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Post-Mission Assessment for Tactical Training-Trends Analysis (PMATT-TA): Usability Analysis Report

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13. ABSTRACT (*Maximum 200 words*) The following report outlines the first iteration of a heuristic-based usability assessment of the Post-Mission Assessment for Tactical Training-Trends Analysis (PMATT-TA) online software system. A unique approach to usability heuristic assessment (i.e., EQUATE) was used that enabled respondents to provide more detail than a traditional survey-based approach allots (e.g., PSSUQ, SUS). Not only is this approach more comprehensive than existing surveys, it also affords respondents the opportunity to articulate issues they identified while soliciting suggestions for how to fix those issues. The resulting analysis provides valuable information to program developers that will enable them to fix issues and optimize system functionality.			
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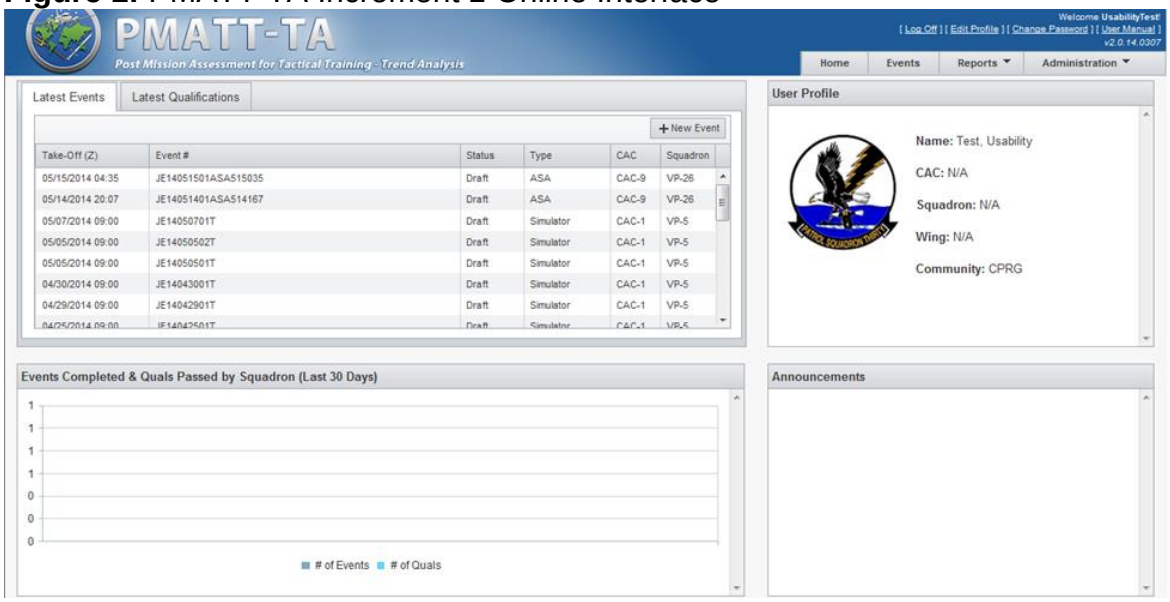
2. Executive Summary

This report details the initial usability evaluation of the Post Mission Assessment for Tactical Training - Trend Analysis (PMATT-TA) Increment 1 web-based application using a novel, heuristic-based measure called the Experience-based Questionnaire for Usability Assessments Targeting Elaborations (EQUATE).

PMATT-TA Increment 1 is an online user interface and database system that primarily supports tracking data points from live training events for P-3 and P-8 anti-submarine aircraft. These data points capture important mission and contextual information (e.g., wind speed, mission type, time, altitude, and communications) regarding a training event. Debriefing officers can review this information along with mission objectives with aircrews to identify performance strengths and areas for improvement. By centrally storing this information, PMATT-TA also supports data calls to understand fleet readiness and proficiency. Additionally, PMATT-TA addresses a need for a digitally based system that streamlines and automates the process of data collection, analyses, and feedback while also increasing accessibility to data. While the PMATT-TA has demonstrated promise in supporting a reduced workload for debriefing officers, it has not been subject to formal usability analysis. To be confident that the system achieves its aims and is operable by end-users usability analyses are imperative.

With usability goals for efficiency, effectiveness, and utility, the development team implemented an iterative testing process (subsequent iterations will be reviewed in proceeding Technical Reports) for the PMATT-TA Increment 1, to evaluate objectively, system usability. This report documents the first iteration of evaluation using a population of human factors Subject Matter Experts (SMEs). It is important to note that these SMEs lacked domain specific knowledge (e.g., knowledge of acronyms, knowledge of PMATT-TA system purpose) and, while six of our nine SMEs rated themselves as “Very Knowledgeable” of usability evaluation, only one was distinguished as “Expert”. For this reason, we will refer to them as “usability evaluators” for the rest of the review. The current analysis is intended to expose both general and specific issues users encounter while using the system and to use this information to inform system developers regarding changes and general system improvements.

Figure 1: PMATT-TA Increment 1 Online Interface



3. Introduction

While variation in the literature exists when defining usability, one common theme is the extent to which a human can use a system to achieve goals effectively (Bevan, 1995; Law & Hvannberg, 2002; ISO, 1998; Shackel, 1991). When a system contains usability problems, users will find difficulty operating the system to complete tasks (e.g., sign in to site, enter data into fields, post announcements) effectively and efficiently (Law & Havannberg, 2002). The following will outline three approaches to conducting these assessments: heuristic evaluation (i.e., analytical methods), usability survey approaches (i.e., empirical methods) (Gray & Salzman, 1998), and hybrid methods[1].

Heuristic Approaches

Nielsen (1994) has referred to heuristic (i.e., rules of thumb) approaches to usability evaluation as “discount usability engineering methods” (p. 152). Heuristic evaluations require expert evaluators to provide their opinion of a system according to a set of predefined rules (i.e., heuristics) (Nielsen & Molich, 1990). While initial heuristic approaches identified as many as a thousand (Mosier & Smith, 1986) rules to follow,

[1] These methods combine features of traditional survey based usability methods with heuristic-based approaches to usability assessment.

Molich and Nielsen (1990) narrowed the list down to “nine basic usability principles” (p. 249). The resulting approach to usability assessment addressed several issues afflicting traditional approaches including time to administer, cost of administration and interpretation, and comprehensiveness, quality, and utility of information (Ahmed, 2008). In the military environment, such efficient and economical methods are desirable, as concern and debate over budgets continues to limit the time and resources of DoD personnel.

Survey Approaches

Survey-based approaches are the most common form of empirical usability assessment in both industry and academia (Ahmed, 2008). These methods solicit information from users that were not involved in the design of the system (Holleran, 1991). These survey-based novice-user usability assessments require respondents to interact with a system, and later fill out a survey that assesses their satisfaction with the interaction. These surveys are usually validated prior to implementation, ensuring that they cover a broad scope of usability issues. While these methods are excellent for attaining the subjective satisfaction of users in a relatively short time-frame (Ahmed, 2008), they tend to fall far short in identifying any and all issues afflicting a system (Jeffries, Miller, Wharton, & Uyeda, 1991).While no approach to assessing usability has ever been completely comprehensive, a need for a method that balances comprehensiveness, cost, time of administration, and cross-platform flexibility is certainly desirable.

