureTel communication

Audio Inputs

Aux. Output Microphone

Audio Output

Aux. Output

Audio Privacy Mode (mute)

Near end mute in Auto answer mode

Line Inputs

ConnectorReference level
Clipping level
Output impedance

Line and VCR Audio Outputs

Connector
Reference level
Clipping level
Output impedance

Transmission Speed
56-128 kbps
Up to 1920 kbps

Network Interfaces Supported

ISDN BRI standard
Optional integrated interfaces (may choose one);
Dual V.35 w/Dual RS-366 for dialing
Dual RS-449 w/Dual RS-366 for dialing
(may also be used for non-dialed connections)
Dual 4-wire switched 56
Triple ISDN BRI w/ integrated BONDIG inverse multiplexer
T1-E1 non-dialed interface

Features and Options

Features:

Supports 20-, 27-, 32- and 35- inch displays
Picture-in-picture windowing (PIP)
Far-end camera
Near & Far end camera preset
Freeze frame graphics
VCR audio
On-screen menus and help
Speed dial directory
H.320 and H.243 bridge compatible, voice activated
Manual, auto answer
Two Rs-232c serial ports: 300 bps-19.2 kbps
Languages available for menus, keypads and user guides; English, French, German, Japanese, Italian, and Spanish

Options

Virtuoso 9ANS, AGC, PowerMic)
Look-At-Me-Button
Remote diagnostics over POTS line
Secondary display (RGB) fpr graphics
High data rates software 9HDR-2)

Venue 2000 Model 50

Specifications

Audio

PictureTel audio enhancements fully compatible with h.320 standards:
Full Duplex Echo cancellation

Auto noise suppression and auto gain control

Audio Performance

Narrowband			
	G.711	56 or 64	300Hz-3.4 KHz
	G.728	16	300 Hz-3.4 KHz
Wideband			
	G.722	48 or 56	50Hz-7.0 KHz
	PT724	24	50Hz-7.0 KHz

Audio Inputs
- Aux. Output
- Microphone

Audio Outputs
- Aux. Output

Audio Privacy Mode (mute)
- Near end mute Auto Answer mode

Line Inputs
- Connector
- Reference
- Clopping level
- Output Impedance

Line and VCR Audio Outputs
- Connector
- Reference level
- Clipping level
- Output impedance

Transmission Speeds
- 56-128 kbps
- Up to 1920 kbps

Network Interfaces Supported
- ISDN BRI standard
- Optional Integrated interfaces
- Dual V.35 w/ Dual RS-366 for dialing
- Dual RS-449 w/Dual RS-366 for dialing
- (may also be used for non-dialed connections)
- Dual 4-wire switched 56
- Triple ISDN BRI w/integrated BONDING inverse multiplexer
- T1-E1 non-dialed interface

Features

Virtuoso (ANS, AGC, PowerMic)
Supports 20-,27-, 32-inch displays
Picture-in-picture windowing (PIP)
Far-end camera control
Near & Far end camera preset
Freeze frame graphics
VCR audio
On-screen menus and help
Speed dial directory
H.320 and H.243 bridge compatible, voice activated
Manual, auto answer
Two RS-232c seriel ports:300 bps-19.2kbps
Languages available for menus, keypads and user guides; English, French, German, Japanese, Italian, and Spanish

Options

Look-At-Me-Button
Remote diagnostics over POTS line
Secondary display (RGB) fpr graphics
High data rates software 9HDR-2)

Concorde.450

Specifications

PowerCam 100
Type ……1/3 Hi-res color CCD
Minimum illumination …… 7 lux
White balance …….Auto or manual
Horizontal resolution …….20 lines
Zoom range …….10 x

Audio
IDEC …….. Full Duplex
Echo cancellation ……IDEC
AGC …… max. gain 12 db
ANS …….12 db
PowerMic
Coverage ……. 360 degree
Frequency Response ……100-7000Hz

Audio Performance

SG3	Proprietary	50 Hz-7.0 KHz
SG4	Proprietary	50 Hz-7.0 KHz
G.722	ADPCM	50 Hz-7.0 KHz
G.711	A-law or u-law	300 Hz-3.4 Kz
G.728	CELP	300 Hz-3.4 KHz
PT724	Proprietary	50 Hz-7.0 KHz

Audio Inputs

- PowerMic input
- Auxiliary icrophone inputs
- Line-level inputs (for microphone mixer and VCR)

Audio Output

- Integrated BOSE speaker system optimized for voice

Audio Privacy Mode (mute)

- Near end mute in Auto Answer mode

Line Inputs

- Connector
- Reference level
- Clipping level
- Output impedance

Line and VCR Audio Outputs

- Connector
- Reference level
- Clipping level
- Output impedance

Features

- KG-194 External encryption devices
- QuickPad Infrared keypad
- Groupview
- 10 LAMBS per camera
- Connection to live Gateway for LAN/WAN interoperability