

AD A136669

①



Report

Prepared for
ARPA

AN EVALUATION OF VERY COMPRESSED VIDEO-
CONFERENCING AND A SHARED GRAPHICS WORK SPACE -
AIR FORCE MANPOWER AND PERSONNEL CENTER, SAN ANTONIO

January 1983

Patrick White

MDA 903-83 -0-0470
(AO 3855)

DTIC
ELECTE
S JAN 9 1984 D
A

DTIC FILE CY

84 01 09 069

This document has been approved
for public release and sale; its
distribution is unlimited.

The Economist Intelligence Unit Ltd

Spencer House 27 St James's Place London SW1A 1NT Telephone 01-493 6711

© THE ECONOMIST INTELLIGENCE UNIT LIMITED 1982 ALL RIGHTS RESERVED

This report is produced on the strict understanding that it is confidential to the client and his staff. Its contents must not be disclosed to third parties or reproduced in whole or in part, by any means, for publication or for the use of third parties without the permission of The Economist Intelligence Unit Ltd. given in writing. It may, however, be reproduced in whole or in part for internal use within the client's own organisation at the client's discretion.

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) An Evaluation of Very Compressed Video-Conferencing and a Shared Graphics Work Space AF Manpwr & Personnel Center, San Antonio		5. TYPE OF REPORT & PERIOD COVERED
7. AUTHOR(s) Patrick White		6. PERFORMING ORG. REPORT NUMBER
9. PERFORMING ORGANIZATION NAME AND ADDRESS The Economist Intelligence Unit Ltd.		8. CONTRACT OR GRANT NUMBER(s) MDA903-83-C-0470
11. CONTROLLING OFFICE NAME AND ADDRESS DARPA		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS AO 3855
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		12. REPORT DATE Jan 1983
		13. NUMBER OF PAGES 64
		15. SECURITY CLASS. (of this report) Unclassified
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT (of this Report) This document is approved for public release and sale; Distribution is unlimited. This document may be reproduced for any purpose of the U.S. Government.		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) VIDEO-Conferencing AUDIO COMPUTERS		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) The rept describes the results of the evaluation of a videoconference system carried out for the US Def Advanced Resch Projects Agency. The author spent three weeks in 1982 running and observing videoconferences held between two ofce in the AF Manpwr & Personnel Ctr., on the Randolph AFB in San Antonio, TX. The Vidoioconference sys used a very compressed video image. The participants were able to retrieve & jointly create graphics using the Shared Graphics Work Space. The conclusions drawn from this exercise are soley the responsibility of the author & should not be interpreted as representing the views of DARPA Or the United States Gov.		

DTIC
ELECTE

JAN 9 1984

S
A



The Economist Intelligence Unit Ltd

London Headquarters

The Economist Intelligence Unit Ltd
Spencer House
27 St James's Place
London
SW1A 1NT

Telephone 01-493 6711
Telex 266353

Regional Office - West Europe

The Economist Intelligence Unit (Europe) SA
137/5 Avenue Louise
B-1050 Brussels

Telephone 02-538 29 30

Other offices, associates and representatives are located in:

Argentina	Greece	Portugal
Australia	Hong Kong	Saudi Arabia
Bolivia	India	Singapore
Brazil	Ireland	South Africa
Canada	Italy	South Korea
Ceylon	Japan	Sweden
Chile	Kenya	Turkey
Columbia	Lebanon	Uruguay
Cyprus	Malaysia	USA:
Denmark	Mexico	<i>New York</i>
Ecuador	New Zealand	<i>Chicago</i>
El Salvador	Norway	<i>San Francisco</i>
Finland	Paraguay	Venezuela
France	Peru	
Germany	Philippines	

**In addition EIU research correspondents are in
almost every country throughout the world**

AN EVALUATION OF VERY COMPRESSED VIDEO-
CONFERRING AND A SHARED GRAPHICS WORK SPACE -
AIR FORCE MANPOWER AND PERSONNEL CENTER, SAN ANTONIO

CONTENTS

	<u>Page</u>
1. SUMMARY	1
2. INTRODUCTION	6
3. VIDEOCONFERENCE EQUIPMENT	8
3.1 Compressed video	8
3.2 Audio	9
3.3 Shared graphics work space	10
4. RESEARCH METHODOLOGY	14
4.1 Procedure	14
4.2 Personnel	16
4.3 Meetings held on the system	17
5. TRAINING	19
5.1 Preliminary instruction	19
5.2 Difficulties encountered	21
5.3 Learning period	26
6. MEETING PERFORMANCE	27
6.1 Users' perceptions	27
6.2 Observations	31
7. ATTITUDES TOWARDS AND USE MADE OF THE EQUIPMENT	38
7.1 Compressed video	38
7.2 Audio	40
7.3 Shared graphics work space	41
8. RELIABILITY OF THE EQUIPMENT	50
9. CONCLUSIONS AND PROCEDURES TO BE ADOPTED	52
APPENDIX A: THE QUESTIONNAIRE	
APPENDIX B: THE SUMMARY COMMAND CARD	
APPENDIX C: THE MODIFIED SUMMARY COMMAND CARD	



Accession For	
NTIS GRA&I	<input checked="" type="checkbox"/>
DTIC TAB	<input type="checkbox"/>
Unannounced	<input type="checkbox"/>
Justification	
By <i>Per M. M. M. M.</i>	
Rv <i>Butterch. file</i>	
Distribution/	
Availability Codes	
Dist	Avail and/or Special
<i>A-1</i>	

AN EVALUATION OF VERY COMPRESSED VIDEO-
CONFERENCING AND A SHARED GRAPHICS WORK SPACE -
AIR FORCE MANPOWER AND PERSONNEL CENTER, SAN ANTONIO

1. SUMMARY

The report describes the results of the evaluation of a videoconference system carried out for the US Defense Advanced Research Projects Agency. The author spent three weeks in 1982 running and observing videoconferences held between two offices in the Air Force Manpower and Personnel Center on the Randolph Air Force Base in San Antonio, Texas.

The videoconference system used a very compressed video image. The participants were able to retrieve and jointly create graphics using the Shared Graphics Work Space (SGWS). The conclusions drawn from this exercise are solely the responsibility of the author and should not be interpreted as representing the views of the Defense Advanced Research Projects Agency or the United States Government.

The main conclusions drawn in this report are listed below under various headings:

Use of the Shared Graphics Work Space (SGWS)

- Before their first videoconference, most groups required a 25 minute demonstration on how to use the SGWS. However, the modified summary command card, included here as Appendix C, may suffice for some first time users so long as at least one other person at their meeting has had previous experience of the system.
- People felt confident about using the system after only one practice session.

- Some difficulties were encountered when using the SGWS. Improvements can be made which would facilitate its use. For instance, appointing one colour as a default colour would mean that, when a colour is not correctly selected immediately before a person attempts to write or draw on the SGWS, this default colour would be traced out. The meeting thereby need not suffer seriously as a consequence of a user's forgetfulness.
- Reducing the pressure required to write using the wired pens would improve the legibility of hand writing. At present the tops and bottoms of letters may be lost.
- Erasing lines is an unsatisfactory and slow procedure and could benefit from faster local processing.
- The role of the indicators SA1, SA2, SA3, DC1, DC2 and DC3 was not obvious to a new user.
- All switches should work in a consistent manner. 'Select one person view', 'select three person view' and 'view yourself' should all work as mutually exclusive one way switches.
- Participants had no clear idea of what the compressed image should look like and did not generally adjust the contrast level during a meeting.
- Other difficulties arose from the fact that users were unclear as to which images were actually being shared on the SGWS. This could be remedied if an extra monitor portrayed what the remote site were looking at during a meeting.

Users' attitudes towards their videoconference

- 40 per cent of participants felt that they were more satisfied with their videoconference compared to similar face to face meetings. Conversely 22 per cent were less satisfied compared to their experience and expectations of similar face to face meetings.
- 40 per cent of participants felt that their videoconference was more time consuming than a similar face to face meeting, and 21 per cent felt that it had been shorter.

- Overall in terms of the other factors which describe a meeting, such as the participants' cooperation, the meetings effectiveness, decision quality etc, between a third and a half of the participants felt that had been an improvement. However, between 10 and 20 per cent felt that their meeting had in fact been impaired by being held over a videoconference system.
- Meetings of over two hours duration were felt to be fatiguing. This may in part have been due to the poor acoustic treatment of the rooms.

Observations on the meetings

- Examining the meetings themselves, it is vital that the chairperson starts the meeting by getting all the participants to talk across the system.
- There was a wide disparity in individuals' participation levels. Some more junior personnel remarked that they felt less inhibited using the system. However, very quiet personnel appeared to talk even less over the system and preferred to talk only to their immediate neighbour.
- Interaction between sites was exaggerated in comparison to that within sites. Participants were, perhaps subconsciously, compensating for restrictions imposed by the medium and spoke where non-verbal cues would have sufficed in a face to face meeting.
- Participants relied on being able to recognise a person's voice when identifying who put forward a particular remark from the remote site. However, very little naming took place in the videoconferences and less than 1 per cent of remarks included a person's name in an attempt to direct a comment to a particular person. It would appear that the subject matter or context of a remark usually allows a person to discover any implied directionality of a remark.

Users' attitudes towards the equipment

- Whereas almost all participants felt the video image was adequate for holding a meeting, only 61 per cent felt that the quality was satisfactory and should not be improved.
- 96 per cent felt the audio system was satisfactory. However the rooms need to be acoustically treated and all extraneous sources of noise removed.
- About 80 per cent felt the SGWS worked satisfactorily. However various improvements were proposed.
- The time taken for the system to display a page is far too long for rapid scanning of the database.
- Words written on the touch sensitive screen tended to be illegible. A stylus is required.
- Transmitting an image from the overhead camera is far too time consuming to be carried out during a meeting.
- The 'view yourself' image is not similar in size to that actually transmitted and could not therefore be used confidently to adjust one's seating position so as to be in camera view.
- The position of the second SGWS monitor at the top of the surrogate column was not considered to be useful. Observers preferred to have a monitor lower down and closer to them in order to be able to read text etc.
- The SGWS was not suited to the large amounts of text. Legibility of text stored via the overhead camera was poor and could only be improved by reducing the amount of text displayed on the screen at any one time. This requires a special typeface and shorter lines and is undesirable for long pieces of text considering the limited number of pages available.
- A page printer was requested by some users. This would print an image displayed on the screen and avoid having to have someone transcribing the SGWS pages either during or after a meeting.
- Light from the overhead lights was reflected off all the monitors and impaired the legibility of the displays. Special studio lighting is required.

- The reliability of the equipment was poor over the course of the three week trial.

Implications for the future

- The equipment required servicing, maintenance strategies need to be agreed and spare equipment needs to be provided for if, and when, failures do occur either during or just before a meeting.
- The various improvements proposed in this report need to be considered seriously if the implementation of the equipment in Washington DC and San Antonio is to be a success.
- SIMeeting is very suitable as a training exercise. However, 'real' meetings are more valuable as sources of information on meeting processes in videoconferences.
- Questionnaires should continue to be used to examine participants' views once videoconferences are held between San Antonio and Washington DC.
- The next stage of the research will examine videoconferences held between five sites in Washington DC using a similar system to the one described here. It should be expected that some findings will differ, since there will only be one person present at each of the five sites.

2. INTRODUCTION

This report describes the results gained from the evaluation of a video-conference system situated on the Randolph Air Force Base in San Antonio, Texas. The work was carried out for the US Defense Advanced Research Projects Agency. The author spent three weeks in November and December 1982 running and observing videoconferences set up between two offices in the same building on the Base.

During December and January, one station will be moved to Washington DC and the system will be used, on a trial basis at first, to hold meetings between the two places. One of the objectives of this report is to provide information on the procedures to be adopted for when the two sides are distanced apart from each other. More sites are planned in the future.

It is anticipated that the teleconference link will enable savings in personnel time, costs and the lead time necessary to hold a meeting. It will no longer always be necessary for one party to travel to the other in order for a meeting to be held between personnel from the two places. However, a videoconference need not just act as a substitute for existing face to face meetings. New meetings may be justified when held as teleconferences which would not have been practicable as face to face meetings, such as those which would require relatively brief attendance from a large number of participants. Thus by improving the flow of information and aiding people's involvement in decision making, the efficiency and effectiveness of the Air Force may be further improved.

