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Usability Assessment of the fly.faa.gov Website

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Technical Report

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16. Abstract The Federal Aviation Administration (FAA) Air Traffic Control System Command Center provides information about arrival and departure delays through its website: www.fly.faa.gov. This document reports results from a usability assessment of this website. Researchers from the FAA Human Factors Research and Engineering Group, Human Factors Team – Atlantic City, ATO-P, conducted the assessment to determine how successfully users could complete common tasks, such as finding delay information, definitions of acronyms and aviation terms, and answers to frequently asked questions. We found that the participants were able to find most delay information easily, but had some difficulty finding non-delay information. Also, we identified some differences in performance between the expert users, moderate users, and novice users, with novice users typically having more difficulty finding information than moderate users and expert users. The assessment also examined user satisfaction. The participants reported a high level of user satisfaction, with no apparent differences based on their level of aviation-related expertise. However, the human factors observations and questionnaire data indicated several areas of the website that could be improved. In this report, we provide a list of usability issues rated and ranked according to severity, and we provide recommendations for addressing these issues, which should help guide future enhancement efforts.					
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Executive Summary

The Federal Aviation Administration (FAA) Air Traffic Control System Command Center (ATCSCC) provides information about airport conditions, such as arrival and departure delays, to the public and the aviation industry by way of the ATCSCC website, www.fly.faa.gov. This document reports results from a usability assessment of this website. Researchers from the FAA Human Factors Research and Engineering Group, Human Factors Team – Atlantic City, ATO-P, conducted the assessment and used quantitative metrics to determine how successfully users could complete common tasks, such as determining the amount of delay at an airport.

Thirty-two employees from the FAA William J. Hughes Technical Center participated in the assessment. First, the participants completed a Background Questionnaire, which the researchers used to evaluate aviation-related expertise. The participants then completed a series of common tasks using the website, while human factors personnel observed. A User Script guided the participants as they completed common tasks, such as finding (a) delay information for flights traveling from one airport to another, (b) definitions of different acronyms and aviation terms, and (c) answers to frequently asked questions. Based on the participants' answers to the items on the User Script, the researchers were able to determine how well the site supported the completion of common user tasks. We found that the participants were able to find most delay information easily, but they had some difficulty finding non-delay information. Also, we found a few differences in performance between the expert users, moderate users, and novice users, with novice users typically having more difficulty finding information than the moderate and expert users.

The assessment used subjective metrics to examine user satisfaction. The participants reported a high level of user satisfaction, with no apparent differences based on their level of aviation-related expertise. However, the human factors observations and participants' responses to the Post-Session Questionnaire data indicated that there were several areas of the site that could be redesigned to improve usability.

In this report, we provide a list of usability issues rated and ranked according to level of severity. The report also provides recommendations for addressing these issues, such as simplifying the organization and layout of pages, reducing jargon, improving the accuracy of search results, and increasing consistency between pages. We anticipate designers will use these ratings and corresponding recommendations to guide and prioritize future enhancement efforts.

1. INTRODUCTION

The Federal Aviation Administration (FAA) Air Traffic Control System Command Center (ATCSCC) provides information about airport conditions to the public and the aviation community via its website, <http://www.fly.faa.gov> (see Figure 1). This website allows users to view airport conditions by looking up regions, by looking up major airports, or by searching for a specific airport. The website also provides information on airport delay conditions, real-time and historical advisory information, real-time airport arrival demand information, current reroutes, and reroute restrictions. The site is a repository of information for use by airlines, pilots, passengers, government personnel, academics, individual aircraft operators, and other stakeholders in the aviation community. It provides access to information related to air traffic management tools, a glossary of aviation terms, a national routes database, pilot tools for making arrival and departure reservations, a collection of National Airspace System (NAS) documents, and many other air traffic tools. The focus of this assessment, however, was on elements of the site that the general public would access the most, such as the airport delay information and the glossary of aviation terms. From the user's point of view, the website needs to provide accurate information quickly, with minimal effort from the user, while minimizing potential mistakes. The site should be appealing, easy to learn, and provide a good "user experience."

