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MITRE TECHNICAL REPORT

Video-Teleconference Team Collaboration:

Identifying the Causes of Delays in Meeting Start Times

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Abstract

This paper presents evidence that operational video-teleconference-room (VTC) interfaces contribute to delaying the start of meetings in corporate settings. Some companies rely on VTCs for cost-effective collaboration across locations; however, if VTCs contribute to meeting delays, they result in lost productivity for entire teams. To explore this notion, the team recorded observations of human subjects in corporate VTC meetings, and identified the various challenges in collecting user-interface data in that environment. The analysis and discussion shows that improvement in equipment setup times would contribute to reducing the delay in meeting start times. Furthermore, evidence points to the significance of the time equipment-use begins, rather than the time it ceases. The data collected is vital to continue research into intelligent user interfaces, assistive agents, and context modeling for improving the usability of VTC equipment.

KEYWORDS: Video-teleconference, user interfaces, meeting delays, conference rooms

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Introduction

Video teleconferences (VTC) are vital for staff communication and collaboration across geographic locations in many corporations. This research examined the causes of team meeting delays in a corporation that hosts a network of over 100 specialized VTC facilities, called *Team Rooms*. Each of these state-of-the-art VTC environments is a complex integrated system of devices from multiple manufacturers and disciplines. A *proxy-control-system*[1] enables users to configure many of the devices from a single graphical user-interface (GUI)[2], e.g., connecting a VTC to another location, displaying a laptop on the wall, transmitting a slide presentation to another location, etc. However, the downside to using such richly-outfitted rooms appears to be growing.

Although VTCs are favored for minimizing travel costs, the complexity of VTC equipment-use may result in lost worker productivity. The proxy-control-system GUIs (also called audio-video [AV] panels) homogenize control of each device with a common button-interface, however they do little to release the user from knowing the sequence of button presses to operate each piece of equipment. So, as equipment capabilities are added to the room, users require more device knowledge. As the amount of equipment employed for a given meeting increases, the number of proxy-control-system actions likewise increases. These increased actions logically result in delayed meeting start time, which translates to lost worker productivity - for an entire team.

To deal with the complexity of equipment-use, MITRE actively researched solutions to simplify the setup and use of Team Room capabilities[3]. Use of intelligent user interfaces, assistive agents, and context modeling showed promise as improvement strategies; see details of MITRE's Perceptive Assistive Agents in Team Spaces (PAATS) project in [HARP2004a], [HARP2004b], [HARP2004c], and [MITRE-PAATS]. The implementation of each improvement strategy needed to be measured to determine its individual merit. Therefore, the team designed a study to understand the effect of the existing Team Room implementation on meeting start time.

This paper describes the team's exploratory study into quantifying the significance of equipment-use on delays in meeting start time. The study focused on three objectives: 1) discover the challenges and nuances involved with collecting equipment-use data in Team Rooms, 2) explore whether such data could quantify the effect of AV panel use on delays in meeting start time, and 3) establish a baseline against which Team Room interface improvements could be evaluated. The latter would be easily achieved as a by-product of the activity.

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[1] Two manufacturers - AMX and Crestron – provide the majority of business-class proxy-control-systems.

[2] The GUI is operated on a touch-panel screen called the AV panel.

[3] a. Perceptive Assistive Agents in Team Spaces (PAATS) MSR, b. Integrated Collaborative Environment (ICE) One Minute VTC Setup.

Figure 1. Typical Team Room.

Overview of Team Room Usage

When a project team at the subject company needs to meet across geographic locations, a meeting *host* (typically the project leader) schedules the Team Rooms at both the local and remote side of the VTC. Scheduling is performed in an online Room Reservation System (RRS), however, ad hoc VTC meetings are also conducted between locations, either with last-minute scheduling or no scheduling at all.

Figure 1 shows a typical Team Room with the AV panel[4], projection screens, and camera in context; figure 2 shows a close-up of the top-level AV panel. The remote side of a VTC typically displays on the right screen, while the left screen is used for PC displays. Note that the AV panel GUI makes use of a hierarchy of button panels that are device-specific. There exist more than a hundred buttons total across all button panels to control the following: a VTC codec, a pan-tilt-zoom camera (or PTZ), microphones and speakers, an audio mixer/switch, a video switch, multiple displays/projectors, motorized projection screens, a satellite television receiver, a VCR, a lighting control system, motorized window shades, etc.

A room PC resides at the rear of a Team Room. Connected by the corporate network, the PCs enable users to share PC desktops between geographic locations via Microsoft NetMeeting (e.g., for slide presentations, for application demonstrations).

The corporate audio conferencing bridge[5] – Meeting Place - enables users to include several staff in a meeting via telephone. Each Team Room is outfitted with one or two hard telephones and the AV panel includes a button-panel for softphone operation.

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[4] The AV panel is a small touch-panel display for interacting with the proxy-control-system GUI.
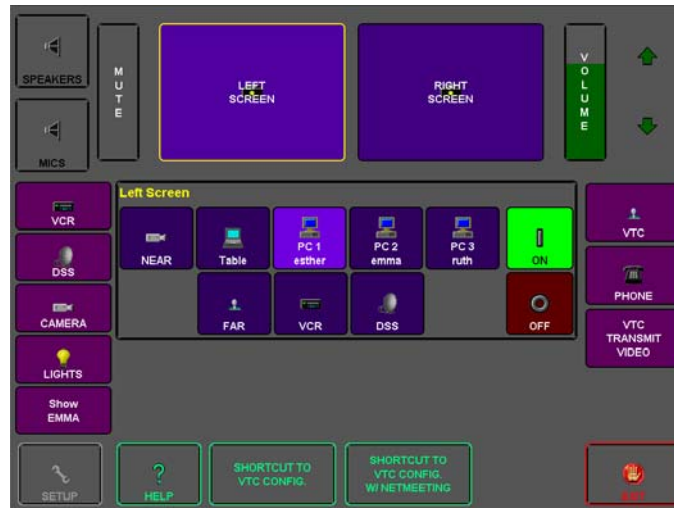
[5] i.e., telephone bridge service

Figure 2. Top-level AV Button Panel.

