CHAPTER 10
MAINTENANCE RESOURCE MANAGEMENT ON-LINE SEMINAR

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10.1 EXECUTIVE SUMMARY

Airlines, repair stations, manufacturers, and the Federal Aviation Administration (FAA) Flight Standards are all under pressure to train personnel to perform a broader range of tasks. Personnel are expected to be skilled in more areas, while fewer dollars are available to meet training needs. While on-the-job training is essential for efficient, effective and safe performance of aviation maintenance personnel, travel to training centers and time away from the job are not cost effective or efficient means of training personnel.

The Gore Commission (Final Report to President Clinton by the White House Commission on Aviation Safety and Security, (http://www.aviationcommission.dot.gov) encouraged the FAA to capitalize on advanced technology to improve aviation safety. In response, this research project offers distance education as an instructional approach where people engage in educational activities without having to be at the site where the instruction is occurring. The Safe Maintenance in Aviation Resource and Training (SMART) Center provides a forum for training and discussion of issues related to Maintenance Resource Management (MRM). This prototype is designed to investigate the utility and feasibility of web-based resources and training centers for the aviation community.

The first on-line MRM seminar was administered from January 4 through February 8, 1999. In this report the SMART Center and the MRM seminar are described. An extensive analysis of the seminar activities and participant evaluation is performed. The report closes with recommendations for future seminars of this kind and a look to future trends in the field of on-line training.

There is no question that the target audience, Aviation Maintenance Personnel, valued the training and saw the Internet as an appropriate vehicle for delivering training. Analysis of participant data revealed that the participants all had backgrounds in aviation maintenance, but within that field there was a wide range of expertise. The participants also represented many areas of the U.S., Canada, and other parts of the world. Participants were very active, not only working their way through the Computer Based Training (CBT) curriculum, but also reading many of the class materials and participating in the chat discussions. The technology stood up reasonably well to active use, though this is the area where the most improvements can be made. The goal in this area should continue to be to make the technology transparent to the user.

Given the target audience, working aviation maintenance personnel located worldwide, the seminar activities were designed to be primarily self paced and accessible any time, day or night. One of the reported drawbacks to distance learning, however, is the isolation students' feel when trying to learn remotely1. To minimize the feeling of isolation, we provided several means for interacting with staff, content facilitators, and other participants. Another design decision that was crucial to the success of the seminar was the conscious decision not to burden the participants with too much technology. Sophisticated technology (live video and audio) is often perceived as the optimal solution to distance education. However, one must moderate this tendency with the goal of the course work, the technical sophistication of the audience, the available hardware, and the available bandwidth. Often the coursework does not require sophisticated technology to meet its stated objectives. One must weight the cost of equipment support, software required, the learning curve and increase likelihood of technical failure to the value added in the medium used. For example, don't risk relying on a high-risk technology that many people don't have to support a core requirement of your course. The success of any on-line training will be do more to pedagogue than technology, though technology can enhance good pedagogy if implemented well.

10.2 BACKGROUND

10.2.1 Why Distance Education

MRM is a more challenging training effort than Crew Resource Management (CRM) because aviation maintenance involves larger more dissociated groups of personnel who must coordinate successfully with each other. Further, the daily individualized, non-proceduralized decision making is greater in maintenance than in flight operations.

Distance education is an instructional approach where people engage in educational activities without having to be at the site where the instruction is occurring. Instruction, resources, and students can be distributed across many different locations, and are usually connected together by technologies, such as computer networks, satellite dishes, and telephone lines. One approach to distance education is to capitalize on the technical capabilities of the World Wide Web (WWW) to create resource and training centers for continuing education of professionals. The SMART Center (Safe Maintenance in Aviation Resource and Training) is an example of such an approach for the delivery of On-the-Job Training.

Web Based Training (WBT) and centralization of information resources lends itself not only to setting standards for MRM practice but also will serve the community as a forum for discussing issues unique to MRM and providing a central repository for MRM research and training resources. The interactive nature of the web both in terms of live interaction, asymmetric interaction, and the dynamic evolution of information over time is the most compelling reasons for research and development of a SMART Center for the aviation community.

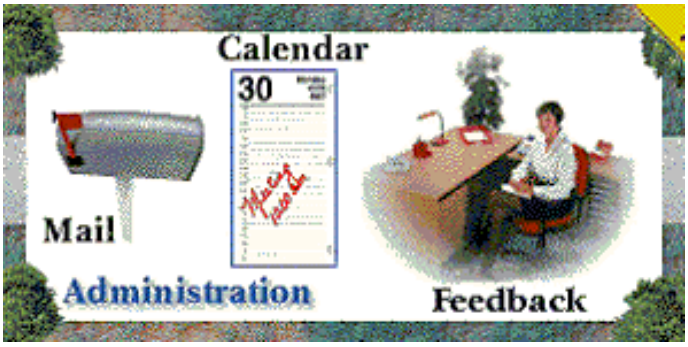
The main purpose of the research product is to promote safe operations in aviation maintenance through the application of human factors concepts and skills, in a distance education forum. The focus of the SMART Center is to train aviation maintenance personnel in MRM concepts and skills. MRM is the chosen topic because the subjects taught within the MRM curriculum (e.g., communication, teamwork, situation awareness, performance management) are applicable to all levels of the aviation maintenance community nationally and internationally.

10.2.2 A Description of the SMART Center

If an individual wants to participate in the MRM seminar, he or she first goes to Registration to sign up for the seminar. The participant chooses a user name and password. When she or he submits the registration request he or she is placed on the course mailing list. The security password provides access to registered class materials and activities.

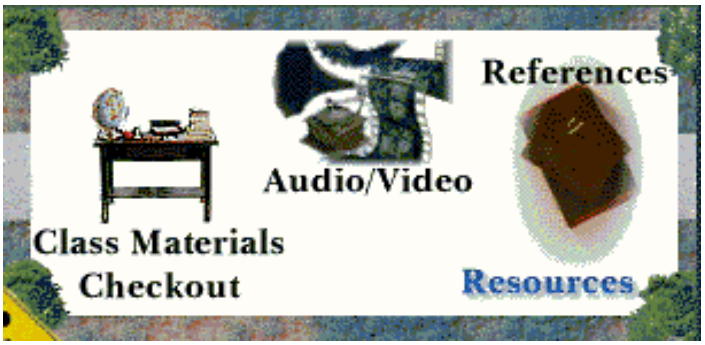
After entering the SMART Center, seminar participants find themselves looking at a map of a virtual school. The map divides the school into four conceptual areas: Administration, Classes, Resources, and Recreation.

In the Administration area, the class mailing list allows participants and instructors to send mail to each other and to submit or receive assignments. The Calendar facility informs participants of current events relevant to the course. Feedback provides a vehicle for participants to give the SMART Center staff feedback on course activities and content.



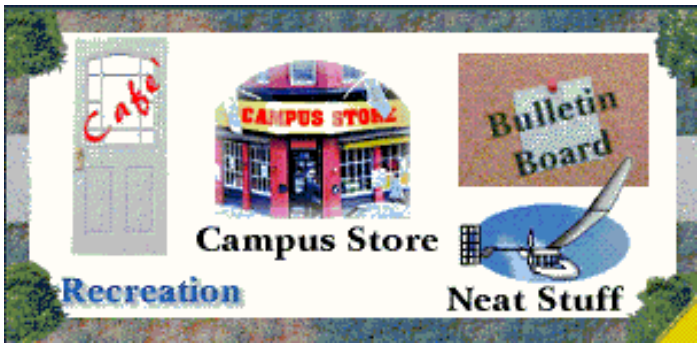
Interactive classes occur in the Lecture Hall, Lab, and Conference Room of the Classroom Area. Real-time lectures can be given through real audio-, video-, or text-based chat sessions. The type and sophistication of the equipment required for the class will change with the type of activity that is planned for the class. Text-based conference sessions require no additional equipment while real-time audio or video sessions require additional equipment and protocols. Transcripts from the conference chat sessions are posted in the Conference Summaries area. The Computer Based Training (CBT) Lab is where the core course materials are presented. Tests for each unit are also found within the CBT Lab.

The Resource area is where general resources pertinent to the seminar are found. Participants can view or download reading materials found in the Class Materials area. They can view on-demand lectures or demonstrations in the Audio/ Video area and they have access to references, relevant to human factors in aviation maintenance in the reference area.



For the MRM course, a video lecture found in the audio/video area introduces the seminar participants and the basic conceptual themes of each of the course sections. The CBT Lab provides interactive multimedia presentations and activities. Testing also occurs in the CBT Lab area. Participants can quiz themselves on the central concepts of each section through a multiple-choice test. Through several facilities (e.g., Calendar and Email) students are informed of dates and times when instructors will be available to discuss a particular course section. These textual chat sessions are held in the conference facility and are based on the readings found in the class materials area. When the participant has mastered all the sections in the course, a certificate of completion is sent to a designated address.

The Recreational area is where more informal interactions may occur. The Cafe is a meeting place for interest groups to gather and chat. Announcements for new classes and other community activities can be posted on bulletin boards. The Campus Store is where participants can update their browser and download any plug-ins they may need for the course. New applications that might be of interest to the group are found in the Neat Stuff area.



10.3 RESEARCH OBJECTIVES

The research tasks for the SMART Center project are as follows:

- Design and implement a resource and training site for aviation maintenance personnel,
- Develop a course that teaches Maintenance Resource Management,
- Conduct the MRM seminar, and
- Evaluate the merits of the project based on the following criterion:
  - Who participates? How many participate? In what manner do they participate?
  - Do they complete the course work?
  - How well does the technology stand up to the demands of active use?
  - Is the delivery of the seminar cost effective?
  - Does the target audience value the training?
  - Is the Internet accepted by the course participants as an appropriate mode of delivery?
  - How well are the site and course materials designed for the target audience?
  - Is this form of training cost effective?

10.4 METHODOLOGY

This research followed a modified Instructional Systems Design approach. The steps that were taken are:

- Analyze current on-the-job training needs for aviation community.
- Design and development of SMART Center and MRM course.
- Employ recognized experts in the field of human factors in aviation maintenance and inspection to write MRM course content and participate as experts in on-line MRM seminar.
- Conduct quality assurance test of all software that will support SMART Center and MRM course curriculum.
- Evaluate seminar on the following criterion:
  - participation
  - course completion
  - technology robustness
  - cost effectiveness
  - value added
  - overall design

10.5 PILOT STUDY

McDonnell Douglas/ Boeing volunteered to used the MRM web-based training in a pilot study to demonstrate the potential for web-based training in an open lab for on-the-job training of aviation maintenance technicians (AMTs). The original intent was to show a proof of concept to the industry and then create a consortium of airline and 3rd party maintenance companies who would share the cost for future online training courses. McDonnell Douglas/Boeing had originally planned to train 200 AMTs using the online MRM CBT portion of the SMART Center during the summer of 1998. Unfortunately, the training department was dismantled not long after the pilot study started. Thus only the first group of students were able to complete the training. Even with this smaller group of 20 students, the pilot study gave the research team valuable feedback about the on-line training experience prior to the seminar start in January 1999.