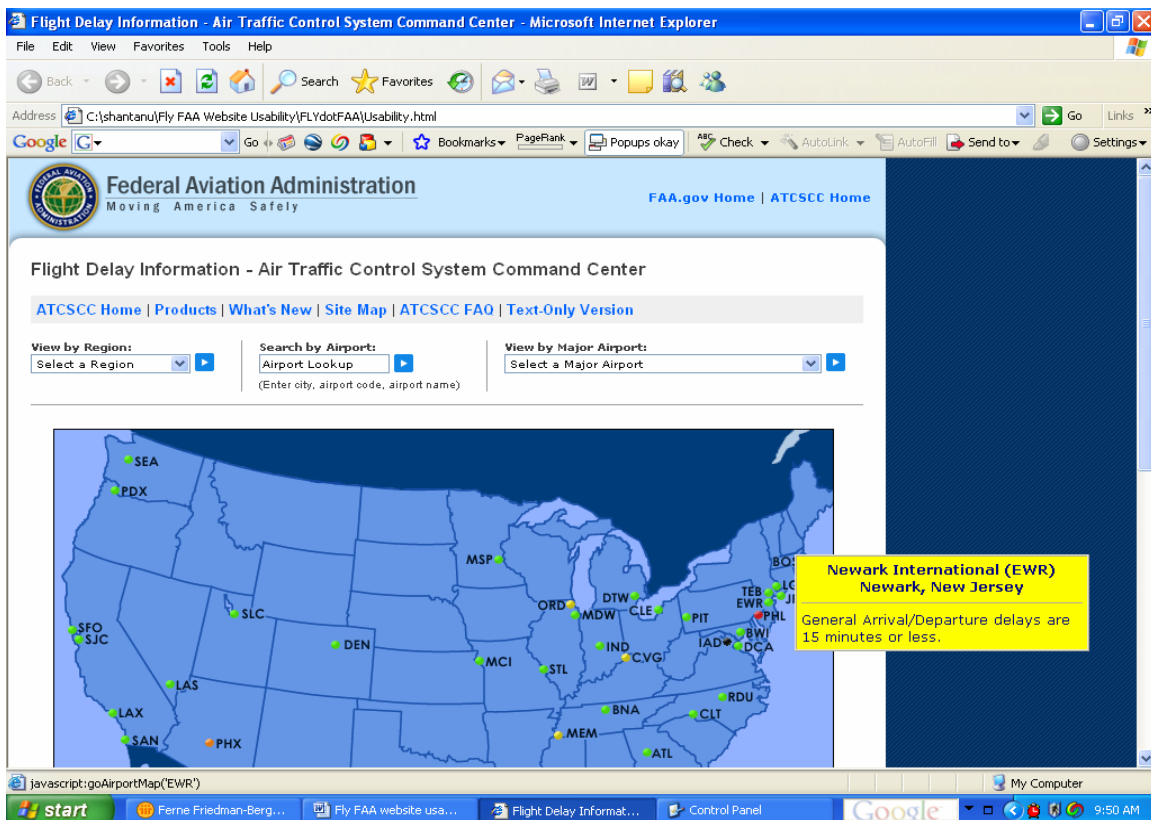


Figure 1. The ATCSCC fly.faa.gov home page.

The Enhanced Traffic Management Systems Sustainment Program Office requested that the FAA Human Factors Research and Engineering Group (HFREG), Human Factors Team – Atlantic City, ATO-P, determine how successfully the website meets its usability goals. In support of this effort, Engineering Research Psychologists (ERPs) conducted a formal usability assessment of the fly.faa.gov website.

2. METHOD

The assessment employed techniques commonly used in the usability evaluation field. We asked the participants to complete a set of representative tasks using the website, and we observed and recorded their actions and comments while they completed the tasks. We also administered questionnaires, asking the users to rate their experiences with the website regarding various usability topics. The data collected through these activities helped us identify a number of usability problems. We assessed the severity of each issue and, when appropriate, suggested design changes to address the issues.