The equipment rack, including the VTC codec, proxy-control-system, audio switch, amplifier, video switch, VCR, satellite TV receiver, etc., is hidden beneath a cabinet in the rear of the room.

Most often, the host is responsible for using the above equipment to set up the room and to modify the room configuration as needed during the course of the meeting.

Data collection

The team set a goal to collect equipment-use data from approximately 40 cases of corporate meetings. A specific meeting profile was targeted in order to achieve the objectives stated above. This meeting profile was defined prior to data collection and before any experience was gained in filtering out undesired meetings:

- Room type: Small corporate Team Rooms
- Meeting type: Project team meetings (i.e., not to include management meetings, department staff meetings, or meetings hosted by VTC experts who support the corporate VTC infrastructure)
- VTC type: Point-to-point (Note that the connections for multipoint VTC meetings are set up by VTC network administrators)
- Host: At the location where observations would be conducted

The reasoning for such a profile was as follows. Project team meetings were of primary interest because they are venues where revenue-generating work is performed. Often, such teams are divided across two primary locations, requiring a VTC. The team received anecdotal reports that as the rank (i.e., staff level) of a meeting-host increased, the skill of the host increased. Therefore, it was anticipated that a focus on project meetings, rather than management meetings and staff meetings, would enable lower-rank users to be observed. Small corporate team rooms are the typical setting for project team meetings that use videoconferencing. Finally, to

adequately observe equipment-use, the meeting host would have to be at the location where observations would be conducted.

Figure 3 shows the process that was developed to select such meetings from the hundreds of meetings that occur each day. The corporate online RRS was the first source to pre-screen meetings. Once meeting-host consent was obtained, an observer would register as a participant, and quietly and respectfully observe and record the data for the first 15 minutes of a meeting. It was understood that the unintrusive nature of the observer would limit the scope and detail of the data collected. Therefore, the team settled on the following items.

- Scheduled Meeting Date and Time – The scheduled time/date for the meeting.
- Participant Arrival Start Time – The time at which the first participant arrived on the local side.
- Participant Arrival Stop Time – The time at which arrivals ceased.
- AV Panel Start Time – The time at which configuration with the AV panel began on the local side (e.g., the time at which any participant began the connect-VTC task).
- AV Panel Stop Time – The time at which AV configuration ceased.
- NetMeeting Start Time – The time at which configuration of NetMeeting began on the local side (e.g., the time at which a participant touched the room PC).
- NetMeeting Stop Time – The time at which configuration of NetMeeting ceased.
- Meeting Place Start – The time at which configuration of Meeting Place began.
- Meeting Place Stop – The time at which Meeting Place configuration ceased.
- VTC Display Start Time – The time at which the VTC connected and displayed remote participants on the local screen.
- Meeting Start Time – The time at which the meeting officially started (e.g., indicated by the meeting host).
- Local Participant Count at 5 minute intervals – The number of participants on the local side at –5, 0, 5, 10, and 15 minutes relative to the scheduled meeting time.
- Remote Participant Count at 5 minute intervals – The number of participants on the VTC remote side (or on a phone connection) at -5, 0, 5, 10, and 15 minutes relative to the scheduled meeting time.
- Notes - Notes/anomalies associated with the start of the meeting.

Identifying target meetings was a challenging, multi-step process (See Figure 3). Meetings posted in the RRS were reviewed to identify candidates that met the a priori criteria. The team placed phone calls to obtain the host's consent for an observer to be present at the meeting. Since the postings often included an administrative assistant's name (aka. the meeting arranger) rather than the actual host, the team first contacted the meeting arranger to ascertain the name of the meeting host. Then, the team contacted the meeting host with the intent of obtaining consent. The primary contact mechanism was phone, however email was used at times. Obtaining consent from the host involved the following.

- Validating that the planned meeting actually met the a priori criteria
- Explaining the objectives of the observation
- Dispelling any concerns the host might have about the observation activity

Often, this contact was followed-up with an email 1) to underscore the need for a meeting to match the criteria, and 2) to dispel concerns about attribution.
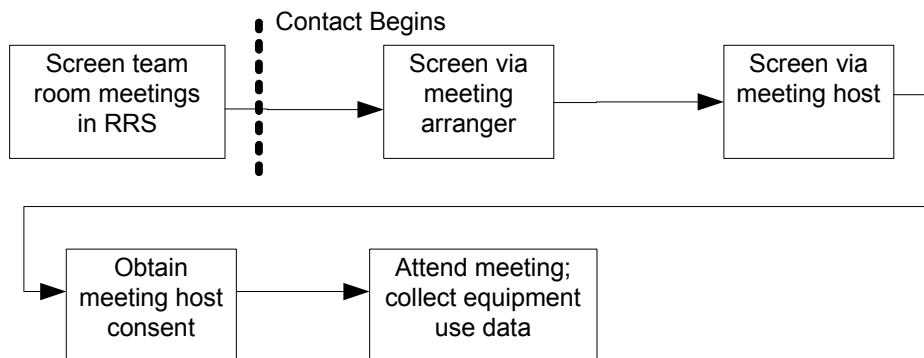

Figure 3. Screening process leading to equipment-use data collection.