The training was conducted over a local intranet located in a room setup as a computer lab. The trainees were given an orientation session to cover the basic operation of the computer and an introduction to the MRM CBT Lab. They were instructed to work through the eight units of the CBT Lab during their down time. If they reached 100% criterion on all eight quizzes in the Lab, then they would receive a certificate of completion for the course from McDonnell Douglas/ Boeing. The Lab was open, with a proctor, during most working hours.

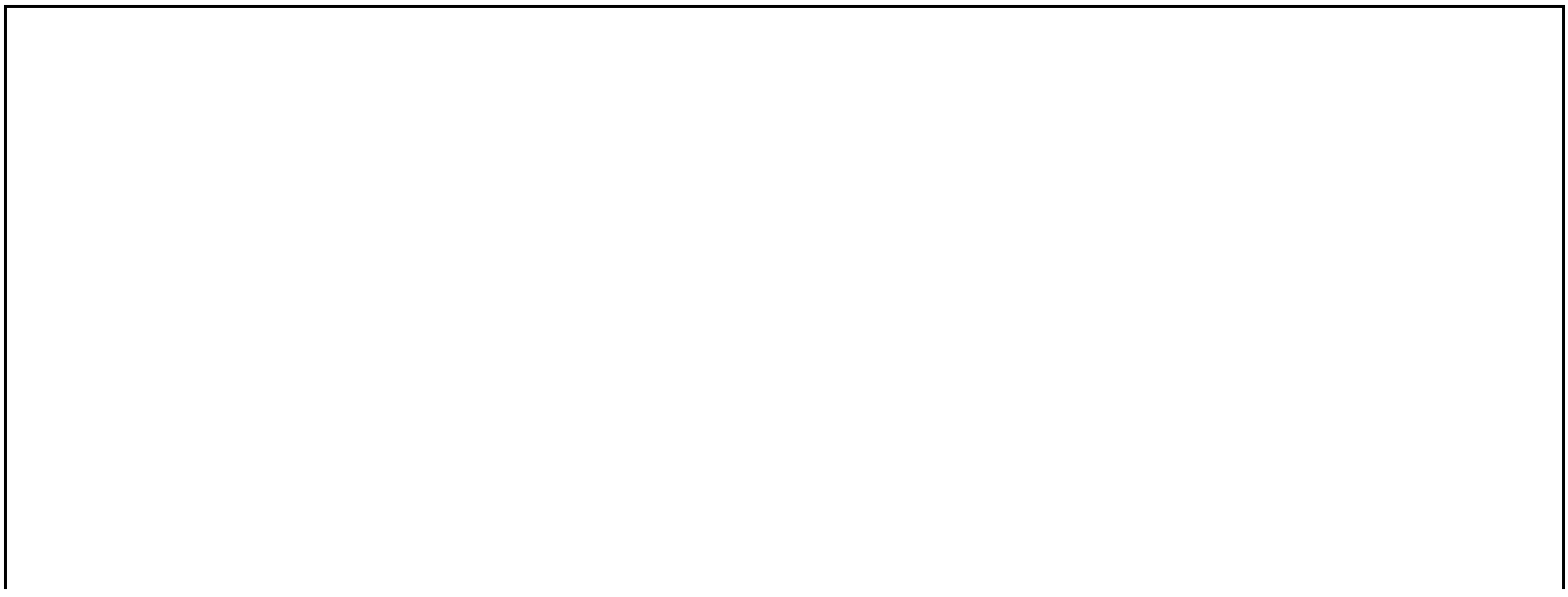
Of the 20 who started the first training course, 9 finished. The 11 who did not finished had been sent to another location midway through training period and were unable to complete the training. Verbal reports from the instructor were enthusiastic. He reported that he had never seen such a serious, concentrated, effort from his AMT trainees. He also assured the researchers that it was not from lack of interest that the 11 students did not complete the course, but from location changes beyond their control.

Table 10.1 Evaluation Form Submitted by 20 McDonnell Douglas/Boeing AMTs

Ease of Use	7.5
Intuitive	8.2
Navigation	7.6
Response Time	7.9
Like Display	8.9
Amount Learning	8.3
Ease Testing	5.2
Concepts understandable	9.1
Relevance	9.4

Table 10.1 shows a summary of evaluation form questions filled out by the 20 students. The evaluation form can be found in Appendix A. The scores are based on a 10 point scale: 1 = low and 10 = high. Trainees found that they liked the display even though they did not always find it easy to use or navigate. They thought the information to be understandable and very relevant to their job. They reported learning a fair amount but they found the test questions difficult.

Figure 10.1 shows the average number of tries it took all the students to reach 100% criterion for each quiz. There seemed to be a psychology of 'test taking' at play. For most tests, students achieved 100% in one to four tries, but often there was one test where an individual would experience a mental block. Sometimes it would take 10 to 15 tries to reach 100% for that particular test. Many people took longer to get 100% on the first test, which we assume is due to learning how to take the quiz. Some students had trouble with other quizzes but there was no pattern of one test being more difficult than another test. We will compare these test scores to the January seminar participants' performance on these same tests later in the report.



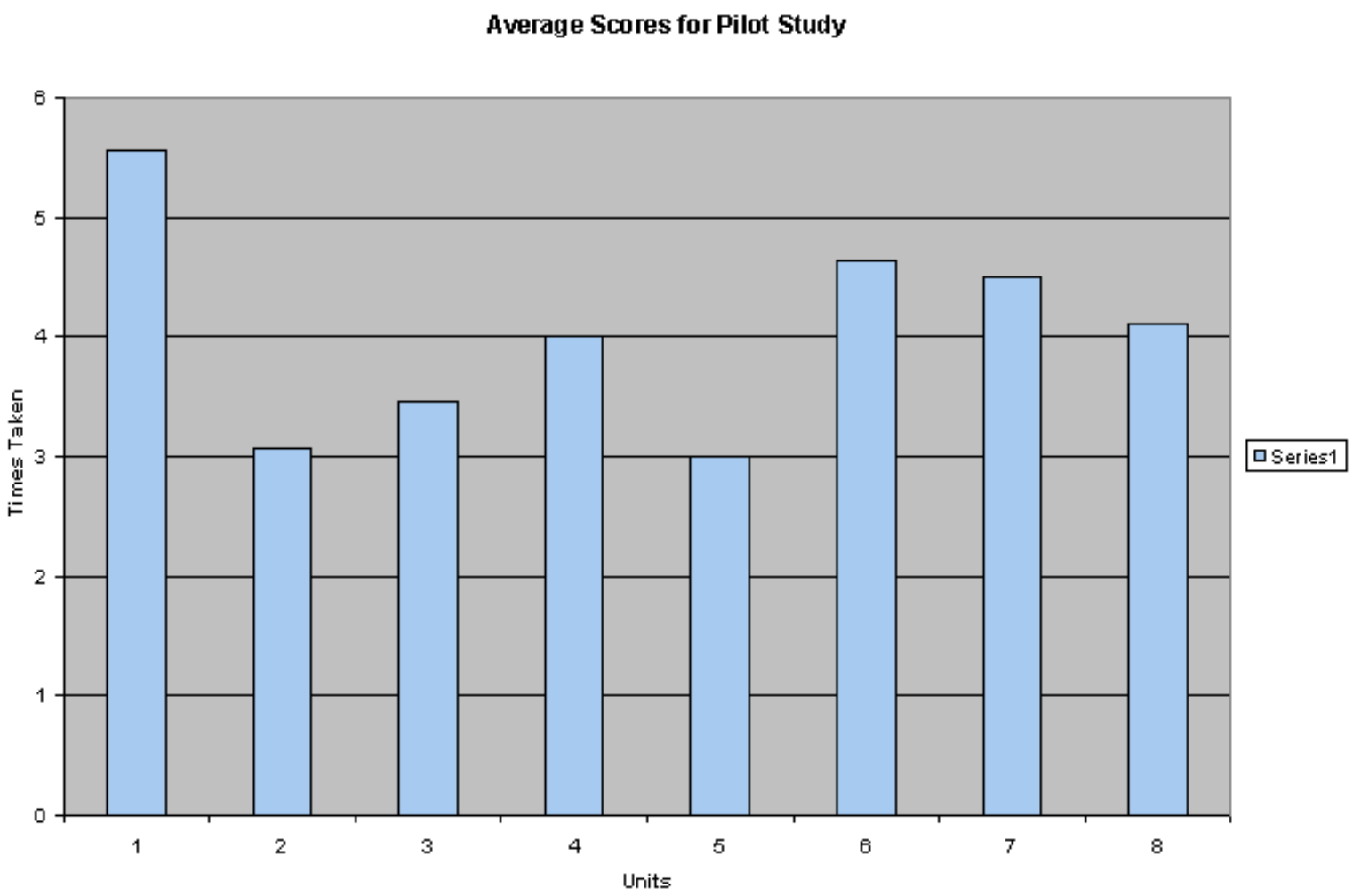


Figure 10.1 Average Scores for Pilot Study

The pilot study gave the research team important quality assurance feedback for both the core curriculum and the training application that was to be used in the January seminar. From this initial experience we found that the core curriculum was appropriate to our primary audience, the AMT, and the delivery system was sound. In other words, the application was stable, the multimedia played across an Intranet in reasonable time, and the interface was relatively self explanatory and easy to navigate.

10.6 THE JANUARY SEMINAR

10.6.1 Technical Features

Since the research team knew that we were going to be catering to an audience that could span the world, we tried to match what was technically required of the student with enough power to present an interesting and motivating seminar. Table 10.2 lists the hardware and software requirements for the students. We made every effort to limit the number of applications that the student needed to install. The student was expected to have equipment that could handle graphics, connection to the Internet, and a browser that could handle Active X and Java applications. Internet Explorer was the recommended browser, though Netscape Navigator, AOL and CompuServe were also supported. Audio and video were used to enhance the course, but the medium was not essential to successfully participate in the course.