2.1 Personnel

Three researchers from the FAA HFREG recruited the participants, administered the user tasks, recorded the participants' comments, and collected questionnaire data. The researchers recruited the participants by placing signs in the atrium at the FAA William J. Hughes Technical Center (WJHTC) main building on data collection days. We also publicized the assessment through email, advertisements in the WJHTC newspaper, and posters placed in public areas.

2.2 Participants

The researchers recruited 32 adult volunteers from the WJHTC to serve as participants. The participants were all employees of the federal government, and they all had enough familiarity with computers and the Web to complete all tasks. Because the participants were FAA employees, many had greater knowledge of the NAS and aviation than the general public. However, there are many FAA employees, such as administrative assistants and facility support workers, whose jobs do not require significant knowledge of aviation or air traffic control but who might use the website when traveling. We included participants of both categories.

2.3 Facilities and Equipment

The researchers tested most participants in the atrium at the WJHTC; other participants were tested individually in their offices. For evaluations conducted in the atrium, we set up tables where the participants completed paperwork and the assessment. We used three laptop computers, which allowed multiple participants to complete the assessment separately and simultaneously. We positioned the laptops to discourage the participants from watching or obtaining help from one another.

The laptops, equipped with Intel 2 GHz processors, 1 GB of RAM, Microsoft Windows XP Professional, and Microsoft Internet Explorer 6.0, contained fully interactive local versions of the website, fly.faa.gov. The website data, however, were static and were stored on the laptops. Using a live version of the site with dynamic data was not suitable for this assessment because airport status could have changed during the assessment. The locally stored website on the laptop contained all the screens and links needed to complete the following common user tasks:

1. View airport status information using any method (e.g., using the graphical map)
2. View airport status information by region
3. View airport status information by searching for the airport
4. View airport status information for a major airport
5. View airport status information using the site map
6. View glossary of air traffic management terms
7. Access the Frequently Asked Questions (FAQ) page

We used SnagIt screen capture software (Techsmith, 2006) to unobtrusively record digital video of the laptop screen as the participants completed their tasks. SnagIt recorded each action on the screen such as when a participant moved the cursor, opened a web page, or clicked on a menu. We did not record the voice or face of the participants.

2.4 Data Collection Procedures

Before participating in the assessment, volunteers received a Statement of Ethics and Informed Consent (Appendix A). It outlined the purpose of the assessment and the participants' rights regarding anonymity, confidentiality, and voluntary participation. The FAA Institutional Review Board approved the research plan prior to data collection. The researchers explained the purpose of the assessment to the participants and described the participants' rights and responsibilities. Once the volunteers gave their consent to participate, we assigned them a confidential participant code. All data were anonymous and no names or other identifying information were associated with the data.

After completing the Informed Consent form, the participants completed a Background Questionnaire (Appendix B). The questionnaire collected information about the participants' knowledge of computers, websites, and aviation terminology. The Background Questionnaire data helped the researchers to categorize the participants into three groups (novice users, moderate users, and expert users) based on their knowledge of the NAS.

Upon completion of the Background Questionnaire, the participants received a User Script (Appendix C). The script asked the participants to search the fly.faa.gov website for delay information, aviation terms, and concepts. The script contained 17 questions: 12 asked the users to search for delay information, 3 asked the users to find the meaning of aviation terms, and 2 asked the users to identify which authority to contact when trying to obtain specific information.

We started the SnagIt screen capture software as soon as the participants completed the Background Questionnaire and indicated that they were ready to begin the script. Each participant completed the script individually. We encouraged the participants to talk aloud and provide comments as they completed the script. One ERP observed each participant and recorded interesting or pertinent actions and comments made by the participants.

For the final part of the assessment, the participants completed a Post-Session Questionnaire (Appendix D) where they rated their experience on several usability issues and provided written comments.

Each session lasted 30 to 45 minutes. The participants were able to work at their own pace and were able to take breaks at any time. They were instructed that they could voluntarily end the session at any time by informing one of the ERPs. The ERPs were able to terminate a session at any time if they believed it to be in the best interest of the participant. However, all volunteers completed the assessment.