Further difficulties were encountered during the course of observation. Only limited, high-level observations could be made about AV-panel-use simply because a view of the AV panel could not be guaranteed. Often the observer found it difficult to maintain a clear view of the AV panel without intruding on the proceedings of a meeting; and performing latter would have breached the agreement with the meeting host and skewed the data being collected. Failing to dispel concern about attribution in advance of a meeting clearly affected the behavior of one meeting host. In a couple of instances the hosts were 1) concerned about their ability to use the AV panel, and 2) concerned that their session would be observed and recorded.

Methodology

The total meetings reviewed in the RRS far exceeded the number of contacts made to meeting arrangers or hosts. Tallies were tracked for the meetings that resulted in contacts to administrative assistants and hosts.

Because of the challenge in obtaining consent, a small number of meetings were identified by means other than RRS.

Pre-screening the meeting description with the host was not always reliable. Discovering at an observation session that a priori criteria would not be met did not discourage data collection. This additional data was captured for exploratory purposes and with the intent of filtering it out from the cases for data analysis.

Deviations from the a priori criteria included the following:

1. The remote VTC site dialed-in, rather than the local host initiating the VTC.
2. The host was using a VTC room, but no VTC was planned
3. The meeting was not a project team meeting (e.g., a division-wide briefing, a lunchtime team-building activity).
4. The meeting was a multi-point VTC meeting, which VTC staff set up.
5. The observer's presence possibly had a significant influence on the meeting host's behavior.

Total number of meeting posts reviewed	Not Tracked
Total number of meeting posts that resulted in contacts to administrative assistants and/or meeting hosts, but did not result in meeting observations	**114**
No VTC planned	46
Administrative Assistant or Host not available	15
Cancelled (or Rescheduled)	28
Not appropriate for observation due to executive level of the meeting	3
Not appropriate for observation due to another reason, e.g., staffing meeting, privileged information, awards-board	11
Host not in McLean	10
Consent was obtained, but the meeting was not observed (e.g., the observer selected an alternate meeting)	1
Total number of meeting posts that resulted in meeting observations	**33**
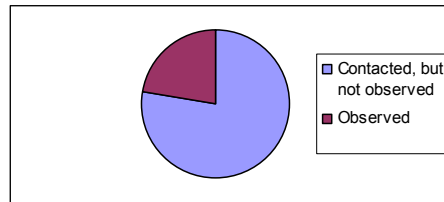
Figure 4. Contacts made vs. observed meetings.

For [1] above, there were two types of occurrences. In the first case, the host started using the equipment to connect the VTC, and almost simultaneously the remote site dialed-in. In the second case, the host was not engaged in a task to connect the VTC, and the remote site dialed-in. The team determined that the former was not a substantive deviation from the criteria, because the host took action with clear intent to connect the VTC.

In some instances, the AV-panel-use continued after the meeting start. Since the team did not track the duration of specific use cases, the AV Panel Stop Time and the Meeting Start Time were not easily separated in these data. To focus analysis on the relationship between the AV-panel-use and meeting delays, data were needed where these two events followed one another. Therefore, the team determined that data should be excluded where there was AV-panel-use after the meeting started.

To filter out the above deviations, the data was cleaned as follows.

- Included meetings where the local user started the VTC connect task.
- Included meetings where a point-to-point VTC was planned.
- Excluded meetings that were clearly not project team meetings.
- Excluded meetings where the observer's presence possibly had a significant influence on the host's behavior.
- Included meetings where the Meeting Start Time was equal to or greater than the AV Panel Stop Time.

In order to regularize the data, each clock-time data point was converted to minute-units relative to the scheduled meeting time, called *Delta* values. The difference between start and stop times revealed equipment-use durations.

Results

The primary interest was examining the influence of AV-panel-use on meeting start times. The approach included first examining the correlations of the measurements on meeting start times. Next, multivariate regressions were performed in order to better understand the predictiveness of the variables on meeting start times. From the meeting observations 6 potential measurements (independent variables) were identified that might help to explain meeting start time (dependant variable):

- Participant Arrival Start Delta
- Participant Arrival Stop Delta
- Participant Arrival Duration
- AV Panel Start Delta
- AV Panel Stop time Delta
- AV Panel Duration
- Total Equipment Use Duration

The Duration variables are derived from the Start Delta and Stop Delta variables. Due to insufficient data the NetMeeting and Meeting Place variables could not be examined individually, but instead were used, along with the AV Panel variables to compute the aggregate variable, Total Equipment Use Duration. Examination of the scatter plots of the variables revealed some departures from normality and homoscedasticity. In order to meet the distribution assumptions for the regression some of the variables were transformed as shown in Table 1.

Table 1. Independent and dependent variable transformations.

Variable	Transformation
Participant Arrival Start Delta	Reflect and Log
Participant Arrival Stop Delta	None
Participant Arrival Duration	Log
AV Panel Start Delta	None
AV Panel Stop Delta	None
AV Panel Use Duration	Log
Meeting Start Delta	Log
Total Equipment Use Duration	None

All the analyses reported below were conducted using data (see Appendix A.2) that was first transformed and then standardized (converted to z-scores).