Table 10.2 Hardware/Software Requirements for Students over Internet

Hardware

- Computer with 8 Mgs of Ram (16 recommended)
- 28.8 Modem or Network PC card
- Sound Card (optional but recommended)
- Internet Service Provider

Software

- Browser: Internet Explorer 4.x, Netscape 3.5 or newer, AOL or Compuserve 4.x, Internet Explorer (recommended).
- Audio/Video use Vivoplayer.

We used a hybrid system, Sun Unix and Microsoft NT, for our servers. We took advantage of the robust security, volume, and history tracing capabilities of the Sun Unix system, while also taking advantage of the database, Microsoft Active Server Pages, and Active X capabilities offered by the NT Server. This gave us the most flexibility to offer a wide range of application features. Table 10.3 shows each feature of the SMART Center and the language in which the feature was.

Table 10.3 Language Used for Each Feature of the SMART Center

Administration

- Registration of all participants (Unix, Perl)
- History trace of participant activities (Unix, Perl)
- Mail
  - Email list of participants, facilitators, staff - used by staff. (resident email)
  - HTML listing email addresses of all participants and facilitators - used by participants. (HTML, resident email)
- Feedback Form (Unix, Perl)
- Calendar (CGI)

Class Activities

- Conference Chat Room (Java)
- Conference Summaries (HTML)
- CBT Lab with HTML, streaming audio, streaming video, testing and student tracking (NT, Active Server Pages)
- Lecture Hall with live video, live audio, text chat, white board - not used for current course (CUSeeMe + Reflector)

Resources

- Reference library with Human Factors Guide Book, all meetings proceedings, and reports for FAA/AAM Human Factors in Aviation Maintenance and Inspection for past 10 year plus 21 NTSB Accident Reports. Full text search capability. (NT, Site Director)
- Audio/Video Library (Vivo, HTML)
- Class Materials (HTML, Site Director, WinWord, RTF)

Recreation

- Bulletin Board (Unix, Perl code, HTML)
- Campus Store (install programs for Internet Explorer, Netscape, Vivo player, PowerPoint player)
- Neat Stuff (Active X and Java)
- Café Chat Room (Java)

About (HTML, PowerPoint)

10.6.2 Description of Seminar Activities

The MRM seminar opened for registration during November and December. Registration closed in mid-December when the number of registrants exceeded the 50 person ceiling. Technically the SMART Center could easily accommodate 200 simultaneous users. The seminar staff felt that, for the initial class, it was better to service a smaller number of participants to insure each participant would receive the quality training he expected.

The seminar spanned roughly six weeks during January through February. The first week was orientation, followed by five weeks of the seminar proper. Participants were told they had until the end of February to finish the course work to receive their certificates of completion.

When the participants registered they were sent the seminar syllabus and a document stating what was expected of them during the course. In order to complete the seminar, they were expected to complete all eight units in the CBT Lab with 100% criterion on each unit test. They were also expected to sign up for four chat sessions, one orientation chat session, and three topic chat sessions. Prior to attending each of their chat sessions they were expected to read an article on the topic of discussion. Finally the participants were asked to fill out an evaluation form before the close of the seminar.

To see what the seminar would be like, the seminar staff had provided a demo version of the SMART Center that participants could walk through. The demonstration version of the SMART Center gave participants an opportunity to introduce themselves to each SMART Center feature and to learn how to navigate through the Center prior to the start of the seminar. Participants were instructed to visit the demo version of the SMART Center, download the audio/video plug-in, and install an updated browser if necessary. They were encouraged to visit each area of the campus map and read the description of the activity that would occur in that area. In the MRM CBT Lab, for example, instructions for using the CBT program were provided. In the Class Materials area, a list of the reading materials was provided along with instructions for using the text browser, Site Director. A video of each seminar facilitator was provided in the audio/video area to introduce participants to the facilitators.

During December, participants were sent a series of "Hints for Success", instructing them on how to best prepare for the seminar. This series of instructions covered such things as hardware and software requirements, computer setup, chat session scheduling, instructions for the MRM CBT Lab and the Chat Room, and video and audio requirements. Technical glitches that we knew about (such as Netscape playing some but not all of the video) was incorporated into these initial notes to the participants. Also, during December participants were asked to sign up for one orientation chat session and three topic chat sessions. Of the 53 initial registrants, 36 signed up for chat sessions. We took this to be an indication of the core group of participants.

The first week of the seminar was orientation week. Participants were expected to log in, orient themselves to the SMART Center if they had not already done so, view the introductory video for each unit, start the first two units of the seminar, and attend their practice chat sessions. The practice chat sessions was designed to orient students to text chatting, and provide them with an opportunity to ask the seminar coordinator questions regarding hardware and software requirements, the SMART Center, or the seminar. This first week is when all the unknowns about the technology were discovered and solved. These will be discussed in detail during the Evaluation section.

The seminar was designed to cover two units per week. Each week participants read the assigned articles and worked their way through two units of the MRM CBT Lab. On Mondays and Thursdays of the following week chat sessions discussed material covered the prior week and answered questions on that material.

Given the target audience, working aviation maintenance personnel located worldwide, the seminar activities were designed to be primarily self paced and accessible any time, day or night. One of the reported drawbacks to distance learning, however, is the isolation students' feel when trying to learn remotely. To minimize the feeling of isolation, we provided several means for interacting with staff, content facilitators, and other participants. The email address of all facilitators and participants were made available in the email area. A general list was not provided to everyone to prevent mass mailing abuses. The email of the staff was sprinkled throughout the Center for easy access. A bulletin board was set up for each unit topic for general discussion of the topic by all participants. And the chat sessions were set up to encourage live interaction between participants and facilitators. Summaries of all the chat sessions were then posted for everyone to read.

In general, seminar staff and participants used email primarily to work through technical difficulties or to answer subject matter questions. The staff made an effort to answer participant questions within the same day. The phone was occasionally used when helping a participant troubleshoot a technical problem; however, the phone was generally not necessary. Chat sessions were used, by participants and facilitators, as a forum for discussion about MRM. As the seminar progressed facilitators began receiving email from some participants wanting to discuss seminar content in more detail.

The seminar staff worked through technical difficulties and answered questions the first two weeks of the seminar. The remaining four weeks showed significant decline in the need for help. Most participants by then were actively working their way through the course.

10.7 RESULTS/DISCUSSION

10.7.1 Participant and Activity Statistics

Participant and activity statistics are summarized in Table 10.4. Of the 53 initial registrants, 36 people signed up for the chat sessions. This we considered the core group. Thirty participants completed all eight quizzes, which entitled them to a certificate of completion. Eight participants formally dropped out, seven cited schedule changes and one cited insufficient computing power. All of these people requested to be kept on the mailing list so that they might participate in future courses. One participant's email bounced back to us. Three participants were identified as guests who dropped in to visit but did not intend to attend the seminar fully. This left eleven participants who registered for the seminar, but neither participated in the chat sessions, nor completed any of the unit quizzes, nor contacted us in anyway.

Table 10.4 Level Of Participation	
Participants registered	53
Participants signed up for chat sessions (core group)	36
Participants completing course	30
Participants who formally dropped out, visitors or could not be reached	12
Unaccounted for registered participants	11
Participants participating in chat sessions	25
Participants unable to participate in chat sessions who completed course	5

Of the 36 core participants 25 participated in at least one topic chat. Many participants initially experienced problems with company firewalls. Most participants were able to resolve these technical barriers within the first orientation week of the seminar. Three participants could not resolve the firewall problem prior to the seminar's end, preventing them from attending the chat sessions. It is unknown why two of the participates finished the lab tests but did not participate in the chat sessions. We suspect that they, too, experienced firewall problems or another technical problem they could not resolve.

The participants represented a large demographic cross-section. All the participants worked in aviation maintenance, however, the capacities varied greatly. Table 10.5 shows the cross-section of core participants in terms of their occupation. Managers were the largest group of participants followed by Technical support engineers and AMTs.

Table 10.5 Occupation of Participant with in the Aviation Maintenance Field

Manager	8
AMT	5
Technical Support Engineer	5
Supervisor	4
Human Factors Specialist	4
Trainer	3
Quality Control	3
Safety Officer	2

Military	1
Vice President Company	1

Table 10.6 shows the home states and countries of the participants. As you can see there is almost a one to one correspondence between number of people participating in the seminar and locations from where they were signing-in. Georgia is the location from which the seminar was broadcast and from where most of the facilitators signed in.

Table 10.6 Location of Participants

Location	Participants and Facilitators
Alabama	1
Arizona	2
Arkansas	1
California	2
Columbia, South America	1
Florida	3
Georgia	6
Germany	1
Indiana	1
Malaysia	1
Massachusetts	1
Mauritius, Africa	1
Mexico	1
Missouri	1
Nevada	1
New Hampshire	1
Norway	1
Ohio	2

Ontario, Canada	4
Pennsylvania	3
Somerset, UK	1
Texas	2
Vancouver, Canada	2
Washington (State)	2

10.7.2 Email Correspondence

The primary mode of communication between staff, facilitators, and participants throughout the seminar has been email correspondence. Table 10.7 shows categories of the typical correspondence from participants, Table 10.8 shows typical problems that were encountered and the solutions that were offered, and Table 10.9 is a list of constructive criticisms about the technical features of the course.

Table 10.7: Typical Discussion Topics through Email

- Inquires about seminar
- Questions about registrations
- Questions about the target audience
- Questions about technical requirements
- Inquires of what should be expected technically
- Notifications (or expressions of frustration) when things didn't work
- Good to go notices when things are working
- Changes in location during seminar
- Expressions of great interest in seminar material
- Concern about missing orientation, chat sessions
- Responsible for payment? Cost?
- Closing before deadline, wanting to register colleagues after registration closed
- Regular reports on progress made - both technical and content
- Notice – completed CBT in 7 working days
- Statistics and other info sent to us by participants
- Request for guest visitors
- Asked if could access info from two locations

- Want to create an MRM email site for continuing the connections started
- When will MRM manual and CD to be sent out?
- How can we continue this momentum
- Did you get my feedback form?
- Is the NT server faster, seems that way.

It is interesting to follow the evolution of each individuals email correspondence. From inquiry to questions about registration, through the trails of setup, orientation, and technical troubleshooting, to the glee exclaimed when they are "good-to-go!" then notes of progress through the content and connections through the chat sessions, and that final sense of satisfaction when the seminar is completed.