The two offices used in the trial were similarly equipped with the teleconference equipment described in Chapter 3. Each station was designed to cater for three active meeting participants plus additional observers who may see and hear the conference but who had only a limited ability to be heard or otherwise contribute to the meeting. The image which each station saw of each other was very compressed; monochrome with no grey scale and restricted temporal and spatial resolution. This equipment was designed by Compression Laboratories Incorporated specifically to maximise, by way of a computer based algorithm, the quality of the

picture transmitted while greatly minimising the necessary bandwidth required. In such a way transmission costs may be minimised, reliability be ensured in conditions of atmospheric disturbances and the signal itself is suited to fast encryption techniques.

In addition to the audio visual transmission system, each room was equipped with the Shared Graphics Work Space (SGWS), designed by Decisions and Designs Incorporated. Using this, the participants may each create graphics or write using six colours, and the collective image of their actions be seen at both stations, displayed on monitors. In addition each participant may draw upon various 'pages' of information: images stored on the computers, on videodiscs or from hard copy placed under an overhead camera. Such images with or without annotations may then be again easily stored on the computer as a series of pages. A further description of the equipment's capabilities is contained in Chapter 3.

This report describes the methodology used to examine the effect which the teleconference system has on meeting behaviour and performance. Observations on the meetings are discussed together with the reported attitudes of the users' themselves. An assessment of the equipment itself follows before making recommendations for actions which should be taken before, or when, the system is distributed between San Antonio and Washington DC.

The author would like to thank Major Allan Krueger and his colleagues in the Technology Applications Branch for suggestions made and invaluable help given publicising this exercise and recruiting volunteers to use the system.

All views and conclusions drawn in this report are solely the responsibility of the author and should not be interpreted as representing the views of the above persons nor of the official policies of the Defense Advanced Research Projects Agency or the United States Government.

3. VIDEOCONFERENCE EQUIPMENT

The description of the equipment given in this chapter will enable a reader to understand what facilities were made available to the conferees. For a more detailed account of the equipment the reader is referred to the Users Guide for the AFMPC Video Teleconference System written by Decisions and Designs Incorporated.

3.1 Compressed video

Two views of one room are shown in figures 3.1 and 3.2. The large eight foot long table has, along one side the three main seating positions for the conferees. Others may be seated elsewhere in the room, but they are not visible to the remote site nor can they interact with the system. They may however hear the discussion, be heard and view the remote participants. The second room is similarly laid out except for the fact that since it is also used as one person's office it also contains his desk and other related furniture.

In front of the table, the surrogate unit contains the monitor which displays the image of the remote participants. Normally, when a conference is first established, an image of all three remote participants appears on this screen. It is possible, however, to opt to view only the centre person at the remote site in which case the system switches to a second camera, also located just above the surrogate monitor, which is set up to give a close up view of the centre person's face only. Conferees may easily adjust their pneumatically controlled chairs so as to appear at an equal height and at the centre of the screen.

The picture quality of some existing videoconference systems and services, such as British Telecom's Confravision Service, is of near broadcast television standard. It is, however, very expensive to transmit such a signal. A more popular alternative digitalises the signal and then encodes, or 'compresses', the information describing the video image and so reduces the size (in bits per second (bps)) of the transmission path required. The picture is then recreated and displayed at the receiving

Figure 3.1

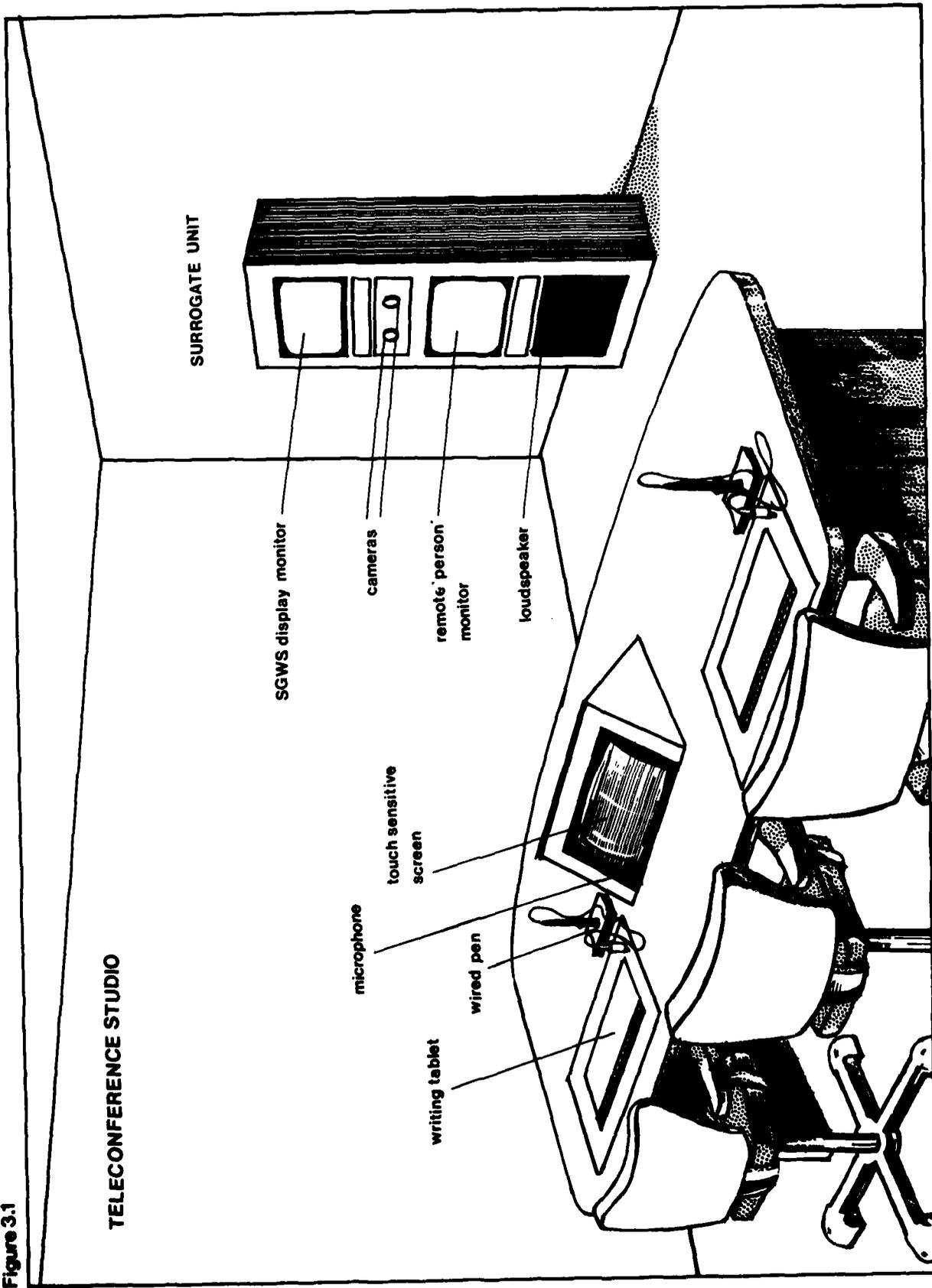
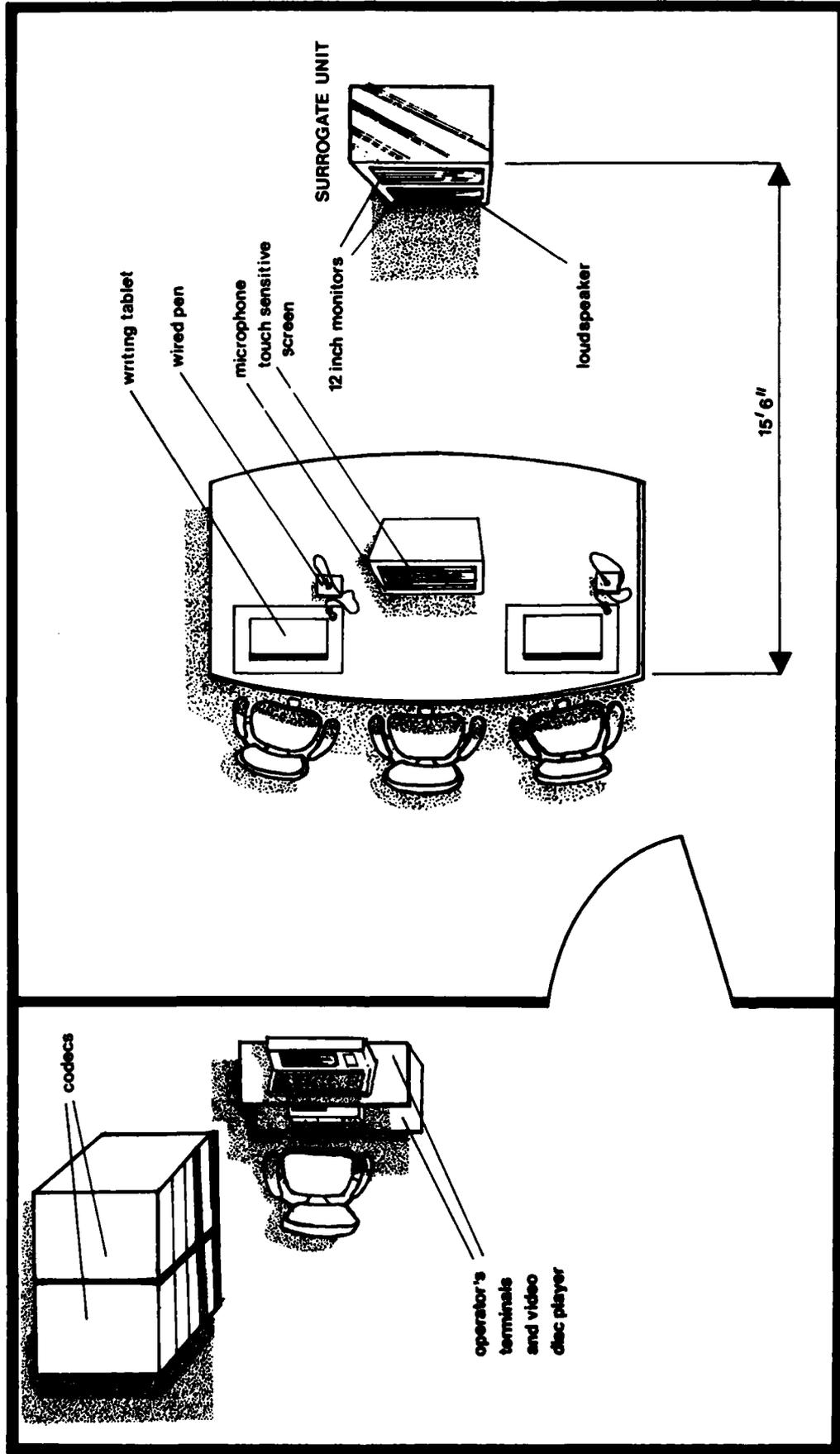


Figure 3.2
PLAN VIEW OF TELECONFERENCE SUITE (not drawn to scale)



station. The equipment used to digitalise and encode the outgoing signal and to decode the incoming signal and return it to an analog form suitable for display on a monitor is called a codec.

There is a level of redundancy inherent in a broadcast television standard signal which enables some compression to take place with relatively minor effect on the perceived quality of the resultant picture. The high frequency at which the still images, which make up a 'full motion' picture, are replaced can be reduced, while maintaining a high refreshment rate so as to avoid flicker. In addition, applying simplified codes for when areas contained in an image do not change or move or are of even brightness and colour can reduce the bandwidth required from about 48 Mbps to 1.54 Mbps, or the size of a T1 carrier. More sophisticated technologies can reduce this bit rate even further.

The codecs installed in San Antonio produce a near full motion monochrome image at a transmission rate of 19.2 Kbps. The image contains about 120 Pels (Picture Elements) and is updated approximately eight to 11 times a second. Elements of the image appear either black or white. There is no colour nor any shades of grey. The effect of the compression process which enables such a low transmission rate is for any changes in contrast or edges to appear as black lines on an otherwise white background. In addition, only the centre portion of the image is transmitted; about a quarter of the total area of the screen.

3.2 Audio

The audio system is an open one in that all participants may speak and be heard at the same time. A hidden microphone is located to the side of the Shared Graphics Work Space monitor shown in figures 3.1 and 3.2. It is especially sensitive to the voices of the three main participants but may also pick up the voice of anyone in the room.

The microphone is thus directed away from the loudspeaker, which is located in the surrogate unit.

3.3 The shared graphics work space

The Shared Graphics Work Space (SGWS) monitor is set into the table at an angle in front of the centre position. This monitor is equipped with a touch sensitive screen. A similar monitor, but without the touch sensitive screen is located at the top of the surrogate unit. This second monitor always displays an identical image to the one displayed by the desk top monitor and allows any extra people elsewhere in the room to also view the same image as is seen by the three main participants.