Correlation Analysis. The correlations between the variables were examined first, in order to better understand how the variables were related to each other. Table 2 shows the results of the correlations. All variables except for AV Panel Stop Delta were significantly correlated ($p < .05$ or less) to Meeting Start Delta. There were three correlations that were of particular interest. First was a high positive correlation between Participant Stop Delta and Meeting Start Delta, which confirmed the team's intuition that the time when participants stop arriving directly corresponds to when a meeting starts. Second was a somewhat perplexing significant negative correlation between AV Panel Start Delta and Meeting Start Delta, which indicated that earlier AV panel start times corresponded with later meeting start times. Third was a strong and

significant positive correlation between Total Equipment Use Duration and Meeting Start Delta, which indicated longer equipment-use corresponds with later meeting start times. Also, it was unexpected that the team found no detectable correlation between Meeting Start Delta and AV Panel Stop Delta.

Table 2. Pearson Correlations

	Meeting Start Delta	Participant Start Delta	Participant Arrival Stop Delta	Participant Arrival Duration	AV Panel Start Delta	AV Panel Stop Delta	AV Panel Use Duration	Total Equip Use Duration
Meeting Start Delta	1							
Participant Start Delta	.397	1						
Participant Arrival Stop Delta	.651(**)	.328	1					
Participant Arrival Duration	.621(**)	.645(**)	.845(**)	1				
AV Panel Start Delta	-.490(*)	-.789(**)	-.251	-.458(*)	1			
AV Panel Stop Delta	-.058	-.221	.034	.125	.338	1		
AV Panel Use Duration	.467(*)	.459(*)	.311	.536(**)	-.602(**)	.473(*)	1	
Total Equip Use Duration	.561(**)	.668(**)	.354	.583(**)	-.769(**)	-.044	.714(**)	1

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

Further examination of Table 2 also shows that many of the independent variables were significantly correlated with each other. This provided constraints on which variables could be included in the regression analyses.[6] For instance, there was strong correlation between the Duration variables and their corresponding Start Delta and Stop Delta. This correlation was expected given that the Duration variables were derived from Start Delta and Stop Delta variables.

Regression Analysis. In order to better understand degree to which each variable contributes to the predictiveness of Meeting Start Time, the team performed several multivariate regressions. As previously discussed, the primary motivation was to assess the degree to which AV panel and other equipment use influences Meeting Start Times. Based on the correlation matrix, the variables of most interest were AV Panel Start Delta, Participant Stop Delta, and Total Equipment Use Duration. Given that Total Equipment Duration was derived in part from AV Panel Start Delta, and highly correlated, the next step was to examine the influence of each independently in combination with Participant Stop Delta. The results of the two regressions are

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[6] Since one of the assumptions of multivariate regression is independence between the predictors, variables that were significantly correlated were not included in the same regression equation.

summarized in Table 3a,b and 4a,b.   The first regression included Participant Stop Delta and AV Panel Start Delta as the predictors for Meeting Start Delta. The team found the overall model to be highly significant fit (p < .001), and both variables added significant contribution to the prediction of Meeting Start Delta (p < .05 or less).

Table 3a. Regression of Participant Stop Delta and AV Panel Start Delta on Meeting Start Delta[a]

R	R^2	Adjusted R^2	Std. Error of the Estimate	R^2 Change	F Change	df1	df2	p
.733(a)	.537	.490	.62272938	.537	11.586	2	20	.000

a Predictors: (Constant), AV Panel Start Delta, Participant Arrival Stop Delta

Table 3b. Coefficients[a] for Participant Stop Delta and AV Panel Start Delta

	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	P
(Constant)	.079	.130		.610	.549
Participant Arrival Stop Delta	.447	.125	.563	3.581	.002
AV Panel Start Delta	-.339	.153	-.348	-2.214	.039

a Dependent Variable: Meeting Start Delta

The second regression included Participant Stop Delta and Total Equipment Use Duration as the predictor for Meeting Start Delta. The over-all model was highly significant, and both independent variables added significant contribution to the prediction of Meeting Start Delta (p < .05).

Table 4a. Regression of Participant Stop Delta and Total Equipment Use Duration on Meeting Start Delta[a]

R	R^2	Adjusted R^2	Std. Error of the Estimate	R^2 Change	F Change	df1	df2	p
.740(a)	.548	.503	.61498227	.548	12.133	2	20	.000

a Predictors: (Constant), Total Equip Use Duration, Participant Arrival Stop Delta

Table 3b. Coefficients[a] for Participant Stop Delta and Total Equipment Use Duration

	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	P
(Constant)	.056	.128		.435	.668
Participant Arrival Stop Delta	.411	.128	.517	3.217	.004
Total Equip Use Duration	.330	.140	.378	2.352	.029

a Dependent Variable: Meeting Start Delta

Discussion

Several key factors that influence meeting start times were identified as a result of the analysis. The most obvious and expected result was that for the observed meetings, the time at which participants stopped arriving to a meeting was strongly predictive of when that meeting officially began.

Next and somewhat counter-intuitive, the team found that the time at which participants started to use the AV panel was inversely related to when meetings started. One possible interpretation of this result is that users may in advance anticipate difficulty with AV panel or other devices and start earlier on setting up the equipment. It may then follow that a more complex equipment setup may then contribute to the later meeting start. To test this hypothesis, a simple measurement of the complexity of equipment use was calculated by adding up the number of additional systems used during the meeting (NetMeeting, Meeting Place, and Laptop display), resulting in a score of 0-3 for each meeting. The finding was a high negative correlation between complexity of setup and AV panel start ($r = -.615$, $p = .002$), which supports the hypothesis that greater complexity leads users to start earlier on the AV panel. This interpretation was further bolstered by the findings from the second regression that longer total equipment use duration is predictive of when a meeting will start.

Conclusions

This paper described an exploratory study into quantifying the relationship between Team Room equipment-use and delayed meeting start time. The data collected effectively established baseline data for measuring equipment-use improvement strategies.