Table 10.8 Problems and Solutions

Logging on

- Wrong URL
  - Sent URL
- Can't remember password or name
  - Sent name and password
- Some registrations didn't take
  - Checked all registration names and passwords, re-entered ones that didn't take
- Problems with capitals
  - Reminded them about case sensitivity

Can't open attachment (most people had no trouble with this)

- Sent as MS Word 6 file instead of rich text format (rtf)
- Sent information to different email address
- Embedded information directly into email message

Orientation confusion

- "Hints for Success" email
- Individual email responses
- Phone calls (rare)

Chat schedule

- Embedded table lost format
  - Resent chat schedule without table format
  - Sent chat schedule as attached word document
  - For those who could not read attached files sent their schedule individually (few)
- Schedule changes prevented participant from attending chats they selected
  - Told to go to whatever chat sessions they could
  - Added more evening chats to accommodate people working at home

Office firewall problems can't reach chat

- Administrators opened up port 7000 (many)
- Participant setup at home instead of office
- Some did not participate in chat portion (a couple)
- Schedule more orientation chats for those who missed because of setup problems

Other chat problems

- Browser version (script error message)
  - Upgraded browser
- Text wrap around error
- Duplicate names error
  - Fixed errors - wrap around, duplicate names
- Browser connection times out
- Sometimes freezes up with no explanation don't know if internet overload or client problem
- Transfer interrupt
  - Need to clear cache, user had hit stop during transfer

Video problems

- Netscape did not play MRM CBT video
  - Recompile CBT video in future to upgrade with browser
- Aloha aircraft video end without completion
  - Could not verify problem

Download timed out

- Need to set browser to longer timeout

Sun Unix System went belly-up on 2/9/99 • Able to move most files to NT within day. Most areas functional within two days

Most technical and scheduling problems could easily be handled through email. Even firewall problems were handled primarily through email announcements. The curricular plan we had in place for the seminar was not so rigid that we could not assist individuals. Our biggest change was to add more chat sessions to accommodate those who missed practice sessions due to technical difficulties. Evening chats were also added to serve people working from home.

Table 10.9 Constructive Criticism

- CBT test questions that need to be reviewed
  - Leadership #5
  - Airline Safety – "1970 accidents increase, decrease, stay the same" - answer in is graphics which are hard to interpret.
  - "An incomplete maintenance log is an example of " - trick question.
  - "Where do teams collapse?" - confusing question.
  - Unit #3 "Human Factors began during WWII not after."
  - Unit #4 CTD risk factor on test not covered in Lab.
- Spell out acronyms
- Lab
  - Clicking on each topic title cumbersome (add page turning buttons)
  - Outline and toobars cut off text displays (put outline/toolbars on right and left instead of top and bottom; make toolbar smaller)
  - Human Errors in Maintenance. "Top eight common errors" - lists only seven.
  - Human Factors Fundamentals - same video shows up for both definition of human factors and description of system.
- Couldn't print lab material (will send CD-ROM with lab material)

Constructive criticism cited during the seminar was minor content and interface issues that were easily corrected. Once people became comfortable with the SMART Center, they were content with how the Center operated. Correspondence dropped precipitously after the first two weeks of the course.

Email is an excellent way to coordinate adult learning. One can respond promptly to requests. The response can be individualized and thorough while simultaneously being quick and to the point. Students are appreciative of the attention they are given; they are polite, interested, informed, and ready to share.

10.7.3 MRM CBT Lab

Figures 10.1 and 10.2 show that both the AMTs in the pilot study and the January seminar participants performed similarly on the eight-unit tests. The pattern of testing was also similar. The seminar participants represent a much broader group and, in the field of human factors, probably a more knowledgeable group than the AMTs in the pilot study. For both groups, it took more trials to finish the first test then subsequent tests. There were participants in each group who struggled with individual tests, but there was no pattern of one test being significantly more difficult than the others. Quiz five seemed to be an easier quiz for both groups. From their responses in the course evaluation, there was a wide range in perceived difficulty of the tests even though there was not a large variation in how many trials it took for individuals to complete each test.

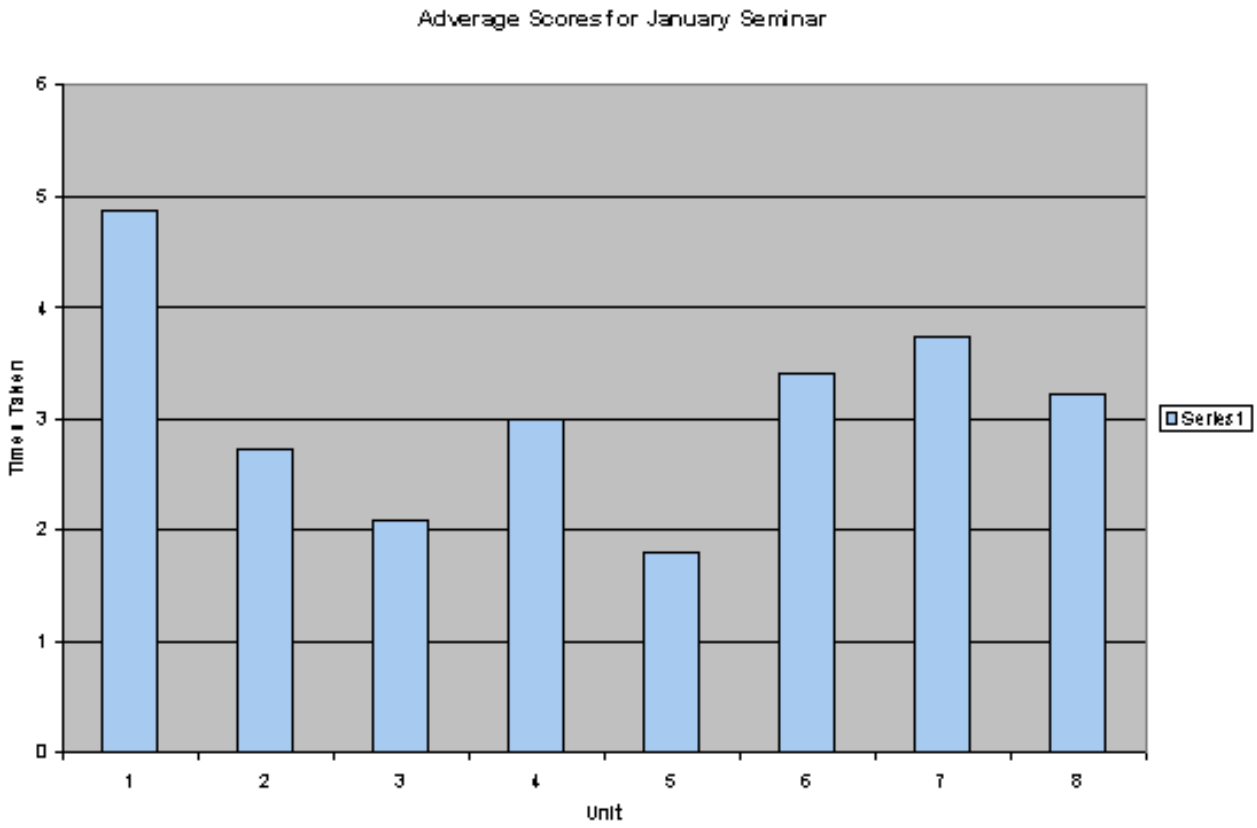


Figure 10.2 Average Scores for January Seminar

10.7.4 Evaluation Forms

Appendix B shows the evaluation form for Seminar participants. It is very similar to the form used by the pilot study. A few questions were added to glean more information about the participants and their motivations for attending the seminar. Some questions were added to include all of the SMART Center and not just the MRM CBT Lab. Unfortunately during the last week of the seminar the Sun Unix system, that served well for five years, died. We were able to move the SMART Center to the NT server; however, everything programmed in Perl could not run on the NT as it was currently configured. The evaluation form is one of those programs processed in Perl. We received 24 evaluation forms from the group that finished the course. About one third of those forms were faxed to us. We anticipate that had the feedback facility had been operating properly, we would have received closer to 30 evaluation forms. The complete compilation of the evaluation form can be found in Appendix C. Table 10.10 shows the numeric ratings for the nine major categories of questions.

The evaluation questionnaire covered two basic areas -- interface design and MRM content. Participants were generally pleased with the content. They thought the information very relevant and easy to understand. Some people thought the tests were difficult while others thought they were easy. Participants were more critical of the interface design but not overly critical. They found the directions sufficient to get them started, though some participants experienced disorientation when navigating through the site initially. Once students got their bearings they found the center well laid out and easy to use. The esthetics of the site were pleasant but not outstanding.

Appendix C shows the written responses for all the questions on the evaluation forms with the exception of the biographical information. The short answer questions are designed to elicit specific positive and negative aspects of the content and interface. The questions are in the form of "Did you every feel lost or disoriented? If so when and where?" or "Was there any information explained particularly well?" By eliciting specific examples of what participants liked or did not like about the experience, we are better able to improve the SMART Center and its content for future courses. Below are samples of participant responses to the short answer questions.

3c. Did you ever feel lost or disorientated? If so when and where?

"I felt disoriented at the beginning when I had some troubles with the first chat session and some programs installation. It was difficult for me to find out when It was a problem with my PC and when with the Web. It would be helpful to have a troubleshooting section on web."

"At the beginning trying to navigate was tough being I had never used the net before. One plus that it was open prior to the beginning of the seminar allowing me to practice and find areas. The suggestions that were sent out on the usage also helped. The only thing was that I accidentally came across the reading material. I went back through the session information and did find it after the fact."

5b. If you were to change the displays, what would you add or delete?

"I really hated the way the course material was broken into sections. It was a hassle to have to back and forth to get to the next section. It would have been nice if it was all in one scroll down area."

"I liked the displays it made me feel like I was back in college a bit with the campus theme."