Hybrid Approaches

The EQUATE is a hybrid approach that leverages a heuristic-based usability assessment method in a survey-based format that is efficient to administer and analyze, while maintaining a necessary level of comprehensiveness and flexibility. The EQUATE was developed to address gaps and issues with past heuristic-based approaches while integrating best practices. For example, while the EQUATE maintains the same dimensions and many of the same items that have been validated in past literature (Nielsen & Molich, 1990; Nielsen, 1994), it also enables experts or evaluators to further articulate their issues in a free-response format. Moreover, the survey allows them to assess the severity of the issue and provide suggestions for fixing it. This is important because not all features of Navy training systems are imperative (e.g., *Graphic Design & Aesthetics*). In essence, the EQUATE is a single method that takes advantage of both empirical and analytical approaches to usability assessment (Gray & Salzman, 1998). The EQUATE developers acknowledged that both approaches have differing strengths and weaknesses and the integration of the two ensures comprehensiveness and accuracy of information. Additionally, while identifying an issue is important, without

specific information Usability Analysts must find creative ways to communicate this information to developers. Unfortunately, the solutions they come to are not always sound in regards to human factors and/or may still not meet the needs of the end-user population.

Based on the aforementioned benefits, the EQUATE was used to provide both quantitative and qualitative feedback to system developers of the PMATT-TA Increment 1. However, it is important to note that this feedback represents an initial evaluation of the system that was also intended to provide the research team with information about the EQUATE. Specifically, we are using this analysis to better understand the psychometric properties of the EQUATE. Subsequent usability and heuristic evaluations may be necessary in order to achieve a desired level of system optimization for end-users.

3.1 Goals

Ultimately, the goal of this effort is to improve the PMATT-TA Increment 1 system for the end-user population. To accomplish this goal a novel approach to usability assessment was conducted. The EQUATE provides quantitative, general feedback regarding eight dimensions of usability (i.e., *Error Handling & Feedback*, *Graphic Design & Aesthetics*, *User Interaction Control*, *Memorability & Cognitive Facilitation*, *User Efficiency*, *Learnability*, *Consistency*, and *Help*) on an easy-to-interpret 1 to 5 scale. System evaluators using the EQUATE are also able to provide free-response feedback to better specify issues, indicate severity and offer suggestions for fixing them. These free responses were organized, reviewed, and cataloged by the research team in order to deliver clear and concise information to developers that focus only on common themes and issues of high priority.

3.2 Objectives

The main objective of this effort was to identify and document issues afflicting the PMATT-TA system and propose fixes to assist the development team in enhancing future versions of the software. In addition to identifying specific fixes to components that directly affect system functionality, the information provided by the EQUATE should also enable program developers to facilitate general improvements.

An indirect objective of this effort was to demonstrate the value of this type of usability method for the consideration of use on other DoD software systems. Utilizing the EQUATE methodology has the potential to deliver huge cost-savings by providing quality feedback to system developers at all stages of the development cycle. If usability

problems arise after full implementation and fielding of a system, fixing those issues can be incredibly costly and practically difficult[2].

4. Methods, Assumptions, and Procedures

4.1 Methods

Recruitment

Participants (*N* = 9) evaluated the PMATT-TA Increment 1, web-based application in a laboratory setting with a desktop computer. Researchers determined the eligibility of participants and provided an informed consent document to qualified participants. Participants then received a brief explanation of tasks and measures as they moved through the protocol.

Each participant filled out a demographic questionnaire asking about education, occupation, years working within that occupation, and experience level within six areas. The participants all had at least a Bachelors degree, while the majority (*n* = 7) had completed a Masters. The primary occupation was Research Psychologist and experience ranged anywhere from 1 to 30 years. Participants also reported their exposure with *Computers*, *System Design*, *Software Development*, *Human Computer Interaction – Graphic User Interface* (HCI-GUI)*, Usability Testing*, and *Heuristic Approaches* (see Table 1).

Table 1. Participant Expertise in Computers, System Design, Software Development, HCI-GUI, Usability Testing, and Heuristic Approaches (*N* = 9)

Area	None	Novice	Average	Very Knowledgeable	Expert
Computers	0	0	3	5	1
System Design	1	3	1	3	1
Software Development	3	3	3	0	0
HCI-GUI	2	1	1	4	1
Usability Testing	1	1	2	4	1
Heuristic Approaches	2	2	1	4	0

[2] New contracts and/or Engineering Change Requests are often necessary to ensure that prime contractors are funded to address all Change Requests and Deficiency Reports when initial contractual obligations are completed prior to identification of issues.

4.2 Procedures

Tasks

Participants completed a series of tasks (see Appendix A) to replicate the collection of post-mission summary data that will occur using the web-based application PMATT-TA[3]. The tasks generated were derived from an informal task analysis with domain subject matter experts (SMEs). The goal was to generate a list of tasks that are commonly performed by subjects. We then selected tasks we felt could be completed by usability evaluators with little to no domain knowledge. The following is the list of tasks we used for this study. Using hypothetical information, participants:

- Created and edited a user account,
- Actively explored the menus,
- Created a new event record with provided information,
- Reviewed a recent event record,
- Deleted an event,
- Explored options, and
- Created a Bravo Zulu announcement recognizing the event.

After completing these tasks, participants logged off the system. While working on these tasks, participants had access to a notes page or "heuristic aid". The aid listed each of the overarching dimensions listed in Table 2. The intention of the aid was to assist the usability evaluators while writing comments regarding the system.

Measures

After completing the PMATT-TA tasks, each participant was given the EQUATE. It was developed based on an extensive review of the extant literature regarding system design and heuristic evaluation. The review identified a number of items (i.e., 200) that qualified as design guidance. These 200 items were then categorized and validated using a card sort with individuals containing extensive knowledge or education in human factors psychology. These card sorts then informed the items and dimensions that formed the EQUATE. The end product was an expert-led method containing design guidance that enabled end-users to provide both general and detailed usability feedback. Likewise, the EQUATE possesses the capacity to generalize to a wide variety of systems (e.g., training and operational), potentially saving the DoD from further developmental costs.

[3] Task descriptions included contextual information and representative data for a reasonable amount of data fields to support completion of tasks without extensive domain knowledge. This information did not include all required data in order to provide users with the potential opportunity to observe error messages for incorrect data entry.

Each overarching dimension contains 10 to 44 sub-items[4] grouped into 17 sub-dimensions (see Appendix B).

Table 2. EQUATE Dimensions and Descriptions

Dimension	Description
1. **Graphic Design & Aesthetics**	Interface display elements (e.g., color, text, graphics) and layout support a positive user experience.
2. **Error Handling & Feedback**	System feedback on status and error supports users' understanding of how to interact with the system.
3. **User Interaction Control**	Mechanisms that allow the user to feel in control of actions and system preferences.
4. **Memorability & Cognitive Facilitation**	System design helps ease learning and memory load (short-term and long-term memory).
5. **User Efficiency**	System design and functionality that supports completion of tasks with minimal time and effort.
6. **Learnability**	System design and aids support users learning how to use the system.
7. **Consistency**	System information and actions are consistently located and formatted throughout the interface.
8. **Help**	Readily accessible instructions or clarifying information that are easy to use and support task completion.

5. Results and Discussions

The quantitative analysis is intended to provide an overview of the usability of the PMATT-TA system as a whole and a localized evaluation of the usability of system and system components across the heuristic categories previously mentioned (e.g., *Learnability*, *Help*, and *Consistency*).

The analysis revealed both positive and negative elements to the PMATT-TA system. Usability was assessed on a 5-point scale (i.e., 1 =*Strongly disagree,* 5 = *Strongly agree, 0= Not applicable*). Items on the EQUATE are framed in both positive and negative terms (e.g., "The design provided a pleasant experience" and "There was too much

[4] Sub-items are detailed design guidance that provide examples of positive or negative applications of the overarching heuristic.

clutter on the display"). Negatively framed items were reverse coded prior to analysis so interpreting dimension averages was clear. In general, higher averages imply better usability while lower averages imply potential usability issues exist.