The team found that merely identifying meetings and obtaining host consent consumed a majority of the data collection effort. User actions could only be tracked to a limited degree though this type of observation. As a result, it is anticipated that more thorough experimental control would greatly improve collection of the data.

Of primary importance to the team was the objective to explore whether or not the data could quantify the effect of AV panel and Team Room equipment-use on meeting start time. This objective was partially borne out by the results of the analyses. The team found evidence that, in general, Team Room equipment-use is predictive of meeting start times. However, given the measurements available, the team could not be more precise in specifying the nature of this relation. That is, the exact influence that AV panel, NetMeeting, or Meeting Place use has on meeting start times remains unknown. Stronger experimental control and measurement would provide a better understanding of the impact that the AV panel has on meeting start times. For instance, the AV-panel-use could be measured in a more granular manner (e.g., by specific use-cases and/or finer measurements of AV panel GUI use and response times). On the whole, the cumulative evidence suggests that improvement in equipment setup times would contribute to reducing the delay in meeting start times. Future studies should examine how alternative user interfaces and approaches can reduce the impact that equipment setup has on meeting start times.

References

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[HARP2004-3] Harper, L., Gertner, A., Herceg, P., Hines, T., Kemon, E., Mireles, D., Shadid, M., Van Guilder, J. "The EMMA System: Enabling Novel User Interfaces to Integrated Conferencing Systems." September 2004, MITRE MP 06W0000081.

[MITRE-PAATS] http://www.mitre.org/tech/etr

Appendix

A.1. Raw Data

	Meeting ID	Data Collector Initials	Date	Time	Host Location	Prtcpnt Arr Start	Prtcpnt Arr Stop	AV Panel Start	AV Panel Stop	NetMtg Start	NetMtg Stop	Mtg Pl Start	Mtg Pl Stop	VTC Start	Mtg Start
1	20051011-01	pmh	10/11/05	2:30 PM	McLean	2:20 PM	2:47 PM	2:20 PM	2:32 PM	2:20 PM	2:29 PM	2:30 PM	2:32 PM	2:21 PM	2:48 PM
2	20051013-01	pmh	10/13/05	11:00 AM	McLean	10:56 AM	11:08 AM	10:59 AM	11:02 AM	10:59 AM	11:04 AM			11:02 AM	11:05 AM
3	20051013-02	pmh	10/13/05	1:00 PM	McLean	1:00 PM	1:03 PM	1:00 PM	1:01 PM					1:01 PM	1:03 PM
4	20051017-01	pmh	10/17/05	10:00 AM	McLean	9:55 AM	10:05 AM	9:59 AM	10:17 AM			10:05 AM	10:10 AM	10:01 AM	10:10 AM
5	20051024-01	pmh	10/24/05	9:00 AM	McLean	8:56 AM	9:11 AM	8:57 AM	9:00 AM			8:57 AM	8:59 AM		9:02 AM
6	20051024-02	pmh	10/24/05	10:00 AM	McLean	9:50 AM	10:13 AM	9:53 AM	9:59 AM			10:00 AM	10:01 AM	9:59 AM	10:16 AM
7	20051024-03	pmh	10/24/05	2:30 PM	McLean	2:15 PM	2:35 PM	2:21 PM	2:35 PM			2:32 PM	2:33 PM	2:35 PM	2:36 PM
8	20051025-01	pmh	10/25/05	3:00 PM	McLean	2:45 PM	3:05 PM	2:47 PM	3:06 PM			3:02 PM	3:03 PM		3:06 PM
9	20051028-01	pmh	10/28/05	1:00 PM	McLean	12:58 PM	12:59 PM	12:58 PM	12:59 PM					12:59 PM	1:04 PM
10	20051101-01	pmh	11/01/05	10:00 AM	McLean	9:55 AM	10:01 AM							9:56 AM	10:02 AM
11	20051101-02	pmh	11/01/05	11:30 AM	McLean	11:20 AM	11:39 AM					11:36 AM	11:39 AM		11:49 AM
12	20051101-03	pmh	11/01/05	1:00 PM	McLean	12:58 PM	1:10 PM	12:58 PM	1:03 PM	1:00 PM	1:10 PM			12:59 PM	1:11 PM
13	20051101-04	pmh	11/01/05	2:00 PM	McLean	1:52 PM	2:03 PM	1:54 PM	2:05 PM	2:04 PM	2:08 PM			1:55 PM	2:08 PM
14	20051101-05	pmh	11/01/05	2:30 PM	McLean	2:27 PM	2:39 PM	2:28 PM	2:29 PM					2:29 PM	2:41 PM
15	20051116-01	pmh	11/16/05	9:00 AM	McLean	8:52 AM	9:06 AM	8:52 AM	9:07 AM			8:53 AM	8:56 AM	8:57 AM	9:04 AM
16	20051116-02	pmh	11/16/05	3:00 PM	McLean	2:58 PM	3:02 PM	3:01 PM	3:02 PM					3:01 PM	3:03 PM
17	20051121-01	pmh	11/21/05	2:30 PM	McLean	2:30 PM	2:32 PM	2:30 PM	2:32 PM	2:31 PM	2:34 PM			2:32 PM	2:35 PM
18	20051202-01	pmh	12/02/05	2:20 PM	McLean	2:18 PM	2:21 PM	2:18 PM	2:21 PM	2:23 PM	2:27 PM			2:19 PM	2:27 PM
19	20051205-01	pmh	12/05/05	1:00 PM	McLean	12:55 PM	1:10 PM	12:55 PM	1:06 PM	12:56 PM	1:02 PM	12:58 PM	1:06 PM	12:56 PM	1:08 PM
20	20051212-01	pmh	12/12/05	2:00 PM	McLean	1:59 PM	2:04 PM							2:01 PM	2:02 PM
21	20051212-02	pmh	12/12/05	3:00 PM	McLean	2:57 PM	3:04 PM	3:02 PM	3:04 PM					3:04 PM	3:05 PM
22	20051214-01	pmh	12/14/05	1:30 PM	McLean	1:29 PM	1:31 PM	1:30 PM	1:33 PM			1:30 PM	1:31 PM		1:33 PM
23	20051214-02	pmh	12/14/05	2:00 PM	McLean	1:58 PM	2:12 PM	1:58 PM	2:06 PM					2:05 PM	2:06 PM
24	20051216-01	pmh	12/16/05	9:30 AM	McLean	9:26 AM	9:44 AM	9:34 AM	9:35 AM			9:34 AM	9:38 AM	9:34 AM	9:35 AM
25	20051221-01	pmh	12/21/05	11:00 AM	McLean	10:49 AM	11:13 AM	10:51 AM	10:54 AM			11:10 AM	11:10 AM	10:52 AM	11:14 AM
26	20060103-01	pmh	01/03/06	8:30 AM	McLean	8:27 AM	8:34 AM	8:27 AM	8:35 AM					8:28 AM	8:42 AM
27	20060104-01	pmh	01/04/06	9:00 AM	McLean	8:55 AM	9:10 AM	8:56 AM	9:15 AM					9:10 AM	9:15 AM
28	20060106-01	pmh	01/06/06	11:00 AM	McLean	11:04 AM	11:12 AM	11:04 AM	11:09 AM			11:04 AM	11:06 AM	11:09 AM	11:07 AM
29	20060110-01	pmh	01/10/06	8:30 AM	McLean	8:31 AM	8:39 AM	8:31 AM	8:38 AM					8:32 AM	8:40 AM
30	20060110-02	pmh	01/10/06	1:00 PM	McLean	12:54 PM	1:07 PM	12:59 PM	1:07 PM			1:06 PM	1:07 PM	1:04 PM	1:07 PM
31	20060110-03	pmh	01/10/06	2:00 PM	McLean	1:48 PM	2:11 PM	2:00 PM	2:15 PM					2:11 PM	2:16 PM