Table 10.10 Program Operation - Numeric Ratings

Person	1a. Ease	2a. Intui-tive	2b. Direc-tions Suffi-cient	3a. Easy Navi-gate	3b. Easy find Info	4a. Response Time	5a. Like Display	6a. Under-Stand Info	7a. Relevant	8a. Tests Difficult	9a. Learned
1		4	yes		10	8	10		7		
2	9	7	Yes	9	7	9	10	9	10	5	11
3	10	9	Yes	10	10	8	10	9	10	9	10
4	8	7	Yes	8	7	7	8	9	7	3	6
5	8	8	Yes	10	7	8	8	8	10	3	5
6	10	8	Yes	10	10	8	10	7	10	7	10
7	10	9	Yes	10	10	5	7	9	8	1	8
8	8	6	Yes	10	7	9	7	10	10	7	7
9	8	6	Yes	10	10	8	8	7	9	8	8
10	5	1	No	8	7	7	8	5	6	10	4

11	6	8	Yes	8	7	8	8	9	8	5	8
12	10	9	Yes	9	10	8	10	9	10	7	10
13	8	8	Yes	8	7	9	9	9	9	7	9
14	9	9	Yes	10	10	10	8	9	10	8	10
15	8	8	Yes	8	10	7	7	8	7	5	5
16	3	8	Yes	5	10	4	4	9	10	3	5
17		8	Yes	10	10	7	9	9	10	7	10
18	3	5	Yes	7	10	8	8	10	10	1	8
19	8	8	Yes	10	10	8	10	9	10	7	10
20		5	yes	3	5	7	7	10	10	8	9
21	6	6	Yes	8	10	9	9	10	10	3	10
22	9	9	Yes	10	10	8	9	9	10	2	10
23	5	7	Yes	9	10	5	10	8	10	5	10
24	7	6	Yes	7	7	5	1	9	10	9	5
AVG	7.5	7.0	17 yes 1 no	8.5	8.8	7.5	8.1	8.7	9.2	5.65	8.2

6b. Was there any information that you could not understand?

"The last section performance management I found the hardest to get through. I don't think it was because it was last but it seemed harder to read than the other sections. I found that PM was written to a higher level of understanding. I am not saying to remove it just make it easier to understand."

6c. Was there anything that was explained particularly well?

"Personally I thought the section on Human Error in Maintenance was well thought out. It had a lot of supporting information that a mechanic can see and relate to almost immediately. The one that in particular that stands out is the item titled A Hangar Example, and the cost break down, it is a great tool."

7b. What information was particularly relevant or interesting to you?

"The article on Group Communication was excellent! Because I live and breathe this stuff, most everything else was "old hat". If the reading material was simplified or outlined in the CBT more it might be better received by the average AMT. Relevance to me or the AMT?"

"The teamwork definitions explain exactly what I have seen in the business over the past 15 years! It's so true."

7c. Did you find any information uninteresting or not relevant? If so, explain.

"Some charts were boring. These charts did not have adequate indexes or reference marks."

"ERK and MESH - Unless you have a staff of 3 or more at a large airline, these are useless. You don't have time. This would also bore the hell out of the AMTs! Even the simple to follow MEDA form evokes zzzzzzzzzz's from the techs!"

"not to down play that safety is a concern because it is. But, the section on worker safety was <not> the most interesting section in the program. It could be that do to all the classes I have had on worker safety it felt like one of those, "here we go again" type of things. Organizations that do not have actual safety programs may feel different about that section."

8b. Were the test questions relevant to the content they were testing? Give an example of one that was relevant and one that was not relevant.

"The Dirty Dozen was a good one to really cement into memory. Some of the Leadership questions were mindless."

"There appeared to always be one or two questions in the tests that may not have been directly addressed in the prerequisite readings. They were obviously placed to test the participants ability to understand the material as opposed to reading the material. I sheepishly admit to the fact it was these such questions that caused me the most difficulty. I would recommend the inclusion and perhaps more of these type of questions in future exams. I apologize for not having an example readily available."

9b. List any ideas you learned about in this course that you think you could apply in your work environment.

"Because I teach this course ALL of it applies. If I think back to when I was in the industry as a Director of Maintenance with 15 people working for me, once again I would say ALL. This has been a great awareness of what has been missing in the industry until now."

"Think situation awareness is a good thing to stress to people. With situation awareness in mind, many incidents should be stopped before they happens."

"Dirty Dozen info and communication within groups"

"How to improve teamwork and cooperation. How to ensure information is passed on to ensure complete job is done."

"Situation awareness and communication"

"There is not enough room to list everything. I believe nearly the entire course can be used, I believe a hard copy of the seminar is needed to reflect back to stimulate the memory also."

10.7.5 General Comments

"As my first experience in two topics: Maintenance Resource Management & Internet training, I felt great. I am really interested on get more information about MRM and now I get a commitment with myself: to share the information and learning's I get now. For all you folks that are in other side, congratulations for this very good job: MRM information, training structure and computers management, everything was great. And finally, to whom it may concern thanks for new technology."

"I was disappointed I could not use any of the videos. Some of the questions were a little backhanded, like question 5 in the last test. I did drop off during the chats a number of time???? I did not find the chats of much help. Other than the above, I found this a great way of getting the word out. I congratulate you, you may have saved a life today."

"Hope to see much more of this type of training in the future. An alternative to the chat sessions may want to be explored. Firewalls and time to participate seem to be barriers. Possibly a FAQ format would work better."

"Great info all the way round. CBT and chats worked very good. Thanks for the opportunity to join the group. Great Experience."

Overall participants enjoyed themselves, they learned, they met new friends, they want their colleagues to take this course, and they want to do another course like this again.

10.8 LESSONS LEARNED

10.8.1 What We Did Right

It is apparent that despite some technical difficulties the seminar was a success. What were some of the factors that made this experience a success? Ironically the things we did right are primarily pedagogical. We limited registration to 50 participants, a manageable size. This size of the seminar allowed the staff to give each participant their undivided attention. Staff members made a point of responding to participants' questions and requests within 24 hours. Staff went out of their way to accommodate schedule fluctuations and changes in (email) locations. The systems administrator worked closely with other systems administrators to solve firewall problems and other technical difficulties. Even if a participant became frustrated, he never felt ignored. This is very important public relations asset.

Roles of staff and facilitators were clearly defined. Each staff member knew what his or her responsibility was and had the authority to accomplish his or her tasks as needed. Facilitators had clearly defined responsibilities. They were expected to lead the discussion for the three chat sessions for the unit they represented. Usually the chat sessions were all on the same day. Facilitators were very good about covering each other if a scheduling or technical problem arose during a chat session. Students were expected to read the materials assigned to the unit and come up with one or more questions or comments related to the material, which was then posted to the discussion bulletin boards or raised for discussion during the chat sessions. The facilitators also worked with the staff to create a introductory videotape of themselves, their background, and the unit they were to facilitate. The facilitators were given many practice chat sessions prior to the seminar's start so that they were comfortable with the technology and discussion format. This greatly helped their comfort level, which is another important consideration when implementing on-line interactive training. Instructors, facilitators, professors, and experts can not feel at a disadvantage with respect to their students.

Since most of the facilitators were volunteers and recognized experts in the field, an effort was made not to overburden each facilitator while also ensuring that what was requested of each added value to the seminar. There were a total of six facilitator for eight units. This gave the participants a range of expertise and points of view. This added more coordination on the part of the staff, but the added value was well worth the added work.

We did several things to facilitate orienting the participants. One was that we had a demonstration version of the SMART Center available to the participants during registration. This allowed the participants to familiarize themselves with the interface, download and test the browser and the video/audio plug in they were instructed to use. Also during registration the staff initiated correspondence with the participants to help prepare them for the upcoming seminar and set the tone for the new instructional experience. The first week of the seminar was orientation week where in addition to familiarizing themselves with the SMART Center they were given an opportunity to practice with the chat facility. These steps, though not fool proof, as noted in the "Where We Can Improve Section" did contribute significantly to the success of the seminar.

Another design decision that was crucial to the success of the seminar was the conscious decision not to burden the participants with too much technology. Sophisticated technology (live video and audio) is often perceived as the optimal solution to distance education. However, one must moderate this tendency with the goal of the course work, the technical sophistication of the audience, the available hardware, and the available bandwidth. Often the coursework does not require sophisticated technology to meet its stated objectives. One must weight the cost of equipment support, software required, the learning curve and increase likelihood of technical failure to the value added in the medium used. For example, don't risk relying on a high-risk technology that many people don't have access to support a core requirement of your course.

The staff chose a medium level of technology that provided multimedia and interaction to keep the seminar interesting, while minimizing the equipment and configuration necessary to participate in the seminar. Even so the technical requirement stretched the limits and patience of some participants. Only one person reported dropping out due to technical limitations. One does have to credit the ingenuity and sticktuative attitude of both the participants and the staff in tackling technical difficulties and the learning curve. It was the "we are all in this together" attitude that guaranteed the success of the seminar. The participants' positive attitude is a testament to this unique group. This does beg the question -- if on-line training is institutionalized and mandated will the success level go down? Undoubtedly that would be the case if one does not scaffold and streamline the technical learning curve, and if one does not commit to customer support of the training. Technical streamlining to the point of making the technology transparent to the user is essential if institutionalized, Web-base training is to be a reality. Customer service should not be compromised if training is to be a success.

The seminar had good ratio between independent work and interaction with facilitators. The seminar was setup so that a participant could complete the whole course and receive his or her certificate without attending one chat session. In the case of a few participants who could not access the chat sessions, this did not prevent them from participating. Posting the chat summaries encouraged these participants to keep up with the threads of the discussions and send email to facilitators to continue the discussion, which they did do. Chat sessions, email correspondence, and bulletin board postings were encouraged. Independent work provided participants with the ability to work anytime, anywhere at their own pace. Also the criterion for success was to master the material. It did not matter how long or how many tries it took. What mattered was that the material was mastered. This gave people a credible structure for achievement. One could feel good about success whether it took many tries or only a few to accomplish the criterion. Since we do not grade the participants on level of success, but rather we are raising the base knowledge of the group, this form of criterion for accomplishment works well.

10.8.2 What We Can Do Better

All the areas where the seminar can be improved are technical. There were several suggestions for improving the MRM CBT Lab. This included being able to print or download the content. Some participants did not like the outline structure of the interface, preferring continuous scrolling of the material or tabbing to the next and previous pages. For some reason Netscape Navigator would not play the video within the MRM CBT, though it would play the introductory video found in the audio/video area just fine. Some participants requested a larger viewing space for reading the content. Finally a few test items and content areas were flagged as needing revision. All of these technical and content improvements are easily addressed.

While design issues were noted for the MRM CBT Lab, upgrades were not performed during the seminar. Since the chat sessions were interactive, and problems usually effected that interactivity, several upgrades were made to the chat facility during the seminar. These changes were transparent to the end user. What one would note is that over the course of the seminar, fewer problems would surface.

There were several surprises that we did not anticipate. The most significant was the firewall problem. Because of the necessary network security for aviation companies, most of the participant who were taking the seminar while at work could not access the chat sessions due to blocks from corporate firewalls. Fortunately, most of the system administrators worked diligently with our web administrator to correct the problem.

Setting people up was not fool proof. There is the issue of how much do you tell people. If you tell them too much, people reach information overload and they stop listening. Also no matter how explicit you think you are, misinterpretation is common. Like any class, the level of expertise with respect to technical knowledge and comfort varied and, since we were using the internet, there was no standardization in equipment used. Despite the concerted efforts to keep the setup and orientation simple, in some circumstances it was not. Fortunately the diligence of both the staff and the participants overcame most of the setup problems encountered.