The average across all items of the EQUATE was acceptable (*M* = 3.41, *SD* = 0.24). While this average appears to indicate the system maintains adequate usability from a global perspective, a more detailed evaluation of EQUATE items, dimensions, and free-responses is necessary to validate and elaborate on this assertion. Only two of the heuristic categories exhibited an average score below 3.0, indicating the need for redesign or adjustment. They were *Learnability* (*M* = 2.89, *SD* = 0.56) and *Help* (*M* = 2.81, *SD* = 0.93), demonstrating participants (i.e., usability evaluators) felt they needed more help to learn the system[5]. The remaining dimensions all maintained adequate or above adequate average scores (see Table 3 for descriptive statistics). In the next section we will review the free responses for each dimension of the EQUATE. This review will help identify issues missed by the survey items, further clarify all system issues, and determine how one might fix them.

The opportunity for participants to articulate system issues in a free-response format was exercised extensively. The vast array of free responses required the research team to qualitatively and quantitatively summarize feedback for the purposes of usability analysis and reporting. To do this, researchers classified free responses based on the heuristic dimension they most appropriately represented; we then poured through each response, coding 'common themes'. Common themes were thought, by the research team, to be any issue that at least half of the respondents identified as problematic. In addition to reporting common themes, we also rated issues based on their perceived severity concerning system functionality. As a research team we acknowledged that common themes alone may not be enough to capture any and all critical issues afflicting the system. The later evaluation was intended to capture important issues not addressed in the analysis of common themes. The proceeding overview organizes these issues relative to the heuristic categories previously mentioned. For further elaboration on the free-response feedback, see Appendix B.

In regards to *Graphic Design & Aesthetics,* more than 50% (n ≥ 5) of usability evaluators described the following as problematic. First, latency between actions and system reactions was reported as troublesome. Specifically, one usability evaluator noted that processing times made the system unpleasant to use[6]. Secondly, usability evaluators

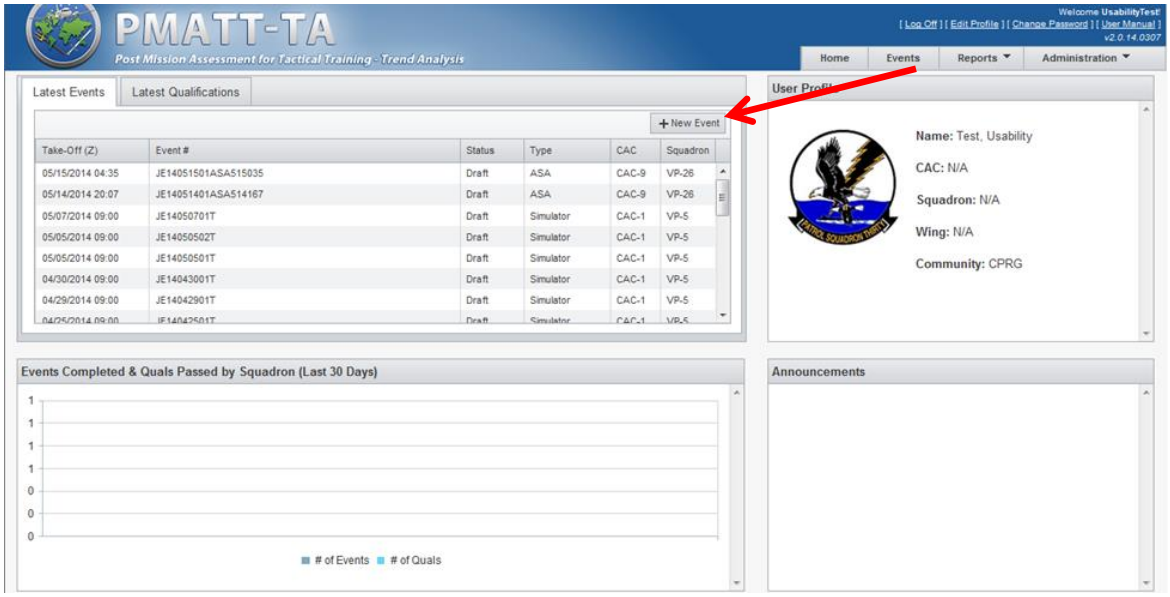
[5] SMEs lacked domain specific knowledge likely influencing their ratings of learnability, suggesting that *Learnability* be re-evaluated in future iterations of testing with end users to rule out this as a factor.

[6] Because faulty hardware or inadequate networks can cause system latency, additional latency testing should be conducted by the development team to determine if specific hardware specifications are necessary or if network issues affected the results in this evaluation.

noted that grouping, chunking, or aligning related fields would help guide users and organize related input. Lastly, usability evaluators listed the lack of consistency in entering time as confusing. As a potential fix, they felt that “typed” entry with format restrictions (i.e., --:--:--) as a preferred method to using slide bars.

In addition to these frequently identified issues, the research team concluded that the “New Event” tab needed to be more obvious to users. We came to this conclusion because it is an issue that directly affected system functionality. Further, this issue was identified by multiple usability evaluators, and was categorized as affecting *User Efficiency*[7], as a result, several usability evaluators needed outside instruction to start a ‘new event’ dialog. One usability evaluator suggested making the button larger or using color to make it more obvious to end users.

Figure 2: PMATT-TA Increment 1 Home page “New Event” button.



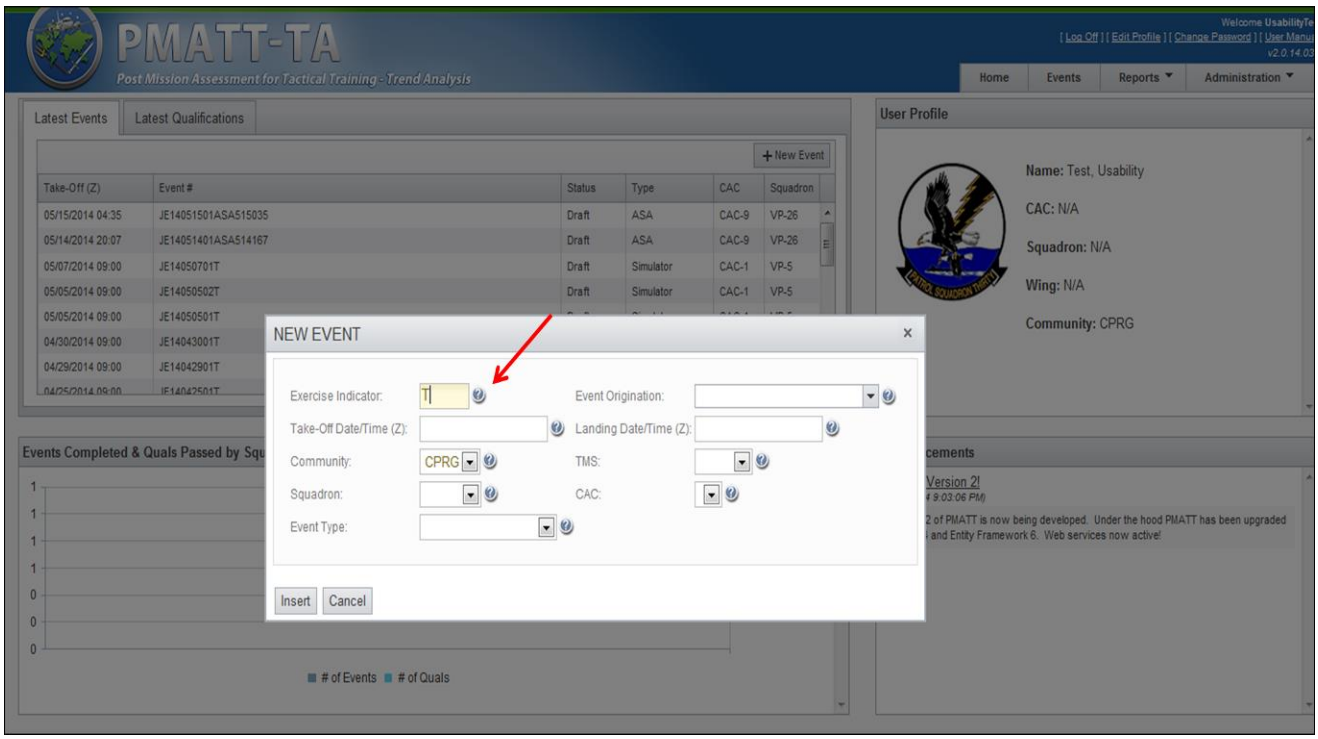
In terms of *Error Handling & Feedback*, more than 50% (n ≥ 5) of usability evaluators designated the following as challenging. First, feedback regarding which fields were required was only provided after you hit save. This caused users to take an extra and unnecessary step in determining what fields were mandatory. One usability evaluator suggested that required fields should be clearly labeled (e.g., asterisk) once the fields are opened. Lastly, several usability evaluators noted that tool tips disappeared from view too quickly. Reporting that they were unable to read the entire message before it disappeared. The simple solution to this issue is to allow more time for messages to be available, especially when those messages are lengthy. Since estimating the amount of