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	Meeting ID	Data Collector Initials	Date	Time	Host Location	Prtcpnt Arr Start	Prtcpnt Arr Stop	AV Panel Start	AV Panel Stop	NetMtg Start	NetMtg Stop	Mtg Pl Start	Mtg Pl Stop	VTC Start	Mtg Start
32	20060113-01	pmh	01/13/06	11:00 AM	McLean	10:58 AM	11:06 AM	10:58 AM	11:02 AM			10:58 AM	10:59 AM	10:58 AM	11:02 AM
33	20060113-02	pmh	01/13/06	1:00 PM	McLean	12:59 PM	1:16 PM	1:01 PM	1:05 PM					1:14 PM	1:15 PM

LP=Local Participant Count; RP=Remote Participant Count

	Meeting ID	LP -5	LP 0	LP 5	LP 10	LP 15	RP -5	RP 0	RP 5	RP 10	RP 15	Local User Proficiency	Local user began VTC connect task	Local user completed VTC connect task	Remote user completed VTC connect task	Local or remote user completed VTC connect task (some VTCs failed)	Local or Remote side called Help Desk	Local Laptop Display task started	Point-to-point VTC was planned	Possible significant influence on host behavior	Not a typical workgroup meeting
1	20051011-01	1	2	2	2	2	0	2	3	3	3	Expert	1	1	0	1	0	1	1	0	0
2	20051013-01	1	8	10	12	8	0	7	7	8	8	Expert	1	1	0	1	0	0	1	0	0
3	20051013-02	0	2	4	4	4	0	0	2	2	2	Expert	1	1	0	1	0	0	1	0	0
4	20051017-01	1	3	7	7	8	0	0	0	2	2	Novice	1	1	0	1	0	1	1	1	0
5	20051024-01	0	3	4	4	4	0	0	0	0	1	Novice	0	0	0	0	0	0	0	0	0
6	20051024-02	1	1	1	1	1	0	1	3	3	4	Novice	1	1	0	1	0	0	1	0	0
7	20051024-03	1	2	3	3	3	0	0	3	3	3	Novice	1	1	0	1	0	0	1	0	0
8	20051025-01	1	5	6	6	6	0	0	1	1	1	Novice	1	0	0	0	0	1	0	0	0
9	20051028-01	0	3	7	7	7	0	1	1	1	1	Expert	1	1	0	1	0	0	1	0	0
10	20051101-01	0	4	5	5	5	2	2	3	3	3	Novice	0	0	1	1	0	0	1	0	0
11	20051101-02	1	3	7	8	8	0	0	0	1	1	Novice	0	0	0	0	0	0	0	0	1
12	20051101-03	0	1	2	2	2	0	1	1	2	2	Novice	1	0	1	1	0	0	1	0	0
13	20051101-04	1	1	2	2	2	0	0	1	1	1	Expert	1	1	0	1	0	0	1	0	0
14	20051101-05	0	2	3	4	4	0	0	3	5	5	Expert	1	1	0	1	0	0	1	0	0
15	20051116-01	1	3	5	5	5	0	1	1	2	2	Expert	1	1	0	1	0	0	1	0	0
16	20051116-02	0	3	5	5	5	0	0	2	2	2	Expert	1	1	0	1	0	0	1	0	0
17	20051121-01	1	2	2	2	2	0	0	2	2	2	Expert	1	1	0	1	0	0	1	0	0
18	20051202-01	0	1	2	2	2	0	0	1	1	1	Expert	1	1	0	1	0	0	1	0	0
19	20051205-01	0	4	4	4	5	0	2	6	6	6	Expert	1	1	0	1	0	0	1	0	0
20	20051212-01	0	1	5	6	6	0	0	2	2	2	Novice	0	0	1	1	0	0	1	0	0
21	20051212-02	0	1	3	3	4	0	0	3	3	3	Expert	1	1	0	1	0	0	1	0	0
22	20051214-01	0	2	2	2	2	0	0	2	2	2	Expert	1	0	0	0	0	0	1	0	0