3. RESULTS

The researchers summarized and analyzed the data from the Background Questionnaire, the User Script, and the Post-Session Questionnaire. Because the focus of this assessment was the identification of website usability issues, we used descriptive and nonparametric statistics as the primary analysis techniques. Where appropriate, we report means, standard deviations (*SDs*), frequency counts, or percentages for the Background Questionnaire items, User Script data, and Post-Session Questionnaire ratings.

3.1 Background Questionnaires

The average age of the participants was 47.5 years, and the range of ages was 22 years to 72 years. Of the 32 participants in this assessment, 19 were male and 13 were female.

All of the participants had experience using computers and the Web. All of the participants reported using a computer nearly every day, and 30 of the 32 participants reported that they had worked with computers for more than 10 years. The other two participants reported computer use of 5 to 10 years. Two participants reported using the Web a few times each week, whereas 30 reported using the Web nearly every day. Eight participants said they had been using the Web for 5 to 10 years, and 24 participants said they had been using the Web for over 10 years. Because all users reported having extensive Web and computer experience, and because we found no discernable differences in reported Web and computer use among the participants, we were unable to stratify the participants' data based on these factors.

Most participants were not regular users of the fly.faa.gov website. Although 27 participants reported that they had some experience using travel-related websites, such as Travelocity or Expedia, only 12 participants reported having any past experience with the fly.faa.gov website; and of these, only 3 reported using the website more than a few times a year (see Figure 2).

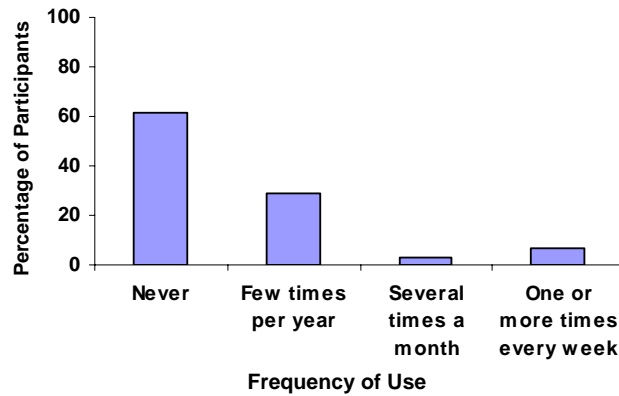


Figure 2. Reported frequency of use for the fly.faa.gov website.

We also measured the participants’ basic knowledge of the NAS. On the Background Questionnaire, the participants answered questions regarding their familiarity with aviation-related terms and acronyms. For example, the questionnaire asked the participants to list three-letter abbreviations for airports (e.g., Philadelphia International Airport → PHL) or gave the three-letter abbreviations and asked the participants to list the airports associated with these abbreviations (e.g., MIA → Miami). Using responses to these and other aviation-related questions, the researchers categorized the participants as novice users ($n = 8$); moderate users ($n = 15$); and expert users ($n = 9$). The novice users were slightly younger than both the expert users and those with moderate knowledge ($M_{\text{novice}} = 41.6$ years; $M_{\text{moderate}} = 49.9$ years; and $M_{\text{expert}} = 49.1$ years). However, 75% of expert users reported using the fly.faa.gov website a few times a year, whereas more than 70% of novice users and moderate users reported never using the website (see Figure 3).

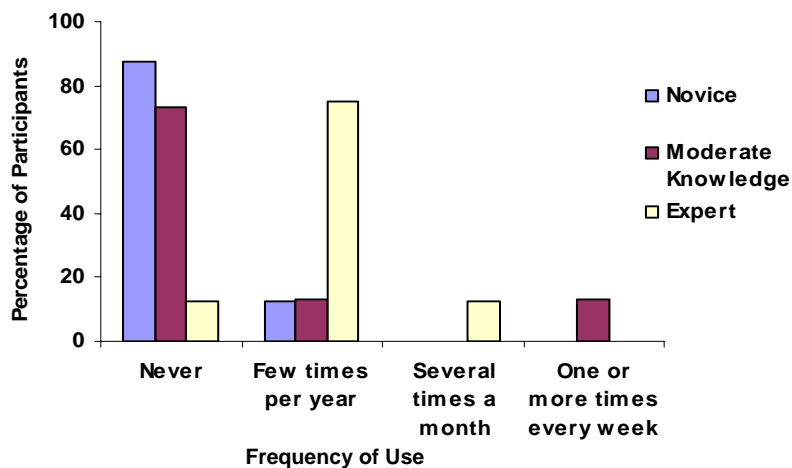


Figure 3. Frequency of use for fly.faa.gov by level of aviation expertise.