[7] Researchers did not identify any other common or high priority issues when reviewing the *User Efficiency* feedback.

time a user needs to read messages may be difficult, one option is to leave the pop-up message visible until the user removes the cursor from the icon.

Pertaining to the *Learnability* heuristic from our assessment, there was one common theme discussed. More than 50% (n ≥ 5) of usability evaluators reported that the help icon (see Figure 2) next to the fields disappeared too quickly and were often not descriptive enough. As an illustration, one usability evaluator stated, “The “?” [help] entries were long and needed to be accessed several times. They weren’t always specific enough to tell you how to enter data either. For example, [they] didn’t always give measurement unit[s] to use (ft, etc.).” Evaluators suggested that detailed help messages should be available to users for a longer amount of time. This is a related issue to that of error messages, and therefore, developers could address both with a consistent fix.

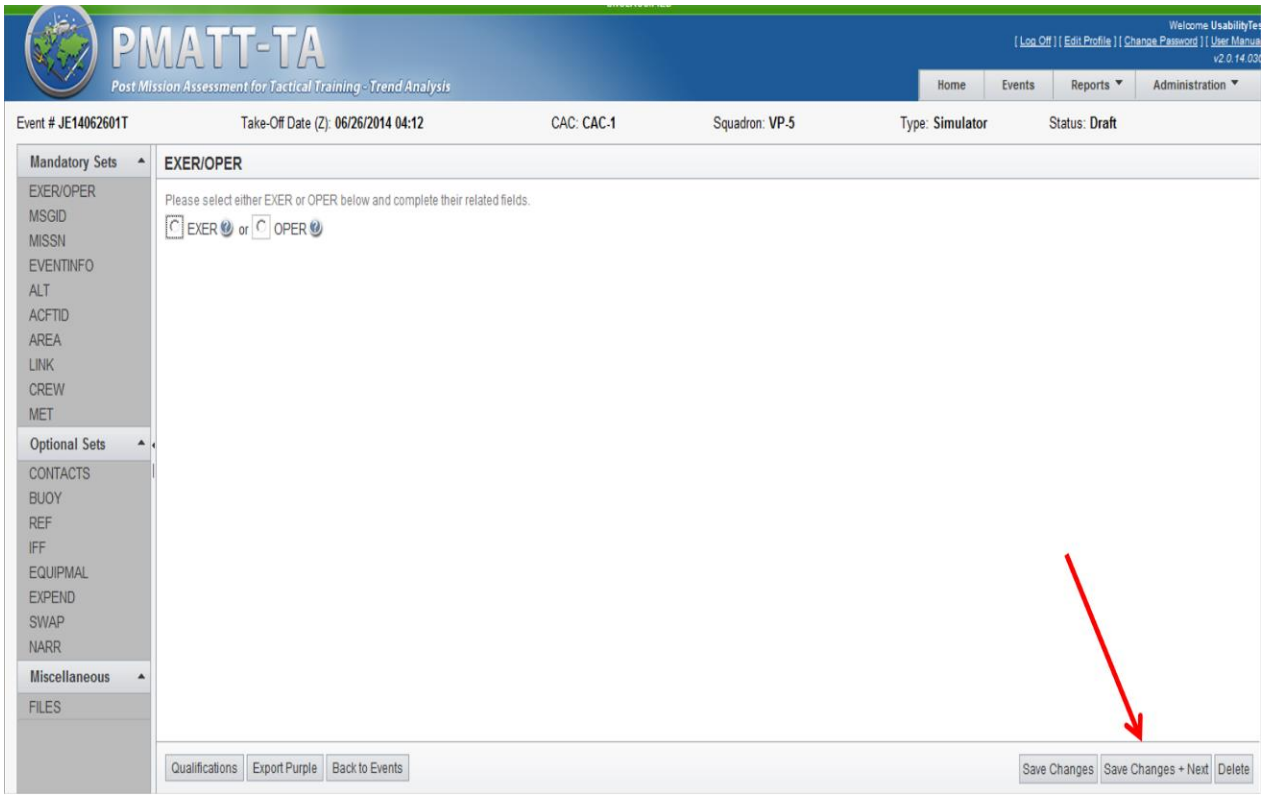
Figure 3: PMATT-TA Increment 1 Online Interface “Help” icons.



While there were no common themes relevant to *Consistency*, there were two issues identified as critical by the research team. First, several usability evaluators noted that the “save/next” buttons were not always consistent from one field to the next. Second, one usability evaluator noticed that, “when entering a new announcement, [the] drop-down list for time entry is in civilian format (5:00pm), but after the selection [time] is

displayed in military format (1700).” The Evaluator suggests that time format remain consistent throughout the program.

Figure 4: PMATT-TA Increment 1 Online Interface “save/next” icons



There were no common themes or critical issues identified for *User Control*, *Help*, and *Memorability & Cognitive Facilitation*. Furthermore, and true of the other dimensions, there were many free responses that noted many positive features of the system (see Appendix A).

Discussion

While the quantitative review provided a broad glimpse of PMATT-TA system strengths and weaknesses concerning usability, the review of the free responses allowed the research team to identify specific usability issues and propose possible solutions to problems. Overall, the system appears adequate in terms of its usability. Additionally, our review demonstrated that the system has at least as many positive as negative features as a whole, but as with any system, improvements are necessary to achieve human-computer optimization.

Table 3. Descriptive statistics for Evaluator responses on the EQUATE (*N* = 9)

Dimension	Range		*M*	*SD*
Graphic Design & Aesthetics	3.34	3.95	3.681	.1968
Error Handling & Feedback	3.19	4.19	3.506	.3131
User Interaction Control	3.20	4.00	3.502	.3161
Memorability & Cognitive Facilitation	2.48	4.15	3.280	.5122
User Efficiency	3.16	4.21	3.687	.4324
Learnability	2.10	3.88	2.897	.5646
Consistency	2.93	4.50	3.875	.5733
Help	1.17	3.91	2.816	.9398
Overall Usability	3.13	3.90	3.409	.2486

6. Conclusions

In sum, our quantitative and qualitative analyses revealed several usability issues concerning PMATT-TA Increment 1 as was consistent with the above assertion. In particular, the quantitative evaluation revealed that the dimensions of *Help* and *Learnability* might need more attention from developers. However, some of the lower ratings within these two dimensions may be due to the lack of domain-specific knowledge on the part of the usability evaluators. A follow-up study with the end-user population of PMATT-TA is necessary in order to determine with more certainty if these dimensions are indeed problematic and if any additional issues might surface.