	Meeting ID	LP -5	LP 0	LP 5	LP 10	LP 15	RP -5	RP 0	RP 5	RP 10	RP 15	Local User Proficiency	Local user began VTC connect task	Local user completed VTC connect task	Remote user completed VTC connect task	Local or remote user completed VTC connect task (some VTCs failed)	Local or Remote side called Help Desk	Local Laptop Display task started	Point-to-point VTC was planned	Possible significant influence on host behavior	Not a typical workgroup meeting
23	20051214-02	0	3	3	3	4	0	0	1	1	1	Novice	1	1	0	1	1	1	1	0	0
24	20051216-01	0	7	13	19	20	0	0	2	3	3	Expert	1	0	1	1	0	0	1	0	0
25	20051221-01	1	1	2	2	3	0	0	0	0	0	Expert	1	1	0	1	0	1	1	0	0
26	20060103-01	0	2	5	5	5	0	0	1	1	0	Expert	1	1	0	1	1	0	1	0	0
27	20060104-01	0	2	4	5	5	0	0	0	0	1	Expert	1	1	0	1	0	1	1	0	1
28	20060106-01	0	0	8	8	9	0	0	1	2	2	Expert	1	1	0	1	0	0	1	0	0
29	20060110-01	0	0	2	4	4	0	0	0	1	1	Expert	1	1	0	1	0	1	1	0	0
30	20060110-02	1	1	2	4	4	0	0	1	2	2	Novice	1	0	1	1	0	0	1	0	0
31	20060110-03	3	4	6	6	6	0	0	0	0	2	Expert	1	0	1	1	1	1	0	0	0
32	20060113-01	0	8	9	10	10	0	1	2	2	2	Expert	1	1	0	1	0	0	1	0	0
33	20060113-02	0	1	4	5	5	0	0	0	0	1	Expert	1	0	1	1	1	0	1	0	0

A.2. Cleansed Data

	Meeting_ID	Prtcpnt_Arr_Start_delta	Prtcpnt_Arr_Stop_delta	Participant_Arr_Duration	AV_Panel_Start_delta	AV_Panel_Stop_delta	AV_Panel_Use_Duration	NetMtg_Start_delta	NetMtg_Stop_delta	Mtg_Pl_Start_delta	Mtg_Pl_Stop_delta	Total_Equip_Use_Duration
1	20051011-01	-10	17	27	-10	2	12	-10	-1	0	2	12
2	20051013-01	-4	8	12	-1	2	3	-1	4	.	.	5
3	20051013-02	0	3	3	0	1	1	.	.	.	.	1
4	20051024-02	-10	13	23	-7	-1	6	.	.	0	1	8
5	20051024-03	-15	5	20	-9	5	14	.	.	2	3	14
6	20051028-01	-2	-1	1	-2	-1	1	.	.	.	.	1
7	20051101-03	-2	10	12	-2	3	5	0	10	.	.	12
8	20051101-04	-8	3	11	-6	5	11	4	8	.	.	14
9	20051101-05	-3	9	12	-2	-1	1	.	.	.	.	1
10	20051116-02	-2	2	4	1	2	1	.	.	.	.	1
11	20051121-01	0	2	2	0	2	2	1	4	.	.	4
12	20051202-01	-2	1	3	-2	1	3	3	7	.	.	9

	Meeting_ID	Prtcpnt_Arr_Start_delta	Prtcpnt_Arr_Stop_delta	Participant_Arr_Duration	AV_Panel_Start_delta	AV_Panel_Stop_delta	AV_Panel_Use_Duration	NetMtg_Start_delta	NetMtg_Stop_delta	Mtg_Pl_Start_delta	Mtg_Pl_Stop_delta	Total_Equip_Use_Duration
13	20051205-01	-5	10	15	-5	6	11	-4	2	-2	6	11
14	20051212-02	-3	4	7	2	4	2	.	.	.	.	2
15	20051214-01	-1	1	2	0	3	3	.	.	0	1	3
16	20051214-02	-2	12	14	-2	6	8	.	.	.	.	8
17	20051216-01	-4	14	18	4	5	1	.	.	4	8	4
18	20051221-01	-11	13	24	-9	-6	3	.	.	10	10	19
19	20060103-01	-3	4	7	-3	5	8	.	.	.	.	8
20	20060110-01	1	9	8	1	8	7	.	.	.	.	7
21	20060110-02	-6	7	13	-1	7	8	.	.	6	7	8
22	20060113-01	-2	6	8	-2	2	4	.	.	-2	-1	4
23	20060113-02	-1	16	17	1	5	4	.	.	.	.	4