The two side participants interact with the SGWS using two digital tablets. These pads allow them, using special pens, to have equal control over the SGWS as does the participant positioned in the centre.

The Shared Graphics Work Space can be in three modes of operation. In each mode, a different menu of the possible options available is displayed on the screen. Boxes appear on the screen, each one identified by a label or legend. Touching or tapping one of these 'buttons' activates a particular process. A user may either touch the screen with his, or her, finger or tap the respective position on a pad, using the pen. A user obtains some feedback concerning the success or appropriateness of his, or her, action. If successful the box lights up on the screen and 'beep' sounds, otherwise they get a 'blat'.

When a station is first powered on, the Control Panel Menu appears on the screen. This menu allows a user, by pressing the appropriate button to:

- Call the other site. When both sites each call each other the conference is established and the audio and video signals transmitted. Conversely each site can also hang up once the conference has been completed in order to break this connection. The live computers however remain linked and may for instance pass information between them.

Once a conference has been established, a user may also:

- Control the volume of the discussion he, or she, hears. However, a user cannot control the level at which a remote site hears him, or her, except by altogether hanging up or leaving the studio, (i.e. there is no mute button or microphone on/off switch).
- Increase or decrease the contrast of the image, or the system's sensitivity to edges and changes in contrast. The required sensitivity is dependent on the amount of detail or contrast in the image.
- Choose between viewing all three people at the remote site or instead zooming in on the centre person only.
- View him, or herself. The image thus seen is similar in quality to that seen by the remote site and can be used to adjust chair height, for example. However, this self view image takes up the whole screen, unlike that seen by a remote site and can not therefore be always relied on to ensure that one is in the remote site's field of view.

Information in the form of monochrome pages of text or graphics may be retrieved via the SGWS. Such pages can come from three sources:

- Up to 50 pages may be stored on both stations' computers.
- Each station has its own videodisc player. A videodisc can hold up to 54,000 frames or pages. (However, it is not possible to re-record frames on a videodisc).
- Each station has an overhead camera which may be used to display anything positioned underneath. Such images, as well as selected images from a videodisc may then be stored as pages on the computer.

Activating the Access Shared Work Space 'button' on the Control Panel Menu, causes that menu to be replaced by the first of the pages stored on the computer. At the bottom of the screen a new menu of possible functions is displayed; the Main Menu. A user may display any one of the 50 pages stored on the computer or, by moving to a third menu and then returning, one from the videodisc or the overhead camera.

Using a blank background or alternatively any one of the above pages as a background, it is possible for a user to create new graphics. Choosing any one of six colours, a user may draw or write on the screen using the pressure of his, or her, finger or finger nail. It is possible to use the side writing tablets in the same way. Pressure on the point of the special pens activates a switch and enables the computer to calculate whereabouts the pen is positioned on the pad. Whatever a user draws on the pad is therefore faithfully reproduced in the appropriate position on the display monitors. In order to judge exactly where a corresponding point on a pad is, faint touching of the pen on the pad gives rise to that person's indicator appearing in the appropriate place on the screen. Each of the six main participant's actions are identified by an indicator (SA1, SA2, SA3, DC1, DC2 or DC3). Once the indicator is positioned in the correct place, firmer pressure on the pen results in whatever is drawn on the pad being reproduced on the screen as before.

The Shared Graphics Work Space can be used either in a stand-alone mode or once a conference has been established. It is preferable to prepare a presentation, in advance, in stand-alone mode; taking pages in turn from a videodisc or the overhead camera, annotating or labelling them and then storing them as a series of pages on the computer together with any new pages which may have been created entirely on the system. When completed the local station may then be powered down at the table and copies of the images be transmitted to the remote site ready to be quickly and easily scanned during the conference.

When a conference has been established, every action any user makes while displaying the Main Menu will be apparent to both sites. The SGWS images seen at both sites are identical and equal to the sum total of all the users' contributions in terms of lines drawn or words written. All six main users may be all drawing or writing at the same time using the same or different colours on the screen or on a pad. All users have equal power to change the pages displayed or delete it. However, if one side moves to the mother menu, the Control Panel Menu, for instance, to adjust their volume, the other site may remain watching and working on whatever image was being displayed previously.

In order to view something from under the overhead camera or from the videodisc, it is necessary, to move from the 'main menu' to the 'select background menu'. When an image is first retrieved from the videodisc or from under the overhead camera, it is seen only by the local site which initiated that action. Only when they are sure that they want the remote site to also see what they themselves are looking at need they transmit the image. This process is faster when a videodisc image is involved since both sides should each have their own identical copy of the disc and the 'transmitting' computer need only tell the other whereabouts on its own disc to find the particular image. An image derived from the overhead camera, however, needs first to be coded digitally and then actually transmitted. If a conference is in progress this may take about four minutes during which the SCWS can not be used. Alternatively, if both stations are powered off at the table, the transmission process may use all the bandwidth available since no picture nor sound need also be transmitted, and the process is somewhat faster.

4. METHODOLOGY

4.1 Procedure

The objectives of the research were to:

- evaluate group to group teleconferencing in a real setting;
- gather users' reactions to videoconferencing via an extremely compressed bandwidth;
- gain information on the use made of and problems associated with the Shared Graphics Work Space;
- develop protocols for the use of videoconferencing facilities in the Washington trial;
- test and develop a simulation task for use in the Washington trial.

In order to achieve these objectives the author observed, over a period of three weeks, meetings held over the videoconference system. In each meeting, half the participants were seated in one office, half in the other. The total number of participants in any one meeting ranged from two to 11. Some of these involved volunteers using the system to carry out discussion tasks arranged by the author, while others involved participants using the system to carry out a meeting which formed a part of their normal work.

Before the meetings commenced the participants were informed of the objectives of the trial and were given a short introductory demonstration of the use of the Shared Graphics Work Space. The meetings themselves lasted from 30 minutes to four hours. The usual length was about one hour. Afterwards the participants collected in one room to complete questionnaires and put forward any comments they wished to make.

The questionnaires given at the end of the sessions examined the participants' attitudes towards the quality of their meeting and the equipment, and their use of the various controls available. A sample questionnaire is contained in Appendix A.

During each meeting a paper record was kept of the number and order of contributions made by individual participants. The purpose of this was to examine participation levels and the sequencing of speech between and within sites. In addition since five minute intervals were also marked on the paper record sheet, it is possible to monitor some changes in activity during a teleconference. However no record was kept of the duration of each individual's comment since this would have required considerable more manpower recording and analysing the information.

The author sat in one room to record and observe the meetings. Detecting exactly who within the remote site made a particular comment was not always possible. However it was possible to know the total number of comments made. In order to analyse individual participation levels, it was therefore, only possible to sample one site at a time. There may have been some confounding effect from having the experiment controller appear in the same side as the measurements were taken. However comparing average participation levels between sites and the questionnaire results, no significant differences are apparent and it is likely that any effect was negligible.

Some meetings were recorded using a single audio tape recorder, placed in the room. It was not possible to record individual site's contributions directly from the system. Therefore the quality of the recordings made was not good enough to examine speech patterns, but does enable particular phases, like the introductory phase for instance, to be listened to again in retrospect.

The questionnaires given at the end of the sessions examined the participants' attitudes towards the quality of their meeting and the equipment, and their use of the various controls available.

In addition to the above meetings the system was used for demonstrations. Much information was also obtained from asking a naive but technically competent senior person to attempt to examine and use the system without any aids apart from a sheet summarising the system's commands (the summary command card) which was given to all users and is attached as

Appendix B. The purpose of this session was to examine which controls were most difficult to understand and the feasibility of letting personnel use the system being without any instruction.

Finally much information was gained from the author's own use of the system and from discussions with the person responsible for the equipment and its use on the Base. At the end of the three week project an outbrief was held attended by Colonel Kurtz, Lieutenant Colonel Livings and Major Krueger.

4.2 Personnel

Personnel were recruited from departments within the Air Force Manpower and Personnel Center on the Randolph Air Force Base in San Antonio. Most participants had expressed an interest in using the system in response to a memo sent out by the Technology Applications Branch.

In total 84 participants used the system to hold meetings, five took part in demonstrations and one attempted to teach himself how to use the system. 16 meetings took place on the system; the largest involving 11 people and the smallest only two. The average number of participants per meeting was over five. One person left before a meeting commenced because looking at monitors made him feel ill.

Participants included members of the United States, Australian and Canadian Air Forces, the US Navy and civilians. Table 4.1 shows a break down of the participants. Most users, had never seen or used the system before. Two people had used it and two had observed it being used. Within the experimental meetings, personnel were often drawn from different departments and in some cases met for the first time during the session.

Questionnaires were completed by 82 of the 84 participants who took part in the meetings. Two people had had to leave during a meeting before having had enough time to be able to comment in detail about its use or effect on meeting behaviour.

Table 4.1. Description of Personnel

<u>Rank or category</u>	<u>Meeting participants</u>	<u>Other users</u>	<u>Total</u>	<u>%</u>
Colonel	1	2	3	3
Lt. Colonel	1	-	1	1
Major/Squadron Leader	6	1	7	8
Captain	6	1	7	8
Lieutenant	1	-	1	1
Sergeant	16	-	16	18
Airman	19	-	19	21
Civilian/other/don't know	34	2	36	40
Total	<u>84</u>	<u>6</u>	<u>90</u>	<u>100</u>

4.3 Meetings held on the system

The majority of meetings held on the system (14 of the 16 in total) used a discussion task produced by Satellite Business Systems, called SIMeeting. This task was designed specifically by David Green and Kathy Hansell to introduce businessmen to teleconferencing. The objective of the task is to sequence six hypothetical speakers from different departments of an organisation in the most logical order for a day long presentation of a new product. The different departments are Legal Affairs, Planning, Advertising, Technical Development, Marketing and Competitive Analysis. The next stage of the task is to allocate times and durations to each speaker. Notes were provided on each speaker, along with photographs.

The task is seemingly simple, yet does provoke discussion and require many decisions to be made. It does not require any specialised prior knowledge, lengthy instructions nor that the participants know each other or indeed come from the same department. The task is a realistic one and is an example of the type of meeting for which a teleconference is very useful, i.e. when many people need to meet for a brief length of time, in this instance to agree on a schedule or agenda in advance of a lengthy face to face meeting.

In addition, since the scheduling form was maintained on the system, it allowed the users to experiment working together drafting and redrafting a complex table using the SGWS. Furthermore, pictures of the particular speakers, and in most meetings, copies of the notes about them, were also stored as pages on the computer. Participants were thus able to retrieve information via the SGWS and use it to create new tables or graphics.

A true test of the medium and the SGWS, however, can only be obtained when the teleconference system is used to hold real meetings which form a part of the participants normal work and in which there is a greater level of motivation to achieve individual and group success. Therefore, two such meetings were arranged. The first involved 11 people who envisaged using the system when one station is moved to Washington DC. Roughly half are usually located in San Antonio and half in Washington DC. Their meetings, which take place regularly, require contributions from all participants and concern the drafting of legal regulations. The particular meeting they held over the system involved the redrafting of a 27 page document, previously drawn up by one of the group. The meeting lasted four hours, excluding breaks for coffee and lunch. In the second meeting four members of the D.P. Department discussed various issues for about an hour.

It had been hoped to hold more 'real' meetings over the system, but this was not possible for various reasons. One other day-long meeting which had been scheduled had later to be postponed by a week by which time the system was due to be relocated. Secondly while individuals may have been keen to learn how to use the system on a trial basis, it was more difficult to persuade a whole working group to hold a 'real' meeting. The reliability of the system during the last two weeks of the project was such that the author could not confidently assure users that their meeting would not be impaired by some sort of system failure. This question about the system's reliability is discussed further in Chapter 8.

When one station is relocated in Washington DC, there will be an incentive for groups to use the system in order to avoid travel costs and wasted time, and there will have been time to service the system. It was important not to discourage potential users with an unsatisfactory previous experience of using the system.

5. TRAINING

5.1 Preliminary instruction

Before each meeting, the author went through each menu explaining and illustrating the effect of each control or command. This process took about 25 minutes. Each user was also issued with card which showed the three menus and summarised each 'button's' function (see Appendix A). Furthermore the users were positively encouraged to experiment with the system during their meeting and the author was available throughout the meeting to answer any queries or give explanations.