While the quantitative analysis provided general information regarding system insufficiencies and strengths, the qualitative feedback helped pinpoint fixes and offered suggestions as to how to reconcile them. In order to consolidate and organize the free responses, the research team evaluated each response systematically. The first step in this systematic evaluation was to identify common themes across our nine usability evaluators. The second step was to identify any single free-response that had implications for total system functionality (i.e., system critical issues).

The first part of this systematic evaluation identified consistent themes pertaining to *Graphic Design & Aesthetics*, *Error Handling & Feedback,* and *Learnability.* In addition to the specific issues identified, respondents also offered suggestions for fixing them. We believe these suggestions will be especially informative to system developers. A review and specific examples of those issues and solutions can be found in the results section and/or Appendix B.

Results from the second step of our systematic overview of usability evaluator free-responses identified two “system critical” issues relevant to the *Consistency* dimension of our survey. These issues require specific fixes to ensure system optimization. The first issue is in regards to the “save/next” buttons underlying the fields being filled out. These buttons are not consistent from one field to the next. It was suggested that these buttons be formatted the same for every field. The second issue is in regards to the format of time. In the “Announcements” field, military time is requested, but civilian time shows up after the time is entered. The suggestion is to stick with a single format for time and, in this context, military time would be most appropriate. Again, these two issues should receive immediate attention by program developers.

Finally, it is important to note that while our usability report using the EQUATE uncovered both general and specific deficiencies regarding PMATT-TA Increment 1, positive elements were also identified. The value of this information may not be relevant to the current version of the system but should be incorporated in subsequent versions. Specifically, the quantitative analysis demonstrated that only two of our heuristic dimensions (i.e., *Learnability* and *Help*) were below the threshold (i.e., less than three) for adequacy in terms of usability. This implies further attention from program developers may be necessary to achieve system optimization. The other six dimensions maintained averages that were deemed as sufficient. This simply implies, that for the purposes of PMATT-TA, *Error Handling & Feedback, Graphic Design & Aesthetics, User Interaction Control, Memorability & Cognitive Facilitation, User Efficiency* and *Consistency*, may not need the same level of attention as *Learnability* and *Help*. In addition to the qualitative analysis, many positive themes surfaced in the free responses from usability evaluators. We did not systematically review positive comments as these would not provide useful information to system developers for the current version of the system. However, a full list of the free responses is provided in Appendix B.

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8. Appendices

Appendix A.
PMATT-TA

Tasks for the Post Mission Assessment for Tactical Training – Trend Analysis (PMATT-TA)

Directions: Below you will find 6 tasks with supporting information. *The information provided may not include all required data, so please use random sample data of your choice in these instances*. These tasks can be accomplished using the web-based application PMATT-TA, which can be found at https://pmatt.innovasi.com. Please complete each task in full. When you have completed all of the tasks, please let the experimenter know.

1. The PMATT-TA system will be managed by the Command Patrol Reconnaissance Group, CPRG. Part of this responsibility includes maintaining control over user accounts and permissions. Login to the system as CPRGUser (password: Password1!). Create a new user account for John Doe, who is a part of the CPRG community (User Name _____ Password _____). Update his profile to indicate that he is assigned the role of a CPRW Staff Officer. After confirming the new user account has been created, log out of PMATT-TA.

2. Users of PMATT-TA may be required at times to edit their profile. Login to the system as John Smith, the account you just created. After CPRG created your account, you were assigned to the VP-5 Squadron and given assigned a second role: Squadron Training Officer. Update your user profile with this information. Additionally, because of these new assignments, you would like to upload a new image to be used for your user profile on your home page (use a photo or icon of your choice). After making these updates to your profile return to the home screen.

3. As you are new user of PMATT-TA, take a few minutes to review the tabs and menu options available from the home page. Use this time to get a general feel for the system to identify functionality that might be required to complete future tasks. You can navigate away from the home page, but please do not save any changes you make. When you are finished investigating different menu options and pages, please return to the home page before continuing to task #4.

4. You have been asked to create a new event record to document what occurred during a training event that was conducted today. The **P-3C** crew completed a 5 hour Anti-Submarine Warfare (ASW) **simulator** training event. This P-3C crew is from **VP-5**, **CAC-1**, which documents training events with a "**T**" Exercise Indicator. The P-3C crew began their **simulated** event at **NAS Pensacola** today at 0900, returning at 1405.

The crew provides you with the following information during their post mission review. *Please remember that this information may not include all required system*

data. If you are missing required information, use random sample data of your choice.

EXER/OPER: This event was part of the exercise TRITON.

MSGID: The event was assigned serial number 001 as part of TRITON.

MISSN: The crew performed an Anti-Submarine Warfare (ASW) training event.

EVENTINFO: This crew logs all events under Unit Designator VP-5 CHARLIE. The crew logged their actual and briefed event times as indicated in the table below.

Event	Actual Time	Briefed Time
Take-Off	0900	0900
On-Station	1000	0945
Off-Station	1245	1300
Landing	1405	1400

ALT: Input the On-Station Altitude for the event the crew recorded within their logs.

ACFTID: The aircraft for this event was a P-3C with an ID number of WTT3.

AREA: The crew reported to area BRAVO as outlined in their briefing.

LINK: During the event, the crew attempted to use LINK to help communicate with other aircrews. It took approximately 1 hour to establish LINK using High Frequency/Net Control. The LINK remained in use for 3 hours.

CREW: The crew for this event (crew number 01) included a Pilot (PC, John Doe 1) and 2 sensor operators (SS1, John Doe 2; SS2, John Doe 3).

MET: The meteorological (MET) report was taken at 1030, while at lat/lon 9999S-99990. This report indicated light turbulence with some fog.

CONTACTS: During the event, the crew identified one contact to report, an enemy submarine (serial number XXX) that remained stationary (Lat/Lon 1234S-87654) from 11:00 to 11:45.

NARR: The crew has requested that you check the narrative (NARR) for accuracy because their Commanding Officer reviews this part of the report to maintain awareness of crew events.

After entering this information, you can log off of PMATT-TA.

5. John Smith has reported to the CPRG community, as a CPRW Staff Officer, that several recent events have been added to the PMATT-TA system and is ready for review. Login to the system as CPRGUser (password: Password1!) and go to the Events page to review all events. CPRG has learned that a recent event was incorrectly input in the system and needs to be deleted. Delete event _____ from PMATT-TA. You have been asked to learn

more about what options PMATT-TA provides for sorting and filtering events. Spend a few minutes investigating what options are available.

6. CPRG has completed a review of the events that were part of the TRITON exercise. VP-5 demonstrated proficiency during the exercise. Create a Bravo Zulu announcement to recognize the event. Return to the home page to check the display of the announcement.

Log off PMATT-TA.

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Appendix B.
Participant Usability Free Responses

Graphic Design & Aesthetics

- I found graphics and aesthetics to be pleasing, clean, and directive.
- Color, font, and graphics are clear and readable with sufficient contrast.
- (+) Nice use of graphical rep of events completed/quals passed on homepage.
- (+) Use of red/yellow/green indicators for qualifications pass/fail (visually appealing).
- (+) Use of green checkmarks in "mandatory/opt/misc" sets checklist
- Not as appealing to the eye, dull colors, but not a cumbersome display.
- At times it was difficult to locate items in a long drop-down quickly.
- Intuitive display.
- Flag menu for NEW CONTACT's contents were red (text) not sure why this is useful.

Overall, I found the system design enhanced the user experience.