10.9 SUMMARY

When reviewing the initial research questions on the merits of the project we found that the participants all had a background in aviation maintenance, but within that field there was a wide range of expertise. The participants also represented many areas of the U.S., Canada, and other parts of the world. Of the 53 registrants, 57% or 30 participants finished. Of the core group of 36, who took the initiative to sign up for the chat sessions, 83% of that group finished. Participants were very active, not only working their way through the CBT curriculum, but also reading many of the class materials and participating in the chat discussions. The technology stood up reasonably well to active use, though this is the area where the most improvements can be made. The goal in this area should continue to be to make the technology transparent to the user. Both the pilot study and the January seminar verified that the course material and site design was appropriate for the target audience, AMTs. The January seminar further revealed that the design accommodates a broad student body. There is no question that the target audience valued the training and saw the Internet as an appropriate vehicle for delivering training.

Was the training cost effective? To run this course for a six-week period costs approximately $15,000 – or about $300 per person for a class of 50. For the time and attention that each participant received, this seems to be a reasonable starting figure. Larger class sizes will reduce the cost per pupil ratio. A happy medium will need to be found between class size and cost effectiveness. This estimate is for conducting the course itself, it does not include the cost associated with building the SMART Center site or developing the course material. Using this type of delivery, the industry should be able to increase their training commitment to maintenance personnel while realizing significant savings through less travel costs and less time away from the job.

The main advantage Web-based centers have to offer over all previous mediums are:

- The ability to simultaneously coalesce distributed information into one body of information that in turn is accessed by a decentralized group.
- The ability for information to dynamically evolve.
- The ability for people to dynamically interact.

Many people will continue to prefer an instructor, but cost accounting will drive training toward self-paced independent remote learning. The good news is, through Web-based training, human-to-human interaction may actually increase rather than diminish. If done well, individuals may actually get more attention, not less. The success of any given training will be to do more to pedagogue than technology, though technology can enhance good pedagogy if implemented well.

10.10 FUTURE TRENDS IN WEB-BASED TECHNOLGY

The next horizon of Web-based development sees a jump in sophistication from relatively simple HTML pages that many people can develop to sophisticated client side and client/server interactions hosted by a suite of new language standards and their supporting application tools. The new standards include HTML 4.0, Cascading Style Sheets (CSS), a document object model, ECMA Script (its predecessor is Java script) and XML. These new standards will usher in the new phase in web development - Dynamic HTML.

HTML 4.0 sets the stage for dynamic HTML by

- separating semantics from formatting,
- standardizing embedded scripting languages,

- broadening the scope of the HTML tag set itself

and

- internationalizing the standards to accommodate different character sets and languages.

HTML 4.0 standard has also lead browser development in the arena of alternative devices accommodating users who can not see a monitor or use a keyboard 2.

Cascading style sheets are the mechanisms that allow one to separate content from format. Web document developers can define styles in a separate file that can apply to a series of documents rather than to a single document. Through unique tag definitions, CSS sets the stage for supporting different representations of material, depending on the context of the display. Styles cascade from general to specific. At the most general are rules that determine a whole class of documents. An example would be the general look and feel of a book. Document level styles are defined in the header of the file and determine unique attributes of a single document. A specific chapter may have rules for unique styles for that chapter. At the lowest level are in line styles most familiar to HTML developers that change a specific heading to a specific color or font, for instance. CSS1 is the current standard. The rules specified in CSS1 are not dynamic in and of themselves. Coupled with scripting language commands they enable the dynamic changing of a style rule after a page has been loaded. CSS2 will incorporate much more interactivity. One will be able to group Style elements and place them on their own levels independent of the content. That way, style elements can be turned on or off or repositioned depending on the current context3.

For a script to communicate with an object, it must know where the object is in relation to other objects. A window, a frame, a form and form elements are all scriptable objects. The document object model creates an internal hierarchical road map of all the scriptable objects. The W3C has charged one of its working groups with establishing a standard for HTML Document Object Model. This task has been one of the most challenging because the leading browsers, Netscape Navigator and Internet Explorer, handle objects very differently. Similarly Netscape and Internet Explorer have competing philosophies for how the document object model should be specified.

Client side scripting languages such as JavaScript and Vbscript are the languages that manipulate the document objects. These language scripts are embedded and run on the client side enabling unique responsive interactions with the end user. ECMA Script is an international standard that has been adopted recently to head off incompatibilities between scripts supported by different browsers. The ECMA standard is essentially JavaScript found in Netscape 3.0 and has been adopted by both Netscape 4.0 and Internet Explorer 4.0.

SGML is a specification mark up language that allows documents to describe their own grammar. HTML applications hard wire a small set of tags in conformance with a single SGML specification. XML is a specification language derived from SGML, but designed specifically for the web, that increases the level of sophistication in content presentation and interaction by providing publishers with a means to define their own markup language using application-specific meanings4. According to Bosak4, "XML differs from HTML in three major respects:

1. Information providers can define new tag and attribute names at will.
2. Document structures can be nested to any level of complexity.
3. Any XML document can contain an optional description of its grammar for use by applications that need to perform structural validation." (p.2)

The areas where XML will be most useful are predicted to be:

- where the web client is expected to mediate between two or more heterogeneous databases,

- where the processing load is shifted from the server to the client,
- where different views of the same data is required, and
- where intelligent agents tailor information discovery to different users[4].

Intelligent agents are a set of new programming techniques that combine resent developments in object-oriented programming, artificial intelligence and artificial life research. What distinguishes intelligent agents from object oriented programming techniques are:

- agents are mobile independent objects,
- they are able to “learn” (that is, able to change their own rule base in the face of a changing environment) and
- they are able to interact and negotiate with other agents.

Some agents will interact directly with the user and as such will have “personalities”; others will work behind the scenes to gather and manage information. There are several challenging research areas that must be addressed in the next few years before intelligent agents become prevalent. Because being mobile and independent is a criterion for being an agent, agent technology requires languages that provide a run time environment independent of the platform that it is on. Java is a language designed for just such platform independence; however, true platform independence is still a major issue[5]. In the commercial Internet arena, interaction and negotiation with other agents demand a standard interaction language between agents. Security for both host servers and agents is another big research area[5]. Intelligent agents could extend the notion of the “personal coach” in training. They could keep track of user preferences, learning styles, and common mistakes performed by the user. One challenge is to be helpful and informative without becoming obnoxious. How to detect when a person is stumped and open to aid, verses actively troubleshooting and not interested in aid, is a tricky question. Research in comprehending user interactions and incremental learning by agents is another important research area.

While the strength and flexibility of the new standards promise to revolutionize (once again) the way information is processed and hopefully turned into knowledge, there are several substantial barriers to their immediate adoption. The browser industry is struggling to keep up with the new standards. And since different browser releases have come at different times during the standards development cycle, different releases support different aspects of the standards and sometimes use different language tags. To write for both browsers one must duplicate coding efforts or choose to leave out capabilities that are found in one browser but not another. The rule of thumb is to code for the common denominator between the two main browsers -- Internet Explorer and Netscape Navigator. To make matters worse users generally do not keep up with the latest browser versions. At work, many institutions and companies have standardized on browsers that do not support Dynamic HTML standards. In addition not all browsers react the same way on different operating systems. Internet Explorer 4.0 is particularly guilty of this incompatibility. Internet Explorer 4.0 is designed for Win32 operating systems and does not react as well on Win16 or Macintosh platforms.

These incompatibilities are currently seen as temporary barriers to an information and commerce delivery medium, which hold great promise. If the corporate powers can overcome their natural warlord mentality, then a truly new way of doing business will emerge. International standards and platform independent programming languages are steps in the right direction.

Dynamic HTML, distributed applications, and intelligent agent technology are the next level of sophistication in web development. These technologies promise to make web applications very dynamic. Soon one will not be able to appreciably tell the difference between CD-ROM based presentations and Web-based presentations.

10.11 ACKNOWLEDGMENTS

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10.13 APPENDIX A
Evaluation of Maintenance Resource Management Web-Based Training (MRM-WBT)

Questions About the Program Initials _____

This questionnaire is intended to give the designers of the MRM Web-Based training information about how well the program performed for you.

I. Program Operation

1. Ease of Use

1a. Please circle the number on the dimensional scale below that indicates how easy you found MRM-WBT to use.
Difficult <==========+==========> Easy
1 2 3 4 5 6 7 8 9 10

2. Intuitiveness

2a. How intuitive is the interface?
Confusing <=====================+============================> Intuitive
1 2 3 4 5 6 7 8 9 10

2b. Were the directions sufficient to get you started?

2c. Did you access help? Once inside help could you find the information you needed?

3. Navigation

3a. How easy was it to navigate through MRM-WBT?
Difficult <=====================+============================> Easy
1 2 3 4 5 6 7 8 9 10

3b. Could you easily get to the unit you wanted from the table of contents?

3c. Did you ever feel lost or disoriented? If so when and where?

4. Response Time

4a. How was the response time overall?
Slow <=====================+============================> Fast
1 2 3 4 5 6 7 8 9 10

4b. How was the response time for going through each item in the concept outline? How about the video? How about the audio?

II. Screen Design

5. Display

5a. How did you like the MRM-WBT displays?
Dislike <=====================+============================> Like
1 2 3 4 5 6 7 8 9 10

5b. If you were to change the displays, what would you add or delete?

5c. Was the media quality adequate for the lesson?

III. Content

6. Conceptual

6a. How easily could you understand the information presented to you?
Difficult <==========+==========> Easy
1 2 3 4 5 6 7 8 9 10

6b. Was there any information that you could not understand?

6c. Was there anything that was explained particularly well?

7. Information Relevance

7a. Did you find the information in MRM-WBT relevant to learning about human factors in aviation maintenance?
Not Relevant <==========+==========> Relevant
1 2 3 4 5 6 7 8 9 10

7b. Did you find any information that was particularly relevant or interesting to you?

7c. Did you find any information that was not relevant or uninteresting?