3.2 User Script Data

3.2.1 Overall Analysis

Tables 1 and 2 show the percentage correct for each question. On average, the participants answered 78.4% questions correctly (13.3 out of 17 questions). For the subset of 12 questions that asked the users to find specific delay information, the participants answered 79.4% questions correctly (9.5 out of 12 questions).

Table 1. Delay Questions and Percentage Correct

Questions	% Correct
Q1. You are flying from Los Angeles International Airport, CA to Salt Lake City International Airport. Find airport delay information, if any.	93.8
Q2. You are flying from Portland International Airport to Memphis International Airport. Find airport delay information, if any.	40.6
Q3. You are flying from Denver International Airport to Philadelphia International Airport. Using the Search by Airport feature, find airport delay information, if any.	90.6
Q4. You are flying from George Bush Intercontinental/Houston Airport to Chicago O'Hare International Airport. Using the Search by Airport feature, find airport delay information, if any.	78.1
Q5. You are flying from Newark International Airport to Burlington International Airport. Find airport delay information, if any.	71.9
Q6. You are flying from Las Vegas McCarran International Airport to New York John F. Kennedy International Airport. Using the View by Major Airport drop down menu, find airport delay information, if any.	90.6
Q7. You are flying from Phoenix Sky Harbor International Airport to Dallas Fort Worth International Airport. Find airport delay information, if any.	59.4
Q8. You are flying from Cincinnati/Northern Kentucky International Airport to Detroit Metropolitan Wayne County International Airport. Using the View by Region feature, find airport delay information, if any.	81.3
Q9. You are flying from Pittsburgh International Airport to Washington Dulles International Airport. Using the Site Map feature, find airport delay information, if any.	87.5
Q10. You are flying from New York LaGuardia International Airport to San Jose International Airport. Using the Search by Airport feature, find airport delay information, if any.	84.4
Q11. You are flying from Orlando International Airport to Lambert-St. Louis International Airport. Using the Search by Airport feature, find airport delay information, if any.	84.4
Q12. You are flying from George Bush Intercontinental/Houston Airport to Tulsa International Airport. Find airport delay information, if any.	90.6

Table 2. Aviation Terms and Contact Information Questions: Percentage Correct

Questions	% Correct
Using information available on the site, provide the definitions of the following aviation-related terms or abbreviations:	
Q1. CIGS	90.6
Q2. MULTI-TAXI	87.5
Q3. VOL	90.6
Using information available on the site, who should a visitor contact to obtain information about the following:	
Q1. Status of an individual flight	78.1
Q2. Why an individual airport was closed	34.4

The participants could use five methods to find delay information for airports, so we divided the 12 delay questions into five corresponding categories. Of the 12 delay questions, 5 were general search questions, where the participants could use any method to find the requested information; 4 asked the participants to find information using the **Search by Airport** method; 1 asked the participants to find information using the **View by Major Airport** method; 1 asked the participants to search using the **View by Region** method; and 1 asked the participants to find information using the **Site Map** (see Figure 1).

For the five delay questions that allowed the participants to find information using their preferred search method (Q1, Q2, Q5, Q7, and Q12), the participants averaged 3.6 correct or 71.2%. For the four delay questions that specifically asked the users to use the **Search by Airport** method (Q3, Q4, Q10, and Q11), the participants averaged 3.4 correct or 84.5%. For the **View by Major Airport** question, 90.6% of participants found the correct answer; for the **View by Region** question, 81.3% found the correct answer; and for the **Site Map** question, 87.5% found the correct answer.

Another set of questions asked the participants to use information available on the site to provide the definition of three aviation-related terms and abbreviations. Although 84.4 % of participants answered all three of the questions correctly, 6.3% of participants answered one question incorrectly, 3.1% answered two questions incorrectly, and 6.3% were not able to answer any of the questions. All three questions appeared to be equally difficult.