- I thought the layout was clear and concise.
- The use of colors and shading assisted in guiding me through the task.
- I did NOT like the latency within the system however all the overall inability to search through events drove me to find creative ways to accomplish tasks only after becoming frustrated while sifting through 1000s of events.
- The order with which information was given in instructions didn't clearly follow order of vertical tabs.
- There was too much lag between action and reaction.
- Grouping, chunking & alignment would help guide user and organize related input.
- There was not much clutter, only found difficulty when in a long drop-down field.
- Had some admin issues in the beginning, but had no issues afterwards.
- Overall the system was clean/not cluttered.
- Design/aesthetics were minimalist and functional. Given the intended audience, it seemed appropriate.
- Updating profile - location more visible.
- Roles of user were not clear to what actions they could person on the system.

Overall, I found the layout to be visually appealing.

- The tabs (data entry boxes) were not grouped in a way that told me that information within them was related.
- Instructions were confusing and seemingly out of order relative to interface.
- Alignment of grouped input would enhance understanding of functional relationships.
- Although the "New Event" button is on the home page, it blends in somewhat with everything else. Consider increasing the buttons size/color/highlight etc.
- Under "Administration > Rules Engine" images aren't all loading.

- Was not able to "reports" tab; needed additional access.
- Consistency issue with entering time. Stick to one method. Prefer just typing it in and have a guide for format "--:--:--"
- I think menu contents/text should be same color across all menus (preferably black) should not change based on conditions (e.g., error state).
- Most error messages appeared in lower portion of window, but one error message appeared in upper portion.

Overall, I found characteristics of the graphic interface (e.g., graphics, text, colors) supported a positive user experience by increasing usability.

- I thought the layout was clear and concise.
- The use of colors and shading assisted in guiding me through the task.
- I did NOT like the latency within the system however all the overall inability to search through events drove me to find creative ways to accomplish tasks only after becoming frustrated while sifting through 1000s of events.
- The only graphic I recall was the map of Earth, but no reason for this picture was given.
- The system was unpleasant to use due to the long wait times and processing times.
- Too many components within certain tabs.
- Need more navigation support. The order wasn't implicit enough by tabs. Need to be explicit to see what has to be done first and when complete.
- The lag in the system made me think a button wasn't active and I would either click again or click somewhere else. The system would go from no action to a burst of several actions and then I would have to figure out what did/did not just occur.
- I found the interaction confusing, hard to follow, and unstructured. May have been a function of unfamiliarity with the context or a shortfall within the instructions.
- Under the "Link" set, a "[CHECK]" and "X" response box set is used but isn't used anywhere else in the system up to that point.
    - Under the "Link" summary, both the column for "Hours Attempted" and "Hours Successful" are labeled "HOURS" only so you can not differentiate the two.
    - Button to move to next set labeled "NEXT" instead of "Save Changes and Next" like every other set.
- Graphical picture buttons ([CHECK], X, Pencil) functions would be clearer if a small popup appears once you hover your cursor above each graphic in which its function is described.
- Sorting isn't intuitive in drop-downs: 1, 10, 11, 12, 2, 3, 4 instead of 1, 2, 3, 4, 10, 11, 12
- Graphics were not used often, which could have added to the visual aspects of the system.
- The addition of more colors can help discriminate between tabs.

- Would be nice to clearly label required fields (not just red error messages when you try to save).
- Not many graphics to judge, which isn't a bad thing.
- "[CHECK]" and "X" sometimes used, but not throughout
- One time the high level menu disappeared, but was able to find home again quickly
- Entering time was inconsistent. Too many different ways (scroll, input manually, use two side scrolls). Just make manual with consistent format.
- Not a clear path for where you are within the options/menus. Maybe add path at top as is common in Windows. "Home/events" also makes it easy to go back.
- Liked the check names in the side bar.
- The additional info bubbles could be more clear - maybe a link titled "more info" to make it clear that there is more info. Many times could not get the pop ups to show just by moving the mouse over it.

Error Handling & Feedback

- The error handling and feedback was executed well in my opinion. I was able to very quickly once presented, understand and correct any said error.
- Red boxes and alerts make it easy to identify missed steps.
- Feedback only provided after save.
- Required fields not marked.
- (-) Use of processing message to indicate system progress.
- (+) incorrect formatting of response in "New Event" indicated by red highlighting.
- (+) Acknowledgement of successful processing.
- (+) Times turned red for future times when entering supposedly past date.
- Error messages were descriptive enough to help me resolve the problem.
- Gave me error and told me to enter email address (clear message).
- EVENT INFO, UnitDesignator field, I typed in the example provided. An error msg appeared at top of screen and disappeared before I read it. Then all data I had entered reverted to default values.

Overall, I found the system design prevented errors and unintended actions.

- The system provided error correction feedback through red text and impeded my advancement and cascading of errors. I thought this feature was executed well sans the delay.
- System does not indicate (under "New Event") which responses are mandatory until AFTER you attempt to save your responses. It would be better to include a visual indicator (i.e., asterisk) next to questions requiring a forced response.
- Long lag time sometimes created the impression that the system was "frozen" especially on homepage.
- Some fields involved in creating a new event did not always give you examples of what should go in the field, but instead would just remain red until you changed the input.
- Within that pop up screen, did not allow you to move beyond pop up screen until error was corrected.
- When deleting, it asked if I was sure, but didn't ask if I wanted to save an entry before moving on and it did not auto save.
- When error messages would pop up they were displayed too quick; needed more explanation.
- Didn't know the autosave was an option.
- Once I pressed the backspace bar on the keyboard and it closed out the "create event" window. I had to type in the info again.

Overall, I found the system provided informative warnings/alerts when errors were identified.

- The system provided error correction feedback through red text and impeded my advancement and cascading of errors. I thought this feature was executed well sans the delay.
- Required data that wasn't provided or improperly formatted input data was not presented through an error message until the save and continue action was selected. Knowing inaccuracies along the way would be helpful.
- Messages indicated a field needed to be filled, but not the type of thing to fill it with. Did give specific error when I entered time wrong though.
- Error messages just said that the info for that box was required but I didn't know what info to put.
- It wasn't clear what info was required in the box. It seemed to accept anything.

Overall, I found the system provided appropriate feedback when interacting with the system (e.g., error message, type of input).

- I did however the latency was unsat.
- Button clicks were acknowledged, but then nothing until the screen refreshed.
- I did not have appropriate permission to view records but was unaware of this restricted permission and thought it was a glitch.

- Feedback was provided when a tab was complete enough to continue, but I didn't know which components were required fields until I selected Save and Continue.
- Didn't see status indicators.
- There were times when I would select something and see no indication of application or progress. I would select again or try another function. I couldn't tell if it didn't work or was locked up.
- On home page, long lag between "no records to display" notification and actual records appearing. It would be better for results box to just stay blank until results appear, otherwise it can be misleading at first glance.
- Completed tasks were usually marked by a check and next field would pop up after I completed the sections by pressing Save & Next.
- When going to a new section, the processing icon is displayed to let me know the status of the system.
- Spinning timer used, not really good indicator. Progress bar preferred so you can tell if it gets stuck/freezes.

User Interaction Control

- The controls and interface were very straightforward from a data entry standpoint however, I was disappointed from the account management standpoint as a non-administrator (we were able to log in in two different methods initially).
- Lag in input & reaction.
- (-) No ability to sort each column on home page.
- (+) Sorting & Filtering IS available in events tab (see consistency).
- (-) Only able to select time in "New Event" with Sliders.
- I had complete control of the info that I placed within the field and the system allows me to make edits to events needed in a quick manner.
- Calendar slide control does not fully support clicking on desired number.
- After correcting landing briefed time, box remained red.

Overall, I found the system made the user feel in charge by responding to user actions (e.g., acknowledge button clicks, indicate wait times).

- Button activation not apparent and wait times not obvious.
- There were items that caused an activation instead of simple selection. Undo would be helpful (selecting an event).
- No ability to sort each column on home page, but possible in other windows (like events tab). Make all columns in interface sortable.
- I felt like I had complete control of the system.