8. Testing

8 a. How difficult were the test questions?
Easy <==========+==========> Difficult
1 2 3 4 5 6 7 8 9 10

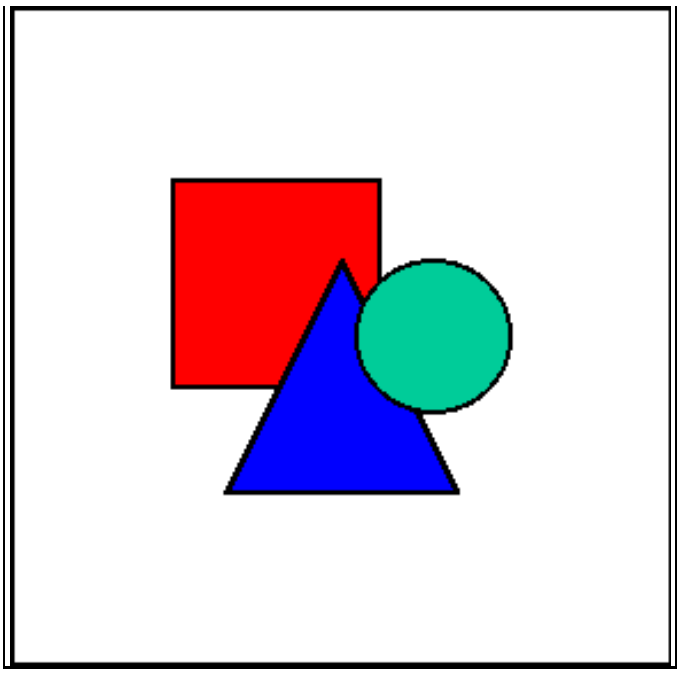
8b. Were the test questions relevant to the content they were testing? Give an example of one that was relevant and one that was not relevant (if any).

9. Learning

9a. How much do you feel you learned from using MRM-WBT?
Not Much <==========+==========> A Lot
1 2 3 4 5 6 7 8 9 10

9b. List any ideas you learned about in this course that you think you could apply in your work environment.

10.14 APPENDIX B
Evaluation of Maintenance Resource Management Seminar (MRM-WBT)



Name or initials (optional):

Email address (optional):

Participant Information

P1. Please give us a brief BIO about your background and where you are from.

P2. Please tell us your purpose for taking this class.

P3. Are you primarily interested in MRM Content?

P4. Do you intend to finish the course and receive a certificate? Yes

Questions About the Program

This questionnaire is intended to give information about how well the program performed for you to the designers of the MRM Web-Based training.

I. Program Operation

1. Ease of Use

1a. Please enter a number between 1 (most difficult) and 10 (quite easy) to indicate how easy you found the SMART Center to use.

2. Intuitiveness

2a. Please enter a number between 1 (very confusing) and 10 (very intuitive) to indicate how intuitive you found the interface.

2b. Were the directions sufficient to get you started? Yes

3. Navigation

3a. How easy was it to navigate through the SMART Center (scale 1 = most difficult to 10 = quite easy)?

3b. Could you easily find the information or activity you wanted from the map? Always

3c. Did you ever feel lost or disoriented? If so, when and where?

4. Response Time

4a. How was the response time of the computer overall (scale 1 = slow to 10 = fast)?

II. Screen Designs

5. Display

5a. How did you like the SMART Center displays (scale 1 = dislike to 10 = like)?

5b. If you were to change the displays, what would you add or delete?

III. Content

6. Conceptual

6a. How easily could you understand the information presented to you (scale 1 = difficult to 10 = easy)?

6b. Was there any information that you could not understand?

6c. Was there anything that was explained particularly well?

7. Information Relevance

7a. Did you find the information in the MRM Seminar relevant to learning about human factors in aviation maintenance? (scale 1 = not relevant to 1 = relevant)?

7b. What information was particularly relevant or interesting to you?

7c. Did you find any information uninteresting or not relevant? If so, explain.

8. Testing

8a. How difficult were the test questions in the MRM lab? (scale 1 = easy to 10 = difficult)?

8b. Were the test questions relevant to the content they were testing? Give an example of one that was relevant and one that was not relevant (if any).

9. Learning

9a. How much do you feel you learned from attending the MRM Seminar? (scale 1 = not much to 10 = a lot)

9b. List any ideas you learned about in this course that you think you could apply in your work environment.

Comments:

10.15 APPENDIX C
Evaluation Form - Written Responses

3c. Did You ever feel lost or disorientated? If so when and where?

Participant	Comment
1	no
2	no I can always hit the BACK button
3	I felt disoriented at the beginning when I had some troubles with the first chat session and some programs installation. It was difficult for me to find out when It was a problem with my PC and when with the Web. It would be helpful to have a troubleshooting section on web.
4	Only with trying to get the Smartchat interface to work, and solving the Video problem.
6	no
7	No

8	I never did have any luck getting the videos to work.
10	In the beginning. Too much information, computer interfaces and setup were difficult to ascertain. No consistency with nomenclature e.g., ("Units" vs. the CBT sections).
11	trying to get into chats from behind corporate firewall
12	NO
13	Occasionally disoriented when in the class materials module. Not always sure of the section I was in. Chat center was confusing when it would not work. It basically returned message chat not available when actual problem was with firewalls.
14	Under Teamwork: On the Team Development page at the top, the last choice was "Storming: Part II". I was not aware I was supposed to scroll down for more topics until I took the test and found questions on "Norming" which were not previously covered. I went back to review and found I that I could scroll down at the top for more titles under Team Development. I subsequently passed the next test!
15	No problems. Just needed a little time to get used to the setup, but no problems.
16	no
17	never
18	At the beginning trying to navigate was tough being I had never used the net before. One plus that it was open prior to the beginning of the seminar allowing me to practice and find areas. The suggestions that were sent out on the usage also helped. The only thing was that I accidentally came across the reading material. I went back through the session information and did find it after the fact.
19	Only in getting started.
20	**Yes, when looking through the other resources. They would leave the MRM site, without notice. This then required starting over at log-in.**
21	**In the beginning of the course, I had some confusion as to where the chat sessions were to be held. Once I figured out where it was, the navigation became much easier.**
22	**no**
23	**never**
24	**no**

5b. If you were to change the displays, what would you add or delete?

Participant	Comment
3	displays were ok for me

5	I'm no web page designer, looked good
6	delete the golf
12	MORE VIDEOS, MORE LECTURE MATERIAL (AND MORE EASY TO DOWNLOAD)
14	At the top, it should have a down-arrow to indicate more choices below and to scroll down.
15	I would have made the lab without all the black border. On my browser at the job (Netscape 3.x) I could not get rid of the black borders. Therefore I also had to scan the page up and down. It should be easier to print or copy the lessons more easily than possible with this lab. Pages. Will you make them available in a printed form? The letters could have been a number or two bigger.
16	I really hated the way the course material was broken into sections. It was a hassle to have to back and forth to get to the next section. It would have been nice if it was all in one scroll down area.
18	I liked the displays it made me feel like I was back in college a bit with the campus theme.
20	Perhaps a little simpler so they would load faster.
21	Haven't given it much thought. I think what you had worked just fine.
22	I would add the photos of the facilitators and their Bio in a sub-menu of the Smart Center.
23	I thought they were very convenient.
24	Look more like TV or computer game.

6b. Was there any information that you could not understand?

Participant	Comment
1	When doing a course the reference material had to be downloaded. Scanning off of a screen when your browsing is most difficult. In labs, MRM references seemed to be only snippets AND NOT REALLY USEFUL. I felt that a HTL to specific chapters or manuals from the "library" would have … (cut off)
2	The last section performance management I found the hardest to get through. I don't think it was because it was last but it seemed harder to read than the other sections. I found that PM was written to a higher level of understanding. I am not saying to remove it just make it easier to understand.
3	Yes but it was about English language, I think (I speak Spanish) but once I got familiar with the new terminology it was OK.
5	I had to read some articles over but then it came together. No, all OK
8	NO
11	no
12	NO

13	No
14	Not so far.
15	No
16	The statistics stuff in the first section was a little confusing.
17	no
18	The only thing that I had a little trouble with was in the airline safety section. It was the chart under Total Accident Rate (plateau). The chart gives the annual rates on the left but only says from 1960-present it does not show the years on the graph.
19	No
21	no
22	Too much statistics in “Airline Safety”
23	Some information regarding performance management was a little hard to understand.
24	yes

6c. Was there anything that was explained particularly well?

Participant	**Comment**
1	The chat room information and directions seemed straight fwd.
2	first seven sections excellent
3	Yes, specially when there were statistics and no aviation examples. About examples I mean those that were used about the daily life. Human behavior on job: awareness, teamwork, communications.
4	The practical examples - particularly the piece on the Canadian military
5	The whole thing. I really like this training concept.
6	There was so much information available if required, there was really no excuse not to have an understanding of the subject material.
8	Leadership styles, communication
10	Not until I stumbled around for days!
11	some questions had what I thought were more than one
12	COMMUNICATION AND MRM CHAPTERS
15	Situation Awareness
16	I liked the section on human error.
17	Chat summaries were very helpful

18	Personally I thought the section on Human Error in Maintenance was well thought out. It had a lot of supporting information that a mechanic can see and relate to almost immediately. The one that in particular that stands out is the item titled A Hangar Example, and the cost break down, it is a great tool.
19	Everything was well done. Critical examination would get in the way of my search for content.
20	Added resource material really added to the basic lesson plan.
21	I enjoyed situation awareness and communications the most.
22	Team building and situation awareness
23	Risk reduction was very well explained.
24	some

7b. What information was particularly relevant or interesting to you?

Participant	Comment
1	1 - Some info was too basic. I suppose it would depend on your backgrd. If you had any previous background it would be very slow.
2	2 - every section
3	3 - Accident vs. maintenance human error statistics.
4	4 - Human behavior on job: awareness, teamwork, and communications.
5	5 - Worker Safety.
6	6 - Performance management was one particular area that I found very interesting.
8	8 - All
9	9 - The part Communication and Situation awareness.
10	10 - The article on Group Communication was excellent! Because I live and breathe this stuff, most everything else was “old hat”. If the reading material was simplified or outlined in the CBT more it might be better received by the average AMT. Relevance to me or the AMT?
12	12 - IN FACT, ALL OF THE INFORMATION WAS REALLY IMPORTANT
13	13 - Dirty Dozen, Communications.
14	14 - The teamwork definitions explain exactly what I have seen in the business over the past 15 years! It's so true.

16	16 - human error, situation awareness and communication.
17	17 - Gordon Dupont's The Dirty Dozen errors in maintenance
18	18 - As stated above the section on Human error in maintenance: A few of the areas in that section that are relevant and eye opening is the Heinrich ratio, the top seven causes of in flight shutdowns and the mental limits disassembly.
19	At this point everything is interesting and relevant.
21	See 6c
22	Communication
23	Communication
24	Stats of safety

7c. Did you find any information uninteresting or not relevant? If so, explain.