As well as explaining the function of every 'button' it was also necessary to tell the users:

- That they should not use the pens on the touch sensitive screens. (This was not specifically stated in the first meeting held and the remote site drew an entire diagram on the screen. This finally disabled their screen and risked damaging its surface).
- How they should adjust the height of their chairs so that they would all be seen and would appear at the same height.
- That the touch sensitive screen should be tapped when activating a 'button', but that continued firm pressure should be applied when drawing or writing.
- That each person's position was identified by either SA1, SA2, SA3, DC1, DC2 or DC3 and that it would be apparent which of the six main users caused what action or drew which line by the fact that his, or her, indicator appeared in the respective 'button' or by the line.
- That, when writing or drawing, the position of a pen on a pad in relation to the display on the monitor could be judged since a light touch of the pen caused that person's indicator to appear on the screen in the appropriate position. Firmer pressure would result in a line being traced out by the movement of the pen.

- That transmitting an image from the overhead camera from one station to the other takes about four minutes, during which time the SGWS can not be otherwise used.

Difficulties with the equipment revealed themselves during the course of the trial and the instructions given to users were continually modified so as to attempt to anticipate them. These difficulties are summarised in the next section. After their meeting had been completed, some users were asked whether they felt that the instruction period had been necessary. Only one or two users felt they could have got by without it and most felt that it was preferable to hold a trial session of the type they had just had prior to a user's first real meeting. However those users who had used the system for the first time to hold a real meeting, while agreeing that instruction was necessary, did not by and large feel that a preliminary session was in fact required.

Notwithstanding the above, nor the fact that many users did make mistakes and get into difficulty during the course of a meeting even when they had had instruction, one session was held to investigate just how necessary instruction was. A senior person from a D.P. department was asked to attempt to investigate the purpose of and effects possible using the SGWS. The person concerned was technically aware and had a positive enquiring attitude towards the equipment. No information was given to him except for the fact that he should not use the pens on the screen and that it was touch sensitive. He was however given the summary command card. The system was already powered on when the person arrived at the station. Notes were taken of his mistakes, difficulties and comments.

He succeeded with very little help in working every control and understanding its purpose. However, it took him half an hour and involved 'blind alleys' down which a less persevering person may have got lost and given up. His difficulties and comments are summarised in the next section.

In conclusion, it would appear that some people may be able to use the system without preliminary instruction. A modified summary command card is included in Appendix C. This should serve as a minimum level of instruction given to anyone. However, the experimental process took longer for one person than did the oral instruction and demonstration given to a large group. In addition, the person concerned could not be thought of as a typical user.

Therefore, while the compressed video image and audio link is self-explanatory (and, if that is all that is required, a real meeting may commence immediately), it is preferable that at least some members of a group have used the SGWS before, or have been given the 20-25 minute oral instruction and demonstration. If one person wishes to use the SGWS to give a presentation, it may be adequate if only he has previous experience with the system. Otherwise, the participants will certainly not take full advantage of all the potential benefits of the system and may be distracted and/or defeated by the time consuming process of learning by trial and error.

The person giving the initial instruction need not remain in the meeting. However, there should be some means of calling for assistance if difficulties arise during a meeting. There is no computer based 'Help' facility on the system. Remarks which may appear during a meeting, displayed on the screen, such as 'transmission in progress' or 'updating other site' are not satisfactorily self explanatory nor are the comments written large enough so as to be obvious to a user who is not expecting them. A useful extra piece of information would be an estimate of how long the system expected to be in such a state of transmission, for instance.

5.2 Difficulties encountered

Some users encountered difficulties using the SGWS even when they had sat through the 25 minute introductory instruction. Usually it would take a minute or so for a user to attempt to remedy the situation before requesting the author's help. The important point here is not that users had forgotten certain aspects, that is to be expected on a complex piece of equipment such as the SGWS, but that the correct procedure was not obvious nor logical enough for them then to remedy their own mistake or forgetfulness.

Difficulties encountered when using the SGWS are summarised below. (Other more general comments made about the system by users are covered in section 7.3):

- The single most common mistake which occurred in almost all meetings was that, when using a pad especially, a user would attempt to draw or write, without having first selected a colour. Since the pen would indeed be writing on the pad, the user would deduce that the system was not working properly. A solution would be to make blue, for instance, the default colour. Therefore whenever a user firmly touched the screen above the Main Menu with his, or her, finger (or the pad, using the pen), a blue line would appear on the monitor's display, unless the user had previously selected another colour or the eraser function. (If a user wanted to draw without transmitting the result, in order to try out something, for example, all he or she need do would be to use a different ordinary pen).
- The second most common mistake was that a user would first select a colour using the monitor's screen and then attempt to write on the pad. The correct procedure needs to be emphasised during the initial instruction period, since the visual cue provided by the coloured squares on the screen's menu is much stronger than that of the colours' names written on the pads. However, if the above recommendation were adopted, a person would, by default, always succeed in writing in blue and the meeting need never be interrupted by the complete loss of a person's written input.
- The pens have two modes of operation; firstly, to indicate a position which is displayed on the SGWS monitor and secondly to actually trace out a line on the display. The pressure which needs to be exerted in order for the pens to work in the latter mode is greatly in excess of that needed for the ink to run as in normal handwriting. In order to write clearly it is necessary to write with the pen held nearly vertical while always applying firm pressure downwards. It is desirable that

the pens be modified so that its switch may be activated more easily. A normal level of pressure should result in a line being traced while an 'unnaturally' light touch should enable the pen to be used as an indicator. The present situation meant that some people failed to use the pads even when they had correctly selected a colour.

- Not one user adjusted the contrast level during a meeting. The volume control which functioned in a similar way was adjusted during a meeting. The working of the control was not therefore a problem. It appeared that naive users can have no clear expectations of what a possible better image may look like, while not being confident enough to experiment fully with the system. In two instances a whole meeting was carried out while the features of one site's participants were completely indistinguishable. A second point here may be that since these users did not complain about their picture quality, the normal compressed image is in fact more than adequate for their purposes.
- Erasing a line or word was found to be a difficult and time consuming procedure. It was sometimes necessary to retrace a wrong line several times before it disappeared from the screen. The problem was only partly due to the thickness of the screen creating parallax errors since difficulties arose even when the centre person was sure he, or she, was going over the correct spot. People's dissatisfaction may have been exacerbated by the few second delay which meant that even though they may have done the right thing first time, they needlessly repeated the process until the display was updated. Some local processing which showed a user the effect of his, or her action immediately would remove this source of dissatisfaction. The remote site would continue to be updated a few seconds later.
- All the controls on the SGWS are one way switches, except for one. A user must press 'view yourself' to display his, or her, own self view image, but must press it again to return to the normal mode of operation. Users would often instead next touch 'one -' or 'three person view' hoping to return to the

respective normal mode of operation. Since such an action would result in a confirmatory beep sounding and the appropriate button being lit up, users felt that they had indeed done the correct thing but that the system was 'jammed' in self view mode. A more logical arrangement would be to make the three buttons (one person view, three person view and view yourself), mutually exclusive, since the same monitor can only display one type of image at a time. Pressing any one 'button' should replace whatever image was presently being displayed by the newly selected one. I can see no advantage in being able to switch from one person view to three person view or vice versa, while viewing oneself since there is no outwardly visible effect unless both sides are both looking at themselves at the same time.

The difficulties encountered by the one person who successfully attempted to teach himself how to use the SGWS included those mentioned above. This person was informed at the start that the screen was touch sensitive, the writing pads could be used with the special pens and that summary information about each control or function appeared on the card he had been given. The first Control Panel Menu, created no new problems and was quickly mastered. He then tried the access shared work space button and encountered some additional problems which are set down below:

- It was not obvious where the image which was then displayed had come from, nor that such pages had page numbers. However in a real context, a user would presumably only look for pages of information, if he, or she, knew that they existed and had been given information about their page numbers. (The page numbering system was then explained briefly to him).
- No other problems were encountered while he created graphics over and above those already mentioned. However, it was not apparent to him that the 'buttons' on the pads were there other than for illustrative purposes and could in fact be worked.

- Once the fact that the pads could be used as could the screen, he would then attempt to activate one by drawing a very short line in the respective box. This had the effect of switching on and then off the function a number of times. Whether the ultimate state was on or off was therefore dictated by chance. He meanwhile incorrectly concluded that the writing tablet only worked very unreliably.
- Encountering similar problems as did the others when attempting to draw while not having first selected a colour, he finally learnt an erroneous procedure whereby in order to write on a pad, he would first select a colour at the screen and then, in addition, select the same colour at the pad whenever attempting to draw a line on the pad.
- He never noticed the indicators on the screen, nor the two levels of the pen's functioning (i.e. indicating versus writing) until this was pointed out to him after the exercise.
- When displaying the Select Background Menu, he was able to retrieve frames from the videodisc or images from under the overhead camera. However, the purpose of the 'verify' and 'cancel' buttons was not apparent. Especially since the same terms 'verify' and 'cancel' had been used previously in order to confirm or abort a clear page command.
- He was completely unaware of which images were being shared between the sites and which were seen only by him.

Conclusions drawn from this exercise were that, if it were necessary that someone be able to use the SGWS without the full training exercise, he or she should be informed in addition that:

- boxes marked on the pads could be worked by tapping them once;
- each position is identified by a unique indicator (SA1, SA2, SA3, DC1, DC2 or DC3);
- touching the pen on the pad gives rise to that position's indicator appearing in the appropriate position on the screen.

In addition the words 'verify' and 'cancel' in the select background Menu should be changed to 'transmit to other site' and 'return to main menu' for instance. Furthermore there should be one more monitor in each site, and displaying the image as seen by the remote site. While the remote site is displaying its Control Panel Menu or the Select Background Menu, a caption instead could appear indicating the fact.

5.3 Learning period

Participants felt that no more than one trial meeting was necessary in order to learn how to use the system. However, most were not then confident enough to want to use it for a very important meeting attended by a more senior participant, for instance.

No participants attempted themselves to prepare information for a meeting in advance. Therefore little information is available on the skills necessary. However from the author's own personal experience it would appear that after one or two trials a person should be confident enough to do so successfully without aid.

6. MEETING PERFORMANCE

The research examined the effect which holding a meeting over the video-conference system had on its style and quality. Questionnaires were administered after each videoconference and a number of observations were made concerning the meetings. It was not feasible to compare the behaviour of the same group of people meeting face to face and over the teleconference system carrying out similar tasks. Instead conferees were asked to estimate, from their own past experience of similar meetings, what changes they could perceive. In addition some aspects of their behaviour were monitored. This chapter first presents the conferees' own attitudes towards their videoconference and then presents measurements taken of their behaviour.

6.1 Users' perceptions

The research examined the effect which holding a meeting over the video-conference had on 13 qualitative aspects of a meeting. These factors are ranked in Table 6.1, according to the proportions of meeting participants who thought them important in their meetings. The most commonly indicated factors which were considered to be important were the effectiveness of the meeting and the quality of the decision, or decisions, made. Next most important appeared to be the cooperation of the participants and accessibility of information. The factors least commonly given as being important referred to a person's own level of control over the meeting, his, or her, sense of privacy, or security, and the aggressiveness or forcefulness, of all the meeting participants.

The questionnaires asked respondents to indicate, for each of the 13 factors, whether there had been any noticeable change comparing the videoconference they had just held with their experience of similar face to face meetings. The question asked whether there had been a large decrease, a small decrease, no change, a small increase or a large increase. It should be noted that for almost all conferences, it had been their first experience of a videoconference and some effects may have been due to the novelty of the technology. However most users had volunteered to take part in this project and may be expected to have

been objective and critical, but would not have included those having a negative attitude to videoconferencing and such technology.

Table 6.1. Factors Considered
by Respondents to be Important in Their Meeting

<u>Factor</u>	<u>% respondents</u>
Effectiveness	90
Decision quality	87
Cooperation of participants	85
Information accessibility	83
Own satisfaction with the meeting	79
Peoples' preparation	77
Task orientation of meeting	73
Friendliness of participants	70
Length of the meeting	67
Own contribution	65
Own control over the meeting	48
Sense of privacy/security	48
Aggression of participants	45

NB: Total of 16 meetings and 82 participants.

These comparisons are shown in Table 6.2. With respect to almost all the above factors, increases were reported by between a third and a half of the participants. Similarly, decreases were reported by smaller proportions of between a tenth and a quarter of the participants. Therefore while the length of most peoples' meetings appeared to have increased, otherwise it appeared that more people felt that, in other ways, the meeting had been improved than impaired.