Overall, I found the system responded to user actions.

- I did however the latency was unsat.
- I tried to use the ? Icons several times to determine required format and/or content. Sometimes it was helpful and sometimes not at all. Additional info would have been helpful.

- No "help" that was accessible at all times. Some boxes had "?," but not all. Should be consistent and some helps should always be available with the ability to search topics.
- Did not know had to change the role to change a profile.

Overall, I found the system provided flexibility to change features of the interface (e.g., reconfigure windows, modify toolbars).

- It did not. I did not see any flexibility within the system nor do I think there should be. It serves a very specified purpose and besides the latency it appears to suit that purpose well.
- Inconsistent date formatting across interface (mm/dd/yyyy vs ddmmmyyyy).
- Unable to sort all columns.
- It was not flexible from my perspective. I felt I had to leave things how they were. This is not a big deal to me.

Overall, I found the system easy to navigate.

- Sometimes I didn't realize they were there and if I don't see them, they don't exist (e.g., tabs, options).
- "Reports" section was not accessible.

Memorability & Cognitive Facilitation

- I did not see any need to offload as all the data was hardcopy presented.
- Check marks show which fields have already been entered, if not necessarily completed.
- (-) Under "Link" set, a "check" and "X" dialog box set is used but isn't used anywhere else in the system up to this point.
- (-) Under the link summary, both the column for "hours attempted" and "hours successful" are labeled "HOURS" only.
- (-) Button to move to next set labeled "NEXT" instead of "Save changes & Next" like every other set.
- The design of the system makes it easy to navigate back and forth except for the reports tab. Could not access without additional approval. I feel familiar enough with the system to complete the additional tasking.
- Lots of acronyms.

Overall, I found the system provided easily understandable information in a format that minimized cognitive workload.

- The error checking was incredibly beneficial and allowed me to immediately address the problem.
- Did not find option for New User until searching several screens.
- Unable to know which information is located in a specific event sub-tab.
- Difficult to know what event info goes where, so I just clicked every sub-menu and re-read the script to see if any info fit. Rather tedious but I expect actual

users will know where the info belongs? If not, perhaps a mouse-over or preview of the info asked for would be helpful.
- Units of measurement for input boxes would have been helpful as a prompt for identifying correct input data.
- Grouping of information in a manner that implied sequence and relation would help.
- Altitude was addressed in more than one tab.
- Instructions were unclear and hard to follow certain parts would have been much easier with substeps listed out.
- I was confused whether ID number was same as mission name.
- Under “MISSN,” all acronyms are explained except for those under "Purpose" which is actually one of only 2 required fields.
- Under "New Link" > "Transmission Mode" full acronym descriptors are cutoff, making selection difficult unless you have an acronym guide available externally. Consider increasing dropdown width or decreasing font size.
- Sometimes information was showed in "?" to know what inputs were needed, but not always. Make help consistent and available.
- Steps were not exactly given. Input could be anywhere at anytime. This is good for flexibility, but makes it a little confusing for navigating. I wouldn't change it though. I think it would be a user preference thing.
- I was unfamiliar with the info being entered so I didn't know what info went into which box.

Overall, I found the system provided aids that helped with memory limitations.

- Check marks show which fields have already been entered, if not necessarily completed.
- Unable to know which information is located in a specific event sub-tab.
- Mouse-over question marks were helpful.
- Graphics in instructions would be helpful.
- Instructions were confusing and hard to understand.
- Directions were not written in steps at all and were confusing.
- The use of learning aids at all was not apparent.

User Efficiency

- I thought the design and system was very clean (sans latency) and it supported the event logging task well.
- Did not find option for New User until searching several screens.
- Unable to read announcement (after clicking Admin>Announcements) without opening Edit dialogue box.
- Unable to know which information is located in a specific event sub-tab.
- (-) Long lat time on home page for events/quals to populate.
- (-) Long lag between "no records to display" and actual records appearing.
- (-) "New Event" button available from home page but could stand out better.

- The design was easy to use and with proper instructions, locating fields to be populated was not difficult.
- When switching between tabs (user details and roles) should ask if you want to save so you don't waste time re-entering data if you forgot to save.
- MSID Originator ? Mouse-over info disappears too quickly.
- Slider bar for time entry for NEW CONTACT is not easy to use (moves thru times too quickly)

Overall, I found the design supported completion of tasks with minimal time and effort.

- Latency…(x3) this was by far the most significant and annoying downfall of the design of the system.
- Difficult to know what event info goes where, so I just clicked every sub-menu and re-read the script to see if any info fit. Rather tedious but I expect actual users will know where the info belongs? If not, perhaps a mouse-over or preview of the info asked for would be helpful.
- I kept getting stuck on steps that seemed like they should be easy.
- Instructions hard to follow and extract data.
- Hard to know what information was required.
- The ? Button wasn't able to reselect; dialog box closed too quickly.
- Seemed like input could have been chunked.
- No search bar within system, but after a few trial runs the location of all features should become more apparent anyway.
- No search options. Should add to main screen with help.
- Complex task required filling in multiple tabs, but it was easy to go back to old, just more time consuming.

Learnability

- I found the system intuitive from a user standpoint, however from an admin standpoint I struggled as permissions and menu structure for those management functions were not implemented smoothly.
- (-) Under EVENTS tab, commands column > pencil box & "X" box (I don’t know what they represent, perhaps have a descriptor appear when you hover over each item).
- The functions within the system allows for learning to occur.
- Buttons mostly self explanatory.

Overall, I found the system easy to learn how to use.

- I found the system very intuitive once I was able to maneuver through the latency issues.
- Difficult to know what event info goes where, so I just clicked every sub-menu and re-read the script to see if any info fit. Rather tedious but I expect actual users will know where the info belongs? If not, perhaps a mouse-over or preview of the info asked for would be helpful.
- Vertical tabs were unfamiliar.

- Could be emphasized by my lack of familiarity with the context and platform [system would be difficult for a new user to use].
- Some operational background would have increased understanding of data entry and data relationships.
- Step-by-step instructions like those given were very helpful. Without them, simply figuring out how to navigate and properly complete forms could be challenging. As mentioned elsewhere, consider some form of guided tutorial.
- Not much training is needed to understand and use the system. It is only important to know the terminology.
- Terms and words used were not commonly known.

Overall, I found the embedded training (e.g., tutorials, help) supported learning how to use the system.

- The mouse-over question marks were helpful but there were no images otherwise in them.
- The ? Buttons closed too quickly and didn't always provide clarifying information.
- Learning aids, if available, weren't present. However, having guilt in tutorials for each activity would be helpful, especially for those with little previous exposure to these types of systems.
- Did not notice a tutorial but the help features did assist in use of the system.
- No "help" or "how to use system."
- The "?" entries were long and needed to be assessed several times. They weren't always specific enough to tell you how to enter data either. For example, didn't always give measurement unit to use (ft, etc.)
- Learning aids were not clear on how to obtain them.

Consistency

- The system appeared to maintain consistency, again in the user functions but NOT in the admin functions.
- User term 'sort' not 'group'.
- (-) Inconsistent date formats (mm/dd/yyyy vs ddmmmyyyy)
- Yes system formatting is consistent.
- Administration tab seemed a good place for user creation.
- Why is the time entry a sliding bar? Weird and unusual! A simple typed interface is easiest and most consistent with way things are normally done.
- Inconsistent save/next buttons/GUI for LINK entry.
- For MET date/time I had to manually enter a "/" between the date and time.
- For CONTACTS, methods to input data and time inconsistent with other sets - 1st time I click on start time entry box, the drop-down list appeared. 2nd time I clicked on box to fix an error only the cursor appeared (no drop-down).
- To filter events by date when I click in the date field cursor appears, but calendar does not pop-up (inconsistent with other date entry fields).
- When entering new announcement, drop-down list for time entry is in civilian format (5:00PM), but after selection is displayed in military format (1700).