The final set of two questions on the User Script asked the participants to use the site to identify the staff person to be contacted to obtain information about the status of an individual flight or why an airport was closed. For these two questions, only 28.1% of the participants answered both questions correctly, 56.2% of the participants answered one question incorrectly, and 15.6% answered both questions incorrectly.

3.2.2 Analysis by Expertise

We also analyzed the data by level of expertise to determine whether aviation-related knowledge had an impact on user performance. We performed ordinal (linear) chi-square tests for each question to determine whether the percentage correct increased or decreased across the different user categories. A standard chi-square allows us to compute whether there is a difference in the percentage correct for the different categories of users. However, whereas the standard chi-square does not take into account the ordering of the user categories, an ordinal chi-square does. Additionally, the ordinal chi-square is less sensitive to small cell sizes (Howell, 2007). Because we had reason to believe that expert users were more likely to have a higher percentage correct than moderate users, who in turn were more likely to have a higher percentage correct than novice users, we believed that this was the most appropriate statistical test to use. In line with our expectations, the data showed that for some of the questions, the expert users were better able to find information on the website than the moderate users, who in turn were better than the novice users (see Tables 3 and 4).

Table 3. Delay Questions: Percentage Correct by Level of Aviation-Related Expertise

Questions	% Correct		
	Novice Users	Moderate Users	Expert Users
Q1. Los Angeles International to Salt Lake City International.	75.0**	100.0**	100.0**
Q2. Portland International to Memphis International.	25.0	53.3	33.3
Q3. Denver International to Philadelphia International. Search by Airport.	87.5	93.3	88.9
Q4. George Bush Intercontinental/Houston to Chicago O'Hare International. Search by Airport.	62.5**	73.3**	100.0**
Q5. Newark International to Burlington International.	50.0	73.3	88.9
Q6. Las Vegas McCarran International to New York John F. Kennedy International. View by Major Airport.	75.0	93.3	100.0
Q7. Phoenix Sky Harbor International to Dallas Fort Worth International.	12.5*	73.3*	77.8*
Q8. Cincinnati/Northern Kentucky International to Detroit Metropolitan Wayne County International. View by Region.	75.0	80.0	88.9
Q9. Pittsburgh International to Washington Dulles International. Site Map.	75.0	86.7	100.0
Q10. New York LaGuardia International to San Jose International. Search by Airport.	75.0	80.0	100.0
Q11. Orlando International to Lambert-St. Louis International. Search by Airport.	87.5	86.7	77.8
Q12. George Bush Intercontinental/Houston to Tulsa International.	87.5	86.7	100.0

* $p < .10$, two-tailed. ** $p < .05$, two-tailed.

Although not all of the questions were significant, 7 of the 12 delay questions showed the expected pattern of results (i.e., Q4 through Q10). Therefore, we also tested the binomial probability that 7 of the 12 delay questions would show the expected ordering (expert > moderate > novice). We found that it was unlikely that this pattern would occur by chance, $p < .001$ (see Table 3). We did not find the same pattern for the aviation term questions (see Table 4).

Table 4. Aviation Terms and Contact Information Questions: Percentage Correct by Level of Aviation-Related Expertise

Questions	% Correct		
	Novice Users	Moderate Users	Expert Users
Using information available on the site, provide the definitions of the following aviation-related terms or abbreviations:			
Q1. CIGS	87.5	93.3	88.9
Q2. MULTI-TAXI	87.5	86.7	88.9
Q3. VOL	75.0	93.3	100.0
Using information available on the site, who should a visitor contact to obtain information about the following:			
Q1. Status of an individual flight	100.0	78.6	87.5
Q2. Why an individual airport was closed	50.0	26.7	44.4

Furthermore, we grouped the questions into categories to analyze the performance of the participants for different question types. We analyzed performance on all 17 questions and found an effect of expertise on overall task performance, $F(2, 29) = 3.54, p = .042$ (see Figure 4). Expert participants were able to answer more questions correctly (85.6%) than both moderate users (79.6%) and novice users (69.1%).