Half the respondents considered that the conferees' effectiveness and cooperation had increased and 40 per cent that the decision quality had likewise. However the other factor which had been most frequently given as important; information accessibility, was considered to have been increased by 18 per cent. Twice as many users (40 per cent) were more satisfied with their meeting than were less satisfied (22 per cent).

**Table 6.2 Comparison
of the Videoconference with Similar Face to Face Meetings**

<u>Factor</u>	<u>% respondents reporting an increase</u>	<u>% respondents reporting a decrease</u>
Cooperation of participants	51 (1/3) ^a	12
Effectiveness	50 (half) ^a	23
Length of the meeting	41	21 (2/3) ^a
Own contribution	40	10
Decision quality	40 (1/3) ^a	12
Friendliness of participants	40	13
Own satisfaction with the meeting	40	22
Peoples' preparation	39	6
Task orientation of meeting	38 (1/3) ^a	15
Information accessibility	35	18
Own control over the meeting	33	20
Sense of privacy/security	32	23
Aggression of participants	21	18

NB: Total of 16 meetings and 82 participants.

a Results of the SBS study.

In conclusion it would appear that, comparing a videoconference held on this system with a similar face to face one, most users felt that the important factors had been either improved or remained the same. Over half felt that information accessibility remained the same, a further 18 per cent that it had been impaired. Users were only able to compare use of the SGWS with having paper based notes which could be passed around a table. It was not possible to obtain their opinions on teleconference alternatives such as facsimile machines and communicating word processors, for instance.

It is possible to compare these results with research done on other teleconference systems. Research carried out by Satellite Business Systems (SBS) in 1981/82¹ surveyed individual users of on-premises videoconferencing systems to determine their perceptions of benefits resulting from their use of the medium. Their results showed that half their respondents felt that the effectiveness of their meetings had been

¹ Videoconferencing in American Business: Perceptions of Benefit by Users of Intra-company systems (A First Look at User Responses) K.J. Hansell, D. Green and L. Erbring (1982).

improved and a third that the decision quality, peoples' cooperation and/or the task orientation of the meeting had each been improved. These results fit well with those collected in this survey. However, the SBS survey did find that two thirds of their respondents felt their teleconference meetings were shorter and 90 per cent were 'satisfied' or 'very satisfied' with their overall use of videoconferencing.

Research undertaken by members of EIU Informatics in 1980 for DARPA¹, used a four site videoconference system with monochrome full motion video. The research findings included the results that a third of the conferees found meeting participants to be more cooperative, half that the meetings more task oriented and 40 per cent that meetings were shorter. 83 per cent of users were either as satisfied or more satisfied (35 per cent) with their teleconference than with similar face to face meetings.

It would appear that the only discrepancies between the attitudes of the users of this system compared to those of other teleconference systems are that they are slightly less likely to be satisfied and consider meetings to have taken longer, not less, time. During the debriefing sessions, comments made by users were generally complimentary, and dissatisfaction voiced was not with the system as whole but rather with a number of aspects of the SGWS, especially. A number of proposed improvements were put forward and these are included in section 7.3. In particular, it was due to delays incurred in using the SGWS that some meetings were needlessly prolonged.

Table 6.3 shows the same information as figure 6.2, but for the two 'real' meetings only. It is not possible to compare data between the two tables and generalise about the differences with real as opposed arranged meetings, since there were only two real meetings. However, the levels of dissatisfaction shown and the widely reported increase in length of a meeting (nine out of 14 people) especially do illustrate the

¹ Teleconferenced Group Decision Making: Designing for improved performance. I. Young et al (1981).

importance of the suitability of a meeting for a teleconference treatment. In the large meeting of 11 people (10 of which completed questionnaires) they attempted to edit a large document (27 quarto pages or 50 computer based pages) stored on the computer. This had been typed using a normal typeface and entered on the system via the overhead camera. They encountered a number of problems, also covered in 7.3, and finally gave up using the SGWS.

Also of importance is the fact that the meeting was a very long one, four hours excluding coffee and lunch breaks. Levels of picture and sound quality were adequate for the hour long meetings, when people could compensate by speaking up and at the microphone. However, it was fatiguing to maintain this level of compensation over four hours.

Table 6.3. Evaluation of a Real Videoconference Meeting

<u>Factor</u>	<u>No. of respondents reporting an increase</u>	<u>No. of respondents reporting a decrease</u>
Length of the meeting	9	3
Cooperation of participants	6	5
Aggression of participants	4	4
Own contribution	4	6
Friendliness of participants	4	6
Sense of privacy/security	4	6
Own control over the meeting	4	7
Effectiveness	4	9
Peoples' preparation	3	2
Decision quality	3	5
Own satisfaction with meeting	3	9
Task orientation of meeting	2	4
Information accessibility	2	7

NB: Total of two meetings and 14 participants.

6.2 Observations

6.2.1 Introductory period. Members of the meetings held on the system had in most cases met one or more of the other participants, only sometimes did all members of a group know each other. When using the SIMeeting task, the author first explained the purpose of the exercise, the working of the SGWS and instructions of the task, while each group was assembled

all in one room. The groups would then split into two halves and people would read the hard copy version of the instructions. The time taken for a discussion to be established between the rooms varied considerably. Sometimes it would begin almost at once, while at other times would take 10 minutes or so. This period when any talk was subdued and directed only to another person at the same site, was much reduced in the two 'real' meetings.

Suggesting that people introduced themselves over the system, seemed to have little effect on this inhibition about speaking at the system. In most cases the meeting would finally be convened by a chairperson. (In the SIMeeting exercise, one person was appointed chairperson randomly). What appeared to have a very beneficial effect was for this chairperson to ask a question of each person in turn, calling them by name. Once a person had been forced to talk once over the system the levels of contribution from each person soon rose to points which would then be maintained for the period of the discussion.

6.2.2 Participation levels. Every comment made during a meeting was logged according to the speaker, whether it was directed at one person in particular and whether that person was named. It was not always possible however to note who it was that made a particular comment at a remote site. A comment was defined by a change in speaker.

There was a considerable disparity between the numbers of comments made by individuals during a meeting. Since no specialist knowledge was required for SIMeeting, all participants should have been equally able to contribute ideas etc. For instance, the proportion of comments made by an individual in five person meetings ranged from 1 to 37 per cent. The general level of conversation was high, ranging from nine to 69 comments made per five minutes and on average equal to about 29 per five minutes.

It was not possible to compare individuals' behaviour at face to face and at teleconferenced meetings. However, it was possible to observe and compare peoples' behaviour as they met afterwards to fill in questionnaires and make comments. It was my opinion that normally taciturn people

spoke even less over the system. That there was an inhibitory effect is supported by the fact that when these very quiet people did speak it was to their neighbours and not directed at the system to the meeting in general. However, several more junior users did comment that they would feel more happily talking to a more senior person over the system than face to face.

In conclusion, it would appear that people were able to talk freely on the system maintaining fast interchanges of comments. However, very taciturn people may need to be actively encouraged by a chairperson to talk at the system to the meeting as a whole.

6.2.3 Interaction between and within sites. Whereas it was difficult to measure an effect on individuals' levels of participation in meetings, it is possible to test various hypothesis that there are differences in the interaction between individuals both at the same site and at different sites. One hypothesis may be that the greater social presence of one's colleagues at one's own site would increase the chances that groups tend to talk amongst themselves. Conversely there may instead be a greater tendency for the remote site, for instance, to verbally acknowledge each remark given, while not being so able to rely on a nod or some other cue that they are attending.

If the probability that each person speaks is independent from who had spoken just beforehand, the expected probability that the next speaker is from a different site is always greater and depends on the total number of speakers i.e.:

$$\text{probability next speaker is from different site} = \frac{2 N_1 N_2}{(N_1 + N_2 - 1) (N_1 + N_2)}$$

where: N_1 = number of participants at one site

N_2 = number of participants at the other site

For each meeting, the sequency of comments or items of speech were noted and the proportion of occasions a following speaker was from the same or different site wss calculated. In the 14 meetings attended by four or more people, 4,052 comments, or changes in speaker, were noted. In seven meetings, the proportion of times that a remark was followed by one from a different site, was greater than to be expected. In four meetings the proportion was as expected for the size of the meeting, while in three meetings the proportion of remarks which followed on from a previous one made at the same site was greater than expected. Overall on 65 per cent of occasions, the sequencing of remarks passed from one site to the other. The expected figure would be 59 per cent.

It would appear that there is in fact a heightened tendency for the flow of the discussion to 'ping pong' between sites. Since expertise, or information, was equally distributed between individuals and sites, the conclusion is that participants probably tend to compensate for the restricted teleconference medium by making more verbal comments, where they would have relied on non-verbal cues in a face to face meeting, showing agreement, comprehension or disagreement with a remote speaker's point of view, for instance, by way of facial expression and posture, for example. The compressed video certainly does not appear from this data to act as a divisive force promoting sub-group formation and coalitions within a site.

Less than 1 per cent of the remarks made included a person's name in order to direct something at one person in particular (33 out of 4,257 in total). Similarly even when only considering the 'real' meetings, only 20 of 1,647 remarks made were prefixed by a person's name. It appears, therefore, that even though a person can not direct a remark to someone in particular at the other site, by the direction of his, or her, posture or eye gaze, it was not necessary to always add the person's name in order to direct someting specifically at him, or her. Participants were able in almost all cases to understand any directionality implied from the subject matter or context of a remark.

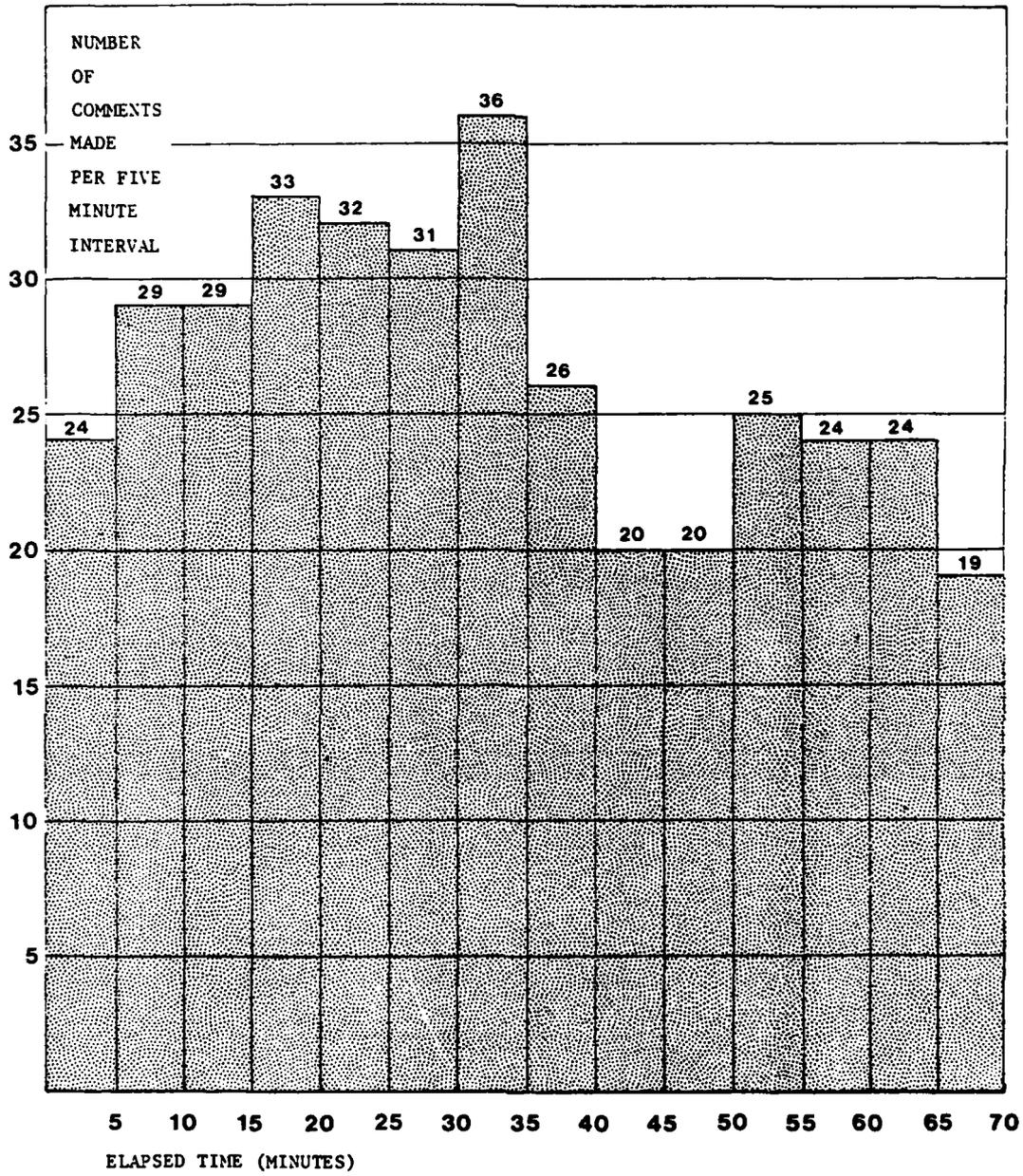
On average, 83 per cent of remarks were put forward to the meeting as a whole. In most meetings the figure was over 90 per cent. The remainder were either directed by name or else were restricted, to the local site by way of reduced volume and turning away from the system to a person's neighbour. A very large proportion of comments were therefore made openly and could be heard by all participants, again indicating no evidence that there is a tendency for the two sites to talk amongst themselves. Conversely, during the larger 'real' meeting, members of the smaller sub-group (four as opposed to seven people) complained that whenever they did make a quiet remark to a neighbour, the other site asked them to repeat it. Such remarks were often unimportant and did not warrant repeating. This 'paranoia' they felt was irritating. There is a tendency for a group to think that the remote site's quieter exchanges are akin to whispering, give them undue importance and treat them with suspicion.