Overall, I found the system maintained consistency (e.g., layout, actions, formatting).

- Military time not used in narrative.
- Date/time & button titles/images vary throughout interface. Consider further standardization.
- Abbreviations not always explained due to space limitations.
- Some columns were sortable/searchable while others equally important weren't. Consider changing all columns to sorting if applicable and appropriate.
- No consistent use of time entry, saving buttons, where to find buttons, etc.
- "[CHECK]" and "X" are not well known ways to save and cancel (especially "[CHECK]"). Stick to words or use floppy save icon.
- Tasks required me to entered the time as 1405, and I was able to do so, but the system later showed the time entered was 205 (task #4 - Event Info).

Help

- I found the help dialogue bubbles where very easy to use and I did rely on them a few times.
- Did not see a help menu.
- Mouse-over question marks were helpful.
- Open too short and couldn't access again.
- (+) Question mark popups with instructions - good use of example responses.
- ? Button clears out too quickly after placing the mouse over it (makes it difficult to read entire advice.
- No help option - need one to explain options, etc. Has some "?" next to items, but no general "help" button.
- General - disappearing tool tips.

Overall, I found the help references easy to use to support task completion.

- The help pop ups provided a lot of utility and help.
- There was no help file or document to search that I saw.
- Closed too quickly; not always clarifying. When they told me required characteristics of data, it was very helpful (e.g., number of letters; units of measurement; definition).
- It was hard to figure out what information went where from instruction sheet.
- I had to re-read and read ahead to identify appropriate information to extract and use.
- Boxes closed too quickly. See above.
- Instructions were difficult to understand.
- No general help/FAQ section was observed, although this may have been an oversight.
- Help function were located next to most fields. Helped to understand what kind of info was needed for the field.
- No general help given. No search capabilities either. Highly suggest adding both.
- Did not see any instructions provided by the system besides error messages.

Miscellaneous

- Difficult to know what event info goes where, so I just clicked every sub-menu and re-read the script to see if any info fit. Rather tedious but I expect actual users will know where the info belongs? If not, perhaps a mouse-over or preview of the info asked for would be helpful.
- Needed units of measurement prompt input.
- Didn't know what path or what to do next.
- Why is narrative not in military time?
- Could not select event without opening it and no progress indicator.
- Have drop down options in filter boxes.
- Allow drag and drop columns.
- Allow hide/unhide.
- Under "Administration > Rules Engine" images aren't all loading.
- Very slow and lagging in "New Event" dialog/popup.
- Sorting isn't intuitive in drop-downs (1, 10, 11, 12, 2, 3, 4 … instead of 1, 2, 3, 4, 10, 11, 12).
- Nice use of map in "Contacts" set.
- Under "MISSN" all acronyms are explained except for those under "Purpose" which happens to be a required field.
- Under "New Link" > "Transmission Mode" full acronym descriptors are cut off.
- Under "NARR" (auto-generated narrative) CAC is placed twice in the script. Also, includes "Wing Commander Patrol" & "Reconnaissance Wing Eleven" who weren't included.
- Great to have the filter/sort feature to search by a specific event #.
- Announcement date/time columns both labeled as "Announcement".
- "[CHECK]" and "X" - no good - change to words… Is it "submit" and "cancel". Not completely intuitive, also inconsistent with "save changes," "delete" used else where.
- Scrolling option for time - VERY inefficient and inconsistent with other save entry.
- Also used "insert" instead of "save" like other places
- I added squadron on "user details" then changed to "roles" without saving. It didn't change or ask if I wanted to save.
- What is the difference between "save changes" and "save changes + next?"
- What is "export purple?"
- System uses way too many short hands (abbreviations and acronyms). There is space, spell out.
- What is different between "serial #" and "serial # of qualifier?"
- Turned my future time red, but didn't say why (did after I submitted/saved).
- It's not clear what is required and optional.
- Sometimes "save" or "[CHECK]" was on left, sometimes on right.
- I found no assistance from the system outside of the error monitoring.
- The system got hung up a lot when input on next step was chosen.

- I did not observe an auto-save feature, but I may have missed it. If it isn't present, it would be useful to implement.
- "Done quickly?"
- No auto-save or even a "are you sure you want to go on before saving" message. Should add this or "would you like to save before continuing?"
- Saving was not automatic.
- The latency was unsat.
- Needed navigation support.
- Needed status indication.
- Improper inputs were identified after save was executed, but would be helpful at time of input.
- Major lags and occurrences of hang ups.
- Only able to select times in "New Event" with sliders, but in another section times are typable. Time inputs should be standardized one way or another across the interface.
- No ability to sort each column on home page, but possible in other windows (like events tab). Make all columns in interface sortable.
- Same as status (running timer) as before. Make progress bar instead.
- The latency was the killer in this application. It exceeds any best HF practices and even with fast connection speeds is painfully slow.
- (-) Does not indicate under "New Event" details which responses are mandatory until AFTER you attempt to save your responses.
- I did experience an error earlier on during task 1 because the user name I was instructed to use was already taken. Also my Bravo Zulu was not updated to the home page announcement section.
- For MET, I entered 0 cloud cover, but it required me to enter a cloud type. I entered cloud type and pressed [CHECK] button and error message remained.

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Appendix C.
EQUATE Dimensions & Sub-dimensions

1.	**Graphic Design & Aesthetics**
i.	The system design enhanced the user experience.
ii.	The layout [was] visually appealing.
iii.	Characteristics of the graphic interface (e.g., graphics, text, colors) supported a positive user experience by increasing usability.
2.	**Error Handling & Feedback**
i.	The system design prevented errors and unintended actions.
ii.	The system provided informative warnings/alerts when errors were identified.
iii.	The system provided appropriate feedback when interacting with the system (e.g., error message, type of input).
3.	**User Interaction Control**
i.	The system made the user feel in charge by responding to user actions (e.g., acknowledge button clicks, indicate wait times).
ii.	The system responded to user actions.
iii.	The system provided flexibility to change features of the interface (e.g., reconfigure windows, modify toolbars).
iv.	The system [was] easy to navigate.
4.	**Memorability & Cognitive Facilitation**
i.	The system provided easily understandable information in a format that minimized cognitive workload.
ii.	The system provided aids that helped with memory limitations.
5.	**User Efficiency**
i.	The design supported completion of tasks with minimal time and effort.
6.	**Learnability**
i.	The system [was] easy to learn how to use.
ii.	The embedded training (e.g., tutorials, help) supported learning how to use the system.
7.	**Consistency**
i.	The system maintained consistency (e.g., layout, actions, formatting).
8.	**Help**
i.	The help references [were] easy to use to support task completion.

Note: Each sub-dimension started with "Overall, I found…"

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Appendix D.
Formatting of EQUATE Sub-Dimension with Sub items

	Strongly Disagree				Strongly Agree	N/A
1.) Overall, I found the system design enhanced the user experience.	1	2	3	4	5	0

	Never				Always
Examples of Strengths Observed					
The design provided a pleasant experience.	1	2	3	4	5
The system design had a professional appearance.	1	2	3	4	5
Examples of Weaknesses Observed					
There was too much clutter on the display.	1	2	3	4	5
The design negatively impacted the overall experience.	1	2	3	4	5

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9. List of Acronyms

1. EQUATE – Experience-based Questionnaire for Usability Assessment Targeting Elaborations
2. HCI-GUI – Human-Computer Interaction - Graphic User-Interface
3. PMATT-TA – Post Mission Assessment for Tactical Training – Trends Analysis
4. SME – Subject Matter Expert