Participant	**Comment**
1	Some charts were boring. These charts did not have adequate indexes or reference marks.
2	it was all interesting and relevant.
4	Some of the Communication and Leadership info was a bit repetitive
7	Human factors fundamentals, Team work, Situation awareness, and Human error in maintenance.
8	NO
10	ERK and MESH - Unless you have a staff of 3 or more at a large airline, these are useless. You don't have time. This would also bore the hell out of the AMTs! Even the simple to follow MEDA form evokes zzzzzzzzzz's from the techs!
12	NO
14	Not yet.
16	no
17	none
18	not to down play that safety is a concern because it is. But, the section on worker safety was the most interesting section in the program. It could be that do to all the classes I have had on worker safety it felt like one of those, "here we go again" type of things. Organizations that do not have actual safety programs may feel different about that section.
20	no
22	no
23	I thought they were all relevant. I also liked the fact that sme questions application of those concepts learned.

24	no

8b. Were the test questions relevant to the content they were testing? Give an example of one that was relevant and one that was not relevant.

Participant	Comment
1	One question that did not seem to be relevant was how had aviation safety changed (better or worse) since 1970. The references were too vague and could have been simplified.
2	There were some question that I took 3 or 4 cracks at to get the right answer and example PM question 8. I think all four answers were correct. question 5 in PM" is not a barrier" maybe could have been worded so it was not a double neg. The questions in the PM section seemed to be different from the other sections
3	all questions were relevant to me
4	The Dirty Dozen was a good one to really cement into memory. Some of the Leadership questions were mindless
6	There appeared to always be one or two questions in the tests that may not have been directly addressed in the prerequisite readings. They were obviously placed to test the participants ability to understand the material as opposed to reading the material. I sheepishly admit to the fact it was these such questions that caused me the most difficulty. I would recommend the inclusion and perhaps more of these type of questions in future exams. I apologize for not having an example readily available.
7	yes
10	I thought that the CBT testing format was cumbersome and frustrating. Some of the questions were too "twisty" and would stymie the average AMT (and slow engineer!). The average AMT needs more "tools" not "theory." "If this, then this" kind of stuff. This was a good primer for Safety/HF practitioners, but it needs some more relevance to the "common man." In question 8a. It was not that the questions were hard but confusing. Maybe the word "difficult" should be defined or substituted. The answers on the test should be numbered or "lettered". Getting out and going back into the test was cumbersome. Too many key strokes. You had to get out of the test go back to any section then hit test then go back into the test, answer all the questions again (if you remembered them , just to answer one that you skipped. If you got another wrong by mistake, you had to repeat the whole process again! By this time most would have given up. Or been driven to say nasty things to the computer! AsI said before, AMTs hate to be tricked, made a fool of, or frustrated! I think there was little time to let the information "sink" in. Specific numbers are irrelevant e.g., $350 million means nothing. Its a big number! That's it.
12	YES. ALL OF THE TESTS WERE REALLY A FEEDBACK TO ME AND THEY WORKED AS A VERY IMPORTANT WAY TO IMPROVE IN MY BLIND SPOTS DURING MY MRM LEARNING.
13	Yes
16	yes
17	Very relevant

18	The question that was confusing until I really though about it was during the Performance management test question 5) Which of the following is not a barrier to leadership. Laziness was the answer. It was confusing because it was not actually mentioned verbatim in the text it was more of a common sense answer. A relevant question of a great reminder was in the communication test question #1) In the communication process, the form of communication: includes spoken, written or visual. It seems that people forget that he is use all 3 items can and does make the best impact.
20	yes
24	Aleady sent to Terry

9b. List any ideas you learned about in this course that you think you could apply in your work environment.

Participant	Comment
1	I would like to see this application used to host a site that would be accessed by safety counselors in the field. They would be asked to respond to a battery of test questions periodically. The test results would be evaluated immediately and both the individual and the … (cut off).
2	Because I teach this course ALL of it applies. If I think back to when I was in the industry as a Director of Maintenance with 15 people working for me, once again I would say ALL. This has been a great awareness of what has been missing in the industry until now.
3	How maintenance personnel could not be aware of his job consequences on time an place. Look for comply with strict safety requirements in order to avoid accidents, nor just to comply with the authority paperwork. Training is basic but could be really a cost or expense (administration looking) if it is not well focused and prepared.
4	A lot of the Teamwork stuff has application in our environment.
6	I am confident that I can effectively apply all of the sections throughout different duties of my responsibility.
9	Personal performance, right communication, right leading.
10	I am developing a course on group communication skills based on the information in the Communication within Groups article. We have excellent “Office” leadership skills courses here but the AMT Managers and Supervisors do not find the office environment relevant to their hangars. We also need a Technical Leadership course for them. In my spare time!
11	distance learning methodology, setup, procedures
12	COMMUNICATION, PROBLEM SOLVING, SHIFT AND WORK DESIGN, ETC.
13	Just about everything. It gave me several ideas for training in MRM. Will also serve as a valuable information resource for developing the training.
15	Think situation awareness is a good thing to stress to people. With situation awareness in mind, many incidents should be stopped before they happens.

16	It was a good course. I already knew a lot of it, but did learn some more. I can apply communication section.
17	Dirty Dozen info and communication within groups
18	There is not enough room to list everything. I believe nearly the entire course can be used, I believe a hard copy of the seminar is needed to reflect back to stimulate the memory also.
20	How to improve teamwork and cooperation. How to ensure information is passed on to ensure complete job is done.
21	Situation awareness and communication
22	To stress the importance of Human Factors in Aviation Maintenance.
23	Risk reduction, communication, leadership.

General Comments

Participant	**Comment**
1	The problem of portal access within the FAA is a big problem. I never was able to visit the chat room at any time. My Lan administrator felt uncomfortable about the issue. My idea about using this type of program to obtain info that is needed in the filed has many applications. Remote testing or learning has wide application both by the FAA and by air … (cut off).
2	I have found the course to be excellent but as everyone probably says that the very very best way is to be in a classroom with other humans. The chat sessions are very good for long distance training. Please, Please, Please, do not stop the program here. The word is getting out there and I have a lot of contacts now that want your training. If the funds were there maybe even a MRM II where MRM trainers can work with other trainers or for people in the Aircraft Manufacturing industry. In Canada the Canadian Aviation Maintenance Council is also working on DISTANCE LEARNING of HF. If you need a contact name just let me know. I am just afraid that for the companies that are not pro-active, that they will not send there people to a class room . They will say “Here is a CD on human factors, do it at lunch, or at home on your time not mine. We are too busy to do that on company time” But this would be extremely helpful as a recurrent training course to be taken yearly after the classroom course. An E-Mail site for all of us to continue to COMMUNICATE with each other and others interested in Aviation Maintenance and Manufacturing Human Factors. I know that the CRMers have this and it is very successful. For everyone that worked on this, keep up the work and please DON’T stop what has been started here.

3	As my first experience in two topics: Maintenance Resource Management & Internet training, I fell great. I am really interested on get more information about MRM and now I get a commitment with myself: to share the information and learning's I get now. For all you folks that are in other side, congratulations for this very good job: MRM information, training structure and computers management, everything was great. And finally, to whom it may concern thanks for new technology.
4	Make the course material easier to print out - much would be good to have for refresher review at a later date.
5	I was disappointed I could not use any of the videos. Some of the questions were a little backhanded, like question 5 in the last test. I did drop off during the chats a number of time???? I did not find the chats of much help. Other than the above, I found this a great way of getting the word out. I congratulate you, you may have saved a life today.
6	Keep up the terrific work. All the facilitators and Terry Chandler are very knowledgeable and accommodating. This is relatively new to most people and as technology advances, hopefully their (mine included) computers will be able to process and display the audio/video portions more effectively. I am very impressed with the efforts put forth by everyone at Galaxy Scientific and wish everyone involved continued success in this very commendable program. Please feel free to contact me at any time should there be any questions concerns, or you just want to say hi.
8	Being involved in designing a program and working with several university professors and many other experts in the field the last few years, most of this was a refresher course for me. I enjoyed the course very much. I believe communication (written especially)i.e. turnovers, non-routines log books continue to need attention. I believe situation awareness plays a large role in the errors that are committed. Another source is that not everyone reads the paperwork thoroughly. step by step. Thanks for the effort that was put in to this program. Look forward to another course.
11	great stuff !!!!
12	IT IS VERY IMPORTANT TO REPEAT THIS COURSE TO SCHEDULE MORE PEOPLE OF MY COMPANY, ESPECIALLY THE SHIFT SUPERVISORS, ENGINEERS AND INSPECTORS (IN THE NEXT COURSE) AND A&P MECHANICS (IN THE THIRD COURSE).

13	Hope to see much more of this type of training in the future. An alternative to the chat sessions may want to be explored. Firewalls and time to participate seem to be barriers. Possibly a FAQ format would work better.
14	This is a preliminary submission. I will submit again after 100% completion. So far so good!
15	I suppose the number used in tables are for USA only. Fine if number and lists etc. more clearly tells if they are for USA or the whole world or for certain airlines. Taken a little further, I think this is a fine way to learn, get ideas, and get in touch with people in the HF field. What about a contact area for different items, where one can put in questions and find answers, exchange ideas and tips. The videos could have been some better to observe, but that has something to do with my browser I guess. Will it be possible to get the video in a such form that they can be used in a class? Several of the videos could be fine to show in a class as samples.
17	Great info all the way round. CBT and chats worked very good. Thanks for the opportunity to join the group. Great Experience.
18	I personally had problems getting through my corporate firewalls to get into the chat sessions. Your technical people helped out a quite a bit with my computer dept. trying to get through but we found more firewalls than corporate was even aware of. I did follow the programs through the chat session notes and was able to ask a few questions of one of the presenters. In my opinion besides (continued) the chat session format I believe a tele-com session should be made available. This would help with the individuals who type slowly or are embarrassed by their spelling and also with individuals who are better at verbalizing their ideas and the use of emotion. I believe that GTE or AT&T could help with the initial set up. I know that United Airlines, Continental, and NWA use a similar system to communicate with all the amt (showed) places at one time. Thanks for the opportunity to be part of this event.
19	I have not had time to reflect specifically on the details of the course. Overall, it has been a positive experience and well worth the effort.
20	Overall concept is good. Actual lesson plan and testing were a bit basic. Would like to be able to down load other resources and basic lesson so they could be <read offline>. Never got video to work. Too bad.
21	I was happy I attended. I would be interested in taking other courses online as they become available. Thank you.
22	Looking forward to more of such Web Based Training. Thank you to all of you!!