6.2.4 Fatigue. Figure 6.4 shows the average frequency of comments or remarks made as time progressed from the start of the meetings. There is a peak of activity at about 35 minutes, falling off towards the ends of the meetings after 40 or 70 minutes. This pattern may have been more due to the particular task used than to a general effect of teleconferencing. After an initial high level of discussion most meetings using the SIMeeting task concentrated more on using the SGWS to enter an agreed schedule.

In the 'real' meetings the level of activity as measured by the number of speakers, not words spoken, was very even. However most users in the longer meeting felt that four hours was too long a teleconference and that two hours or a morning, for instance, was preferable. Participants certainly appeared to be more irritable after lunch. They claimed that the loudness and picture quality were tiring.

6.2.5 Preparation/start up. The time needed to prepare the information stored on the system in advance of a meeting, ranged from about 25 minutes to two hours. The most time consuming part was taking images from the overhead camera. When done in stand-alone mode, it took about 52 seconds to verify, or digitally encode each frame, and then a further

Figure 6.4. FREQUENCY OF COMMENTS MADE DURING TELECONFERENCES



24 seconds to store it on the system under a page number. The minimum time needed to store all 50 pages would therefore be over an hour for these reasons alone.

When this is done while the videoconference is established another four minutes are needed in order to transmit an image from one site to another. If the system is left with both stations switched off at the desk, the transmission process takes less time (about 1 hour 30 minutes for all 50 pages).

The time taken to start up the system at both stations, when no transmission of information need occur, was about 10 minutes, when all went well. This includes the time taken to load both discs. Otherwise the time needed is probably only a minute or so at each station.

7. ATTITUDES TOWARDS AND USE MADE OF THE EQUIPMENT

All the users were favourably impressed with the videoconference system as a whole. However, most felt it could be improved further. A number of their suggested improvements are contained in this chapter together with an analysis of the questionnaires which examines the use made of the equipment.

7.1 Compressed video

61 per cent of respondents to the questionnaire reported that the picture quality of the compressed video image was satisfactory. The main purpose of the compression process is to reduce transmission costs once one of the stations is relocated at Washington DC. When this was explained to users again after a meeting, almost all felt that the video image was indeed adequate for meetings to be held over the system. It would therefore appear that while a majority of users felt the picture quality was satisfactory, about a third would have liked a better level of resolution or colour but did not however consider that to be essential for a successful meeting.

Users felt that importantly one could tell from the visual image that the remote site's participants were there and were attending to the meeting. However, further visual information such as lip movements or a person's facial expression or attitude towards a point made, for instance was not available. Instead discussions were interspersed with phrases such as 'did you understand that?', 'how do you feel about that?' and 'did you hear that?'

All users feel that a visual image was important in their meetings and that the compressed video gave some benefit to the meeting over and above the information conveyed in the audio communication. This was so even though users spent only a small proportion of their time actually looking at the 'people image' in preference to their hard copy notes or the Shared Graphics Work Space display.

Three quarters of the respondents felt they could identify people from their compressed image, who was speaking and who were being spoken to. However, they did rely on recognising faces or voices of people they already knew. Since in most meetings people did know at least some of the other participants, this did not create any problems and there was a very low incidence of occasions when people named who it was they were referring a comment to (less than 1 per cent of remarks). People were able to detect any intended directionality of comments from their content and context. When used to hold real meetings, the majority of users will similarly probably know at least some of the other participants.

A few users had had previous experience of audio only teleconferences and freeze frame equipment. Compared to audio only teleconferences, such videoconferences they felt could be of much longer duration. The main reason given for this was that one could feel assured that the remote participants were devoting their full attention to the meeting and were not, for instance, simultaneously writing or carrying out another piece of work by covering the telephone mouthpiece or microphone in order to talk to someone else in the room. One user did, however, point out that this system was limited to meetings held between two sites only and that moreover potential sites were restricted to those equipped with this particular equipment whereas in order to participate in an audio only teleconference a user need only have access to a telephone. Compared to freeze frame images a full motion, albeit compressed image, was felt to be more 'natural'.

In most meetings, the participants selected the three person view of each other. Several users felt that the surrogate column was too far away and that the image would appear better if seen closer to. In the San Antonio room, the screens in the surrogate column were 15 feet six inches from the front of the table.

The amount of detail visible in a person's face when the one person view was selected was much improved and users then felt they could perceive the centre person's facial expression etc. When a three person view is selected much of the screen is wasted, displaying empty space above people's heads. Information contained in a three person view would be increased to a level approaching that possible in a one person view, if at the same as one switched from a one person view to a three person view the aspect ratio of the transmitted image were changed so that it was much wider than it was tall. A larger monitor would be necessary in order to be able to display both types of images. The fact that three was the maximum number of participants who could easily be seen on the monitor was not thought to give rise to any problems.

In conclusion, meetings appeared to proceed very naturally with only a few compensations being made for the restrictions placed on the medium. However, the result that 61 per cent of participants were satisfied with the picture quality should cause some concern. While the medium did appear to be entirely adequate for holding meetings it is still necessary, in order to get people to actually use the system, to make it as attractive as possible. Recommendations which are made in this report should therefore be given serious attention. When a new technology is first introduced users have the additional task of learning how to use it and the attractiveness of the equipment can do much to overcome this initial inertia. Only after users have used it more than once or twice do the advantages over travelling to meetings become apparent.

7.2 Audio

96 per cent of respondents felt that the loudness was satisfactory and 93 per cent that the sound quality was. These high figures are very complementary. However, in several meetings people did attempt to increase the volume and encountered 'howl around' problems. This occurred at a level below that indicated as the maximum on the control panel. 'Howl around' takes place when, after a critical level has been reached, sound passes round in a positive feedback loop from each room's loudspeaker to the microphone via the audio system, while being amplified upon every circuit until a loud howl sounds. In addition, during the largest

and longest meeting there was considerable complaint made about the sound quality. Levels of performance which are satisfactory for short meetings may be fatiguing when users attempt to compensate for the system, by speaking up and directly at the microphones, for longer periods of time. There are, therefore, a number of improvements which should be made. These are as follows:

- The ceiling, floor and walls, which are presently bare, should be covered in non-sound reflective materials in order to raise the threshold for howlaround.
- Other sources of noise in the rooms should be removed. At present the sounds of the unrelated equipment located in the same room, printing and the public address loudspeaker all cause meetings to be interrupted and make it difficult for users to hear the other participants.
- Extra microphones should be made available for additional people taking part in a meeting who are not located in either of the three main positions. These people can be heard, if they speak up, but the added effort required, especially for female voices, is not reasonable for any length of time. Extra microphones could either be of the very directional type and pointed at the extra participants or else individual tie clip microphones may be used. These may be attached to the system, via jack sockets. It would not, however, be desirable to change from an open audio system to a voice switched one.

7.3 Shared graphics work space

Two thirds of the respondents felt that the overall readability and speed of response of the SGWS were satisfactory. More felt that the ability for more than one person to work on it at a time and its method or use were satisfactory, (79 and 77 per cent respectively). The questionnaire also asked whether the respondents actually used each of the individual controls or functions available on the SGWS. These results are shown in figure 7.1.

Figure 7.1. Controls or Function Used Personally

	<u>% participants</u>
Use SGWS at all - via writing tablet	74
- via touch sensitive screen	72
Colours	65
Eraser	65
One vs three person	62
Draw lines	60
Volume	57
Point	56
View yourself	51
Retrieve stored page by number	41
Contrast	38
Page +/-	29
Videodisc	13
Overhead camera	12

83 per cent of the respondents used the SGWS at all, 74 per cent via the writing tablet and 72 per cent via the touch sensitive screen. The most commonly used functions concerned the writing, drawing and erasing of lines. Retrieving stored pages by page number or sequentially, (using page + or page -,) was usually delegated to one person at each or only one site and were hence used by only 40 or 29 per cent of respondents respectively. The tasks used in meetings did not require users to use videodisc frames nor the overhead camera and these were thus only used experimentally by a few users.

The most commonly used function available on the first Control Panel Menu was the ability to switch between a one person and three person view of the other site (62 per cent of respondents). This was, however, rarely used actually during a meeting rather than afterwards. 57 per cent used the volume control and 51 per cent the view yourself control. Most controls were thus used by a majority of users. This indicates the success of the SIMeeting task as a training instrument, getting people to use the system and learn how the controls function.

Figure 7.1 included occasions when the SGWS was used by people experimentally rather than for any specific purpose. More interestingly, figure 7.2 shows the opinions of those people who used the controls. It is un-

reasonable to ask people to estimate the usefulness of controls they have not used, when they must in addition first guess their effect without encountering any of the possible problems which may be associated with their use. The most useful controls were the page + and page - 'buttons'. These were only used by 29 per cent of participants, but were considered by the majority of them to be very useful. Least useful facilities were the abilities to draw lines, as opposed enter text or write, use the touchpad and view yourself. The ability to draw lines and use the writing pad were in fact felt to be a distraction by 14 per cent of the people who used them. 20 per cent of the few people who used the overhead camera felt it was distracting. This was due to the fact that its use led to the system then being inoperative for a further four or so minutes.

Figure 7.2.
Usefulness of Controls or Functions by Those Who Actually Use Them

Function	Usefulness (% of users)			Whether distracting
	Very useful	Quite useful	Not useful	
Page +/-	58	42	0	4
Colours	56	38	6	4
1 vs 3 person view	55	39	6	0
Eraser	54	40	6	6
Retrieve stored page by number	52	45	3	3
Volume	50	46	4	2
Videodisc	50	42	8	0
Point	47	47	6	2
Contrast	45	45	10	6
SGWS-screen	43	48	9	3
Overhead camera	40	60	0	20
Draw lines	39	47	14	14
SGWS-writing tablet	38	47	15	15
View yourself	36	43	21	0

In conclusion it would appear that almost all the controls were tried at least once by someone in each meeting. However the proportion of actual users who found particular controls to be very useful was never higher than 58 per cent. Between 40 and 50 per cent found most controls to be quite useful. In order to make the extra advance preparation necessary for the SGWS worthwhile compared to issuing paper based notes via mail, facsimile or electronic mail methods, it is necessary to improve the way the controls work, as follows:

- Page +/Page -. Most groups gave up scanning each and every page made available to them on the system and avoided returning to a previous page, because of the time needed to display a page. This ranged from 24 seconds to three minutes, for a fairly complex hand drawn image. This time is far too long, if people are to use the system to scan quickly and easily through a number of pages.
- Colours. If there were a default colour, as suggested in section 5.2, colours would work satisfactorily. However, it should be noted that it is difficult to distinguish yellow, white or tan on a white background and blue on a black background.
- One versus three person view. These would be used more during a meeting, if the speed of response were faster. Otherwise returning from the Control Panel Menu requires the users to wait 24 seconds or longer while their shared graphics page is redrawn.
- Eraser. This appears to work unreliably. A faster response and some level of local processing would at least allow a user to see quickly whether his, or her, action had been successful or not. When having selected the eraser function, the difficulty encountered when attempting to retrace and thereby delete a line is not an illustration of the function's specificity or accuracy of working. The minimum width of a deletion is relatively large (of the order of several millimeters).
- Retrieve a stored page by number. As with page + and page - this works too slowly.
- Volume. The volume control works well. The problem here concerns the lack of acoustic treatment given to the rooms.
- Videodisc. The 'cancel' and 'verify' buttons need to be renamed if their use is to be reasonably self explanatory. The usefulness of the facility depends on the type of task and appropriateness of a videodisc for that task.
- Point. This feature is vital when using the writing tablets and yet is not obviously apparent to a new user. If the indicator remained while a person was actually drawing a line for instance, he, or she, would be more likely to notice it and deduce its purpose.