	Meeting_ID	Last_Equipment_Used_Stop_delta_both_local_and_remote	VTC_Start_delta	Mtg_Start_delta	Meeting_Start_follows_or_same_as_AV_Panel_Stop	EquipUseComplexity	ZI10MeetStart	ZN10PartStart	ZPrtcpnt_Arr_Stop_delta	ZI10PartDur	ZAV_Panel_Start_delta	ZAV_Panel_Stop_delta	ZI10AV_Panel_dur	ZTotal_Equip_Use_Duration
1	20051011-01	2	-9	18	1	3	1.4634	0.99039	2.04455	1.2905	-1.77953	-0.498	0.94468	1.01709
2	20051013-01	4	2	5	1	1	-0.38808	0.08403	0.141	0.29626	0.39456	-0.498	-0.47957	-0.39456
3	20051013-02	1	1	3	1	0	-1.12644	-0.95887	-0.91652	-1.40341	0.63612	-0.6999	-1.60826	-1.20122
4	20051024-02	1	-1	16	1	1	1.29316	0.99039	1.19853	1.09391	-1.05484	-1.10368	0.23256	0.21043
5	20051024-03	5	5	6	1	1	-0.12455	1.50082	-0.49351	0.92255	-1.53797	0.10768	1.10306	1.42042
6	20051028-01	-1	-1	4	1	0	-0.71062	-0.36187	-1.76254	-2.75036	0.15299	-1.10368	-1.60826	-1.20122
7	20051101-03	10	-1	11	1	1	0.75157	-0.36187	0.56401	0.29626	0.15299	-0.29611	0.04525	1.01709
8	20051101-04	8	-5	8	1	1	0.29127	0.73648	-0.91652	0.18958	-0.81327	0.10768	0.85529	1.42042
9	20051101-05	-1	-1	11	1	0	0.75157	-0.12495	0.35251	0.29626	0.15299	-1.10368	-1.60826	-1.20122
10	20051116-02	2	1	3	1	0	-1.12644	-0.36187	-1.12803	-1.0507	0.87769	-0.498	-1.60826	-1.20122
11	20051121-01	4	2	5	1	1	-0.38808	-0.95887	-1.12803	-1.90053	0.63612	-0.498	-0.89613	-0.59623
12	20051202-01	7	-1	7	1	1	0.09826	-0.36187	-1.33953	-1.40341	0.15299	-0.6999	-0.47957	0.4121
13	20051205-01	6	-4	8	1	2	0.29127	0.27097	0.56401	0.56984	-0.57171	0.30957	0.85529	0.81543
14	20051212-02	4	4	5	1	0	-0.38808	-0.12495	-0.70502	-0.36458	1.11925	-0.09422	-0.89613	-0.99956
15	20051214-01	3	.	3	1	1	-1.12644	-0.63538	-1.33953	-1.90053	0.63612	-0.29611	-0.47957	-0.79789
16	20051214-02	6	5	6	1	1	-0.12455	-0.36187	0.98702	0.48525	0.15299	0.30957	0.52812	0.21043
17	20051216-01	8	4	5	1	1	-0.38808	0.08403	1.41003	0.79338	1.60239	0.10768	-1.60826	-0.59623
18	20051221-01	10	-8	14	1	2	1.10015	1.1049	1.19853	1.14609	-1.53797	-2.11315	-0.47957	2.42875

	Meeting_ID	Last_Equipment_Used_Stop_delta_both_local_and_remote	VTC_Start_delta	Mtg_Start_delta	Meeting_Start_follows_or_same_as_AV_Panel_Stop	EquipUseComplexity	ZI10MeetStart	ZN10PartStart	ZPrtcpnt_Arr_Stop_delta	ZI10PartDur	ZAV_Panel_Start_delta	ZAV_Panel_Stop_delta	ZI10AV_Panel_dur	ZTotal_Equip_Use_Duration
19	20060103-01	5	-2	12	1	0	0.87734	-0.12495	-0.70502	-0.36458	-0.08857	0.10768	0.52812	0.21043
20	20060110-01	8	2	10	1	1	0.61381	-1.35479	0.35251	-0.20086	0.87769	0.71336	0.39093	0.00877
21	20060110-02	7	4	7	1	1	0.09826	0.44008	-0.0705	0.39439	0.39456	0.51146	0.52812	0.21043
22	20060113-01	2	-2	2	1	1	-1.71251	-0.36187	-0.28201	-0.20086	0.15299	-0.498	-0.18401	-0.59623
23	20060113-02	14	14	15	1	0	1.19987	-0.63538	1.83304	0.7233	0.87769	0.10768	-0.18401	-0.59623

A.3 Use Cases

Display use-cases observed [local side]

Action	Display Source	Display Equipment Source	Display Destination	Display Equipment Destination	Method
Display	Remote	Laptop	Local	Room PC and Projector	Netmeeting
Display	Remote	Room PC	Local	Room PC and Projector	Netmeeting
Display	Remote	Laptop	Local	Laptop	Netmeeting
Display	Local	Laptop	Remote	Projector	Composite Video
Display	Local	Room PC	Remote	Projector	Netmeeting
Display	Local	Laptop	Local	Projector	RGB Video
Display	Local	Room PC	Local	Projector	RGB Video

Connect use-cases observed [local side]

Action	Destination	Method
Connect participants	Team Room	VTC
Connect participants	Meeting Place Bridge	Hard phone
Connect participants	Meeting Place Bridge	AV panel softphone
Connect participants	Direct dial phone number	Hard phone

Miscellaneous use-cases observed [local side]

Action
Troubleshoot video
Troubleshoot audio
Troubleshoot meeting place
Troubleshoot audio or video by calling the help desk
Lower window shades
Adjust camera
Adjust volume
Connect laptop to network
Connect laptop to VGA cable for display