- Contrast. This feature worked well and people might again be more prone to adjust it, were it possible to switch to the Control Panel Menu without encountering delays when returning to the Main Menu.
- SGWS-screen. Use of the SGWS from the screen would be greatly facilitated for the purpose of writing, drawing and erasing lines, if styli were issued and could be used instead of people's fingers or finger nails. Otherwise the legibility of handwriting, especially, using the screen is very poor. In addition the pressure required was felt by some users to be too great and a stylus would maximise the pressure over a small area of the screen.
- Overhead camera. If the overhead camera is to be used during a meeting, it is vital that the time taken to transmit an image is reduced considerably from the present four minutes. Otherwise, since it is likely that a requirement for a particular document only becomes evident during the meeting, a facsimile machine and/or a communicating word processor should be located nearby, available to be used if necessary. There should in addition be an 'abort' button which would allow one to cancel the transmission even once it has started.
- Draw lines. The way the system passes back through all the stages in a page's evolution whenever re-displaying it, by drawing each line in sequence and then erasing any which were then erased, is time consuming and very distracting. Once a page has been 'saved', the ultimate image should be the only one which is seen redrawn when it is next displayed. Lines flicker unless gone over twice. At the expense of a slight loss in vertical resolution, it would be preferable for the system itself to automatically portray each point on a line on two adjacent horizontally scanning lines which would then be refreshed alternately at a combined frequency above the threshold of perceived flicker. Thickening the lines thus would also improve the visibility of some colours against a white or black background.

- SGWS-writing tablet. Use of the writing tablets would be facilitated and less distracting to the meeting, if, as discussed above and in section 5.2, the role of indicators to find a position corresponding to one on the screen were more obvious and if less pressure were required to enter a line or a word onto SGWS. Normal handwriting results in the tops and bottoms of letters being lost as the hand naturally releases the downward pressure.
- View yourself. This facility was not found to be distracting, but would be of much more use if the image thus seen by a user were exactly the same as that seen by the remote site. At present, the image seen has a much larger field of view than that actually transmitted.

Some more general comments about the system were also made by users.

These include the following points:

- The SGWS monitor in the surrogate column was not useful. It was too far away to be seen clearly by the main participants and by any additional observers, who also need to be near the table, if any comments they make are to be easily heard. A preferable arrangement would be to have this second image displayed on a large back projection screen suitable for a large presentation for instance. Otherwise normal sized monitors should be mounted on casters, able to be moved about within the room so as to be conveniently near any additional participants.
- All participants need to have a horizontal surface on which to lay paper and to write. Additional desks may be required from time to time or alternatively the extra chairs may be equipped with optional swing out surfaces for writing upon.
- When the system is used by one person at a site, he, or she, can not remain 'on camera' in one person view while writing on one of the pads positioned on either side of him, or her. A moveable pad would enable such a person seated at the centre to write more legibly using the pad than is possible using a finger on the screen.

- No more than half an A4 page of normal typewritten text may be displayed at a time via the overhead camera. Text needs to be specially typed using a larger typeface. At this density of text, the number of available pages (50) is too small for many purposes.
- Word processing facilities would be required if the system is to be used for much text manipulation.
- In order that the SGWS be most useful, if it is necessary also to have a printer which could print a page of graphics as displayed on the screen. Otherwise someone in the meeting must keep a hand written copy of any graphics drawn on the system or amendments made to pages. Alternatively, a secretary must at present enter the teleconference studio after it has been vacated and transcribe any minutes, for example which have been written during a meeting.
- Some users felt that a more useful information retrieval system would allow both sites to interact with a computer database, using visicalc for instance, sharing the display while both being able to enter data using keyboards.
- Another useful feature put forward would be the ability to define an area on the screen and then be able to either move or delete it.
- Similarly some users would have liked the ability to erase one colour at a time from a graphics image built up on the system.
- Several users complained that the legibility of the images displayed on all the monitors suffered from the fact that light from the ceiling lights was reflected off the screens. The lighting in the present videoconference studio needs to be completely replaced with purpose built television studio lighting which can have prismatic diffusers directing the light away from the screens. Light should shine directly onto the participants and be reflected off the table so as illuminate people's faces while not casting shadows under their eyes, for instance.

- Users were unclear as to which images were being seen by them alone and which were being shared between the two sites. A third monitor was proposed which would be clearly labelled and would display the image as seen by the remote site. When the remote site switches from the main menu, this third monitor would need only display a caption saying 'Displaying Control Panel Menu' or 'Displaying Select Background Menu'.
- A few users felt that even when they would be competent at using the SGWS, they would prefer there to be on hand a technician who would advise on and prepare information before a meeting. This person would, they felt, be best able to use the SGWS to its greatest advantage.
- When transmission is in progress, there should be some indication of how long the system expects this situation to last.

In conclusion, there are a number of things which can be easily done to the acoustic properties of the rooms and the mechanics of the SGWS, especially, which would greatly enhance the system's attractiveness. These should be carried out as soon as possible if the San Antonio-Washington link up is to be a success. Other enhancements listed here require some extra investment in software development and equipment purchases. These should be implemented if there are plans to extend the network beyond the trial two site state. The system as at present is a very good one. However other organisations have found that the inertia met by attempts to introduce teleconferencing can be very great and it is necessary to increase a system's attractiveness beyond that which is merely adequate if it is to be fully used.

Something which needs to be emphasised to prospective users is that this system is designed primarily for holding discussions or meetings. There is an ability to create and share graphics but this is limited to 50 pages. The capacity of videodiscs is huge, but being immutable the number of suitable applications in personnel and managerial matters is limited. The SGWS is designed to be used by people who need not have keyboard skills. It is not designed to be used for text or data manipulations where computer terminals would be more appropriate.

Observing the use made of the SGWS by the participants it was apparent that because of the effort and time needed to write on the SGWS, people tended to avoid changing a table, for instance, once drawn. This side effect of a cumbersome technology could have a serious effect on the quality of decisions made on the system. People may agree on the first reasonable solution without first experimenting with all the possibilities.

The SGWS is potentially a very powerful instrument in a meeting. However, people during their first meeting at least, did not think up new uses for it over and above those required and specified by the task. Potentially novel uses might include using it as a group scratch-pad allowing all users to easily, and with some degree of anonymity, jot down ideas during a brainstorming session. In addition the SGWS was not used by a chairperson, for instance, to maintain a changing agenda, visible to all participants, and use this to keep the meeting on schedule.

Time is needed to prepare information for the SGWS. However, it is wasteful that the whole system be booked just so that one person can prepare his, or her, information. A preferable arrangement would be for each site to have at least a spare workstation, using which a user could prepare pages from the overhead camera and then annotate them more quickly once the studio becomes free.

Recurrent users will probably want to keep pages from meeting to meeting and since only 50 can be stored on a disc at a time, extra discs may be required for each of the frequent user groups.

8. RELIABILITY OF THE EQUIPMENT

The performance of the equipment during the last two weeks of the three week evaluation exercise was such that the planned research had to be reduced and we could not risk jeopardising further real meetings by holding them over the system. Problems encountered were:

- The need to restart when one or other station took an unusually long time to be updated.
- Stations would begin again to transmit data when powered on even when both computers had been left on overnight and had apparently completed exchanging information.
- The loss of the synchronisation of San Antonio's compressed video image. This could not be remedied once started.
- The loss of synchronisation when either site viewed themselves.
- The loss of synchronisation in the lower third of the screen when retrieving a frame from a videodisc. This could be remedied by restarting the system.
- The loss of any response from the writing pad or from the touch sensitive screen. This could be remedied by restarting the system.
- The inability of Washington DC to view San Antonio in freeze frame mode.
- Faulty writing pads meant that three SA2 and DC2 indicators flashed on the screen continuously. This confused users and reduced the usefulness of the indicators in general.
- The height of the overhead camera above its associated display monitor meant that it was impossible to adjust the focus or aperture while still being able to look at the monitor. In addition the image as displayed in this monitor was not aligned similarly to that when displayed on the table-top monitor via the SGWS and therefore could not be confidently used to centre an image.
- The quality of an image from the overhead camera once transmitted from one site to the other was much poorer when then viewed at the receiving station compared to when viewed at the sending station.

The three week exercise had been the first occasion that the system had experienced such a high level of use since it had been installed some three months earlier. The reason for the poor level of performance may have been due to the equipment being still at a prototype stage or due to the lack of any maintenance being carried out. Nevertheless, the main result to be derived from this is that there should be a spare monitor, codec or even a complete spare system, if the system is to be expected to be 100 per cent reliable. The effect on a user group's work and their attitude towards the system may be disastrous, if because of a system failure, their meeting has to be cancelled. Users will be far more forgiving of delayed flights, for instance, than on the occasion of their first experience of a videoconference.

The system should be serviced and these faults remedied before the system is used to hold meetings between San Antonio and Washington DC. If after that the reliability is still poor, this should have serious consequences for the trial and any planned extensions into a network.

9. CONCLUSIONS AND PROCEDURES TO BE ADOPTED

The meetings held over the videoconference system were, by and large, natural, successful and, at times, very animated. Participants appeared to automatically compensate for some of the restrictions imposed by the medium, by for instance, checking verbally that each other was following the discussion. In comparison with the results from other full motion videoconferences, however, users of this system were more likely to be dissatisfied with their meeting and tended to feel that meetings took longer. Whereas the previous research tended to show the teleconferences were usually shorter than similar face to face meetings. Most of the dissatisfaction concerned the reliability of the equipment and specific aspects of the SCWS. A number of suggested improvements have been put forward in this report, in chapters 5 and 7.

The SCWS is a very sophisticated item of technology and some instruction is necessary before a user goes ahead and uses it. If the SCWS is not required a videoconference may proceed without any preliminary introduction. The SCWS is not very suited to portraying textual information, but is ideal for creating graphics together with handwriting. If a group needs to deal with large amounts of text, either hard copy should be distributed beforehand or else they should use the electronic mail capabilities of the Xerox star, for instance. Users need to prepare information in advance, preferably the day before, so that the system has time to transmit the data. Many suggested improvements are put forward in this report, however, this system is already a very good one and, once serviced, perfectly able to cater for most meetings.

When one station has been moved to Washington DC, the system will begin to be used to hold real meetings between the two sites. Participants should be encouraged to continue to complete questionnaires after their meetings. This will give them the opportunity to record their views as they become more accustomed to using the system for a wider range of real meetings. This information will be very valuable and should be used by the Air Force as the basis for any modifications to be made to the system and in order to anticipate any problems that may be encountered by the users.

Some attention will have to be given to scheduling meetings on the system. A calendar page may be maintained on the system. A potential user from either location could then check this calendar and enter the times he, or she, wishes to book the system for. An allowance should be made of over-runs and for preparing information in advance.

The next stage of the research will examine multi site videoconferences in a similar way as this report studied two site videoconferences. SIMeeting can be used both as a training exercise and as a tool for examining meetnigs. However, greatest benefit will be obtained from examining as many real meetings as it is possible to arrange. The main difference between this next trial and the one reported here, apart from the fact that there will be five as opposed to two sites, is that there may only be one person per site. This will have implications for people's interaction with a SGWS, whether by a touch sensitive screen or by a writing pad, and for the patterns of communication between the participants. Users will not be able to choose to talk to their neighbour, for instance, in preference to talking to someone across the system. In addition all participants will appear as equals, there being no equivalence of a centre person solely in charge of the touch sensitive screen.

APPENDIX A: THE QUESTIONNAIRE

EIU INFORMATICS

Spencer House, 27 St. James's Place, London SW1A 1NT Telephone: 01-493 6711 Telex: 266353

Teleconference Questionnaire

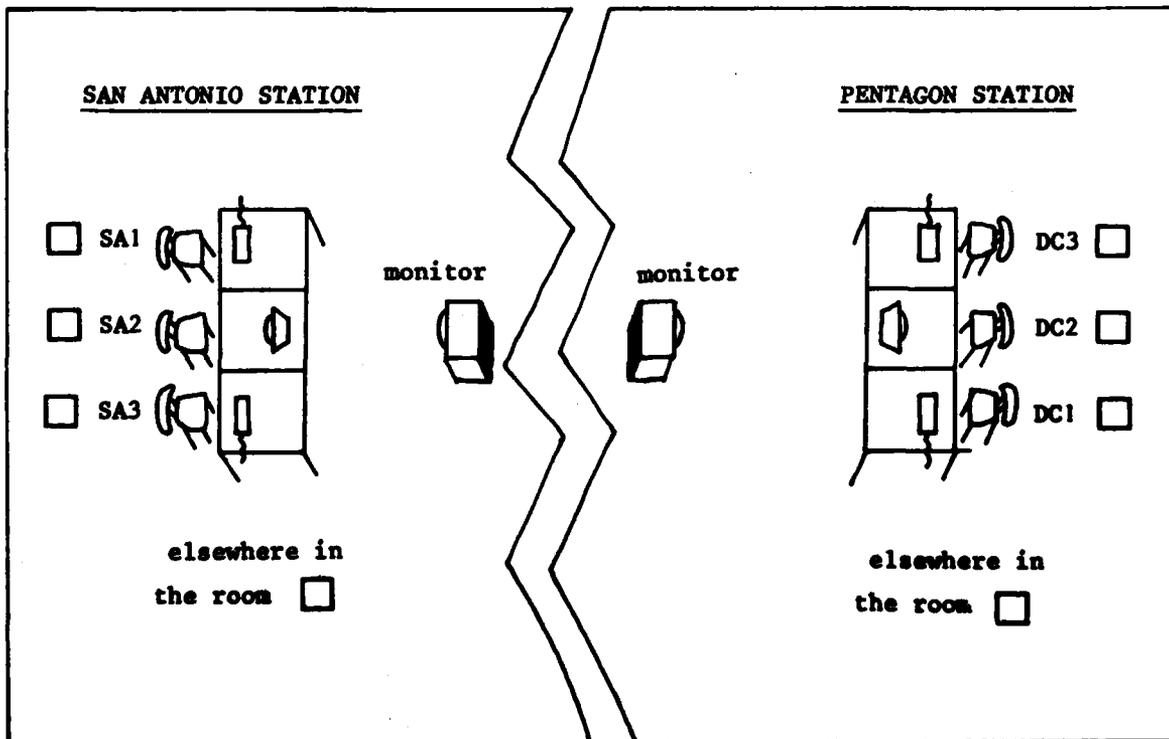
Please spend a few minutes, after you have finished your teleconference, filling in this questionnaire. In most cases, questions can be answered by simply ticking the appropriate box. Any comments would be very welcome.

NAME.....DATE.....

RANK/GRADE.....

DEPARTMENT.....

Please tick the position you sat in during the teleconference:



A. MEETING TYPE This section examines the nature of the meeting you have just held.

1. Was it routine, or special?
2. How far in advance had it been scheduled?
- Less than a day
 Several days
 Week or more
3. Which of the following categories best describes the meeting?
 You may tick more than one box
- Presentation of ideas or views
 Problem solving
 Ideas generation
 Discussion
 Negotiation
 Exchanging information

B. YOUR PERCEPTION OF MEETING PERFORMANCE Below, there is a list of the factors which describe a business meeting. Indicate whether the teleconference you have just participated in showed an increase or decrease in each attribute compared to your experience of similar face to face meetings. Also indicate the importance of each factor.

Important	Not important	Importance of each factor	Change due to Teleconference	Large decrease	Small decrease	No change	Small increase	Large increase
<input type="checkbox"/>	<input type="checkbox"/>	Your satisfaction with the meeting		<input type="checkbox"/>				
<input type="checkbox"/>	<input type="checkbox"/>	Length of the meeting		<input type="checkbox"/>				
<input type="checkbox"/>	<input type="checkbox"/>	Information accessibility		<input type="checkbox"/>				
<input type="checkbox"/>	<input type="checkbox"/>	Sense of privacy/security		<input type="checkbox"/>				
<input type="checkbox"/>	<input type="checkbox"/>	Effectiveness		<input type="checkbox"/>				
<input type="checkbox"/>	<input type="checkbox"/>	Decision quality		<input type="checkbox"/>				
<input type="checkbox"/>	<input type="checkbox"/>	Task orientation		<input type="checkbox"/>				
<input type="checkbox"/>	<input type="checkbox"/>	Cooperation of participants		<input type="checkbox"/>				
<input type="checkbox"/>	<input type="checkbox"/>	Aggression		<input type="checkbox"/>				
<input type="checkbox"/>	<input type="checkbox"/>	Friendliness		<input type="checkbox"/>				
<input type="checkbox"/>	<input type="checkbox"/>	Peoples' preparation		<input type="checkbox"/>				
<input type="checkbox"/>	<input type="checkbox"/>	Own Contribution		<input type="checkbox"/>				
<input type="checkbox"/>	<input type="checkbox"/>	Own control over the meeting		<input type="checkbox"/>				

C. THE EQUIPMENT Now please consider the performance of the equipment you have just used.

TELECONFERENCE EQUIPMENT

Satisfactory
Not satisfactory

Loudness

Any comments

Sound quality

Clarity of picture

Movements of the image

Ability to determine:

a) identity of the participants

b) who was speaking

c) who was being spoken to

THE SHARED GRAPHICS WORK SPACE

Satisfactory
Not satisfactory

Ease of use

--	--

Any comments

Readability

--	--

Speed of response

--	--

Ability for more than one person to use it at a time

--	--

D. USE OF CONTROLS OR FACILITIES

Indicate whether you personally used each of the following controls of facilities, and, if so, how useful were they?

Did any distract your attention from the meeting?

Whether used		usefulness of facility	Very useful	Quite useful	Not useful	Distracting
Yes	No					
<input type="checkbox"/>	<input type="checkbox"/>	Volume control	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	Contrast control	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	1 Person vs 3 person view	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	View yourself	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		Access shared workspace:-				
<input type="checkbox"/>	<input type="checkbox"/>	a) using screen	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	b) using touchpad	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	Draw lines	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	Point to a position on the screen/or pad	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	Use colours	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	Use eraser	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		Select background from:-				
<input type="checkbox"/>	<input type="checkbox"/>	a) videodisc	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	b) overhead camera	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	c) stored pages by page number	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	d) stored pages, using page +, or page -	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Would you like to make any other comments about the teleconference or the equipment you have just used?

APPENDIX B: THE SUMMARY COMMAND CARD

EQUIPMENT GUIDE

CONTROL PANEL MENU

CALL
HANG-UP
VOLUME

CONTRAST

1 PERSON VIEW
3 PERSON VIEW
VIEW YOURSELF
ACCESS SHARED WORKSPACE

MAIN MENU

COLORS
ERASER
SELECT BACKGROUND

RECALL
A & 1
SAVE
PAGE +

PAGE -
CLEAR

SELECT BACKGROUND MENU

To display a videodisc frame at your own site:

- Key in frame no. and press enter or
- Point to approximate position on line and press

STEP FORWARD or STEP BACK.
OVERHEAD CAMERA
VERIFY
CANCEL

- To display slide
- To show other site what you are looking at
- To return to main menu

CALL

HANG-UP

VOLUME

CONTRAST

1 PERSON VIEW 3 PERSON VIEW

VIEW YOURSELF

ACCESS SHARED WORKSPACE

TEST MODE

CONTROL PANEL MENU

RED	BLUE	WHITE	ERASER	SELECT BACKGROUND	RECALL	A	PAGE +	PAGE -	CLEAR	CONTROL PANEL
GREEN	YELLOW	TAN								

MAIN MENU

0 FRAME: 21,648

54,000

ENTER FRAME NO. 21648

7	8	9
4	5	6
1	2	3
0	CLEAR	

ENTER

BACKWARD STEP FORWARD

VERIFY CANCEL

SELECT BACKGROUND MENU

OVERHEAD
CAMERA

APPENDIX C: THE MODIFIED SUMMARY COMMAND CARD

IMPORTANT: READ THIS BEFORE ATTEMPTING TO USE THE SYSTEM

SUMMARY INSTRUCTIONS FOR USING THE SHARED GRAPHICS WORK SPACE

USING THE TOUCH SENSITIVE SCREEN

- * Do not touch the screen with the pens. This may damage its touch sensitive surface. Use your finger or finger nail.
- * When the system is powered on, the first of three 'menus' of possible functions or controls is displayed. The labelled boxes act as buttons. The purpose of each is explained on the following pages. To activate a button, tap it firmly with your finger nail. If you do this correctly and accurately, it should then light up and a beep will sound.
- * To write or draw on the screen, tap ACCESS SHARED WORKSPACE and the main menu will be displayed. You should always select a color, by tapping a colored box, before writing in the space above while pressing hard with your finger.
- * When both sites have tapped ACCESS SHARED WORKSPACE, and are displaying the main menu, anything drawn at either site will be visible to both sites.

USING THE WRITING PADS

- * The 'buttons' drawn on the two writing pads may be similarly used by tapping the boxes with the wired pens.
- * To write or draw using the writing pads display the main menu on the monitor and then select a color by tapping the appropriate color box shown on the pad using the wired pen. Press down firmly as you write.
- * When the center person in San Antonio touches the screen with his, or her, finger the indicator SAI appears at that particular spot on the screen. Similarly all the actions of the center person at Washington D.C. are identified by the indicator DC1. When the side people at each site touch the writing pads, gently with the wired pens, their indicators (SA2, SA3, DC2 or DC3) are displayed on the screen at the appropriate positions. You can use this feature to judge the position of the wired pen on the pad, by touching the pad gently, before actually writing something by pressing down more firmly.

STARTING YOUR TELECONFERENCE

- * Tap CALL to start the videoconference. When both sites have done this the meeting can commence.
- * Check you are clearly visible to the other site by tapping VIEW YOURSELF and adjusting your chair height, if necessary. To adjust the height, stand up and then gently place your weight back on the seat, while holding up the button hidden under the right side. When at the right height, release the button and the seat will be locked at that position.
- * Transmitting a new image from your overhead camera to the other site will take about four minutes. For this and other reasons, prepare the day before any graphics required for a meeting so that the system will be ready when you want to start.

EQUIPMENT GUIDE

CONTROL PANEL MENU

- Top: CALL HANG-UP
VOLUME CONTRAST
- 1 PERSON VIEW 3 PERSON VIEW
VIEW YOURSELF
ACCESS SHARED WORKSPACE
- To commence teleconference
 - To end teleconference
 - (TOP) To make louder
 - (BOTTOM) To make quieter
 - (TOP) For more contrast
 - (BOTTOM) For less contrast
 - To view center person at other site
 - To view all three people
 - To check how the other site sees you
 - To create or view graphics (menu changes to main menu)

MAIN MENU

- (always select a color before writing or drawing)
- Top: COLORS ERASER
SELECT BACKGROUND RECALL
A & 1 SAVE PAGE +
- PAGE - CLEAR
- CONTROL PANEL
- To select color and draw lines
 - To delete individual lines
 - To view picture from videocassette or overhead camera (menu changes to select background menu)
 - To view page no. indicated
 - To change page no. indicated
 - To store displayed page as the above no.
 - To move to next page in sequence (i.e. A1 to A5, B1 to B5, C1 to C5, J1 to J5)
 - Last page is stored automatically
 - To move back one page
 - (ONCE) To remove any drawn lines (press VERIFY to confirm or CANCEL to abort) (TWICE, OR ONCE IF NO LINES) to clear screen completely)
 - To return to control panel menu

SELECT BACKGROUND MENU

- To display a videocassette frame (at own site only - see VERIFY below)
- key in frame no. and key ENTER or
 - point to approximate position on line and then key STEP FORWARD or STEP BACK, if necessary
- Top: OVERHEAD CAMERA
VERIFY
CANCEL
- To display slide (at own site only)
 - To show other site what you are looking at
 - To return to main menu

CALL HANG-UP

VOLUME CONTRAST

1 PERSON VIEW 3 PERSON VIEW
VIEW YOURSELF
ACCESS SHARED WORKSPACE

TEST MODE

CONTROL PANEL MENU

RED	BLUE	WHITE	ERASER	SELECT BACKGROUND	RECALL	A	PAGE +	PAGE -	CLEAR	CONTROL PANEL
GREEN	YELLOW	TAN		IND	SAVE	1				

MAIN MENU

0 FRAME: 21,648 54,000

ENTER FRAME NO. 21648

7	8	9
4	5	6
1	2	3
0	CLEAR	ENTER

STEP BACKWARD STEP FORWARD

VERIFY CANCEL

OVERHEAD CAMERA