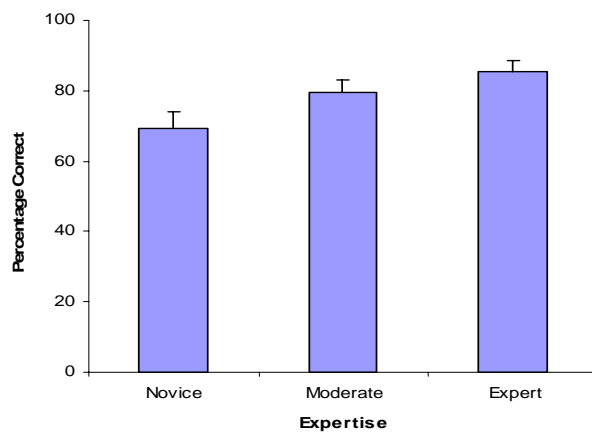


Figure 4. Percentage correct for all 17 questions by level of aviation expertise (error bars are equal to 1 Standard Error).

For the 12 questions that asked the users to find delay information, expert users, moderate users, and novice users answered 88%, 81.7%, and 65.6% of the questions correctly, $F(2, 29) = 5.04$, $p = .01$ (see Figure 5). Expert users were better able to find delay information than both moderate users and novice users.

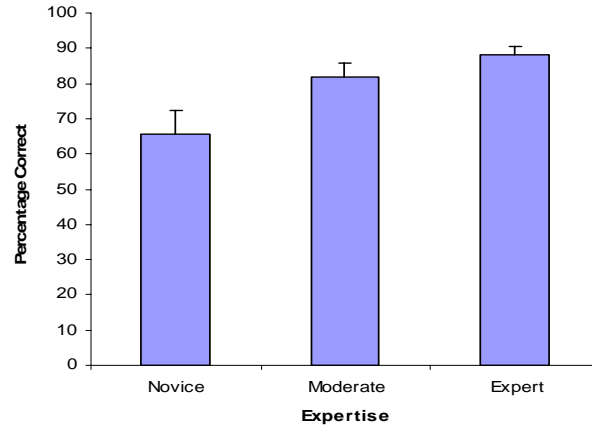


Figure 5. Percentage correct for the 12 delay questions by level of aviation-related expertise.

As in the overall analysis, we further divided the 12 delay questions into categories based on the requested search method. For the five delay questions that allowed the participants to find information using their preferred search method, we found an effect of expertise on user performance, $F(2, 29) = 9.93$, $p = .001$ (see Figure 6). Expert users and moderate users answered an average 80% and 77.3% of the questions correctly, but novice users only answered an average of 50% of these questions correctly, indicating that both expert users and moderate users performed better than novice users when searching for delay information using their preferred search method.

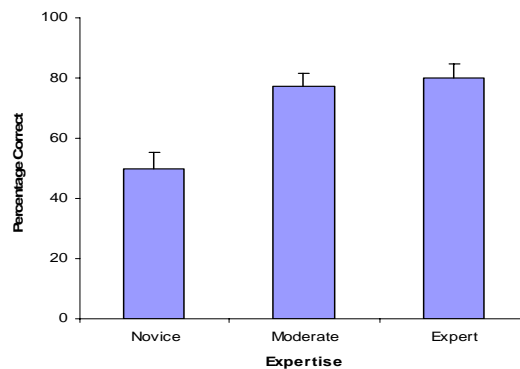


Figure 6. Percentage correct for the five general search questions by level of aviation-related expertise.

As for the four delay questions that asked the users to specifically use the **Search by Airport** method, expert users, moderate users, and novice users answered 91.7%, 83.3%, and 78.1% of these questions correctly. Although these results were not significant, they demonstrated the same trend as the other delay search sets.

For the three questions where the participants used website information to find the definition of three aviation-related terms and abbreviations, there were no significant differences between expert users (92.6%), moderate users (91.1%), and novice users (83.3%). For the two User Script questions that asked the participants to find the person or agency to contact to obtain certain information, novice users (68.8%), moderate users (50%), and expert users (61.1%) all appeared to have some difficulty. We found no significant differences based on the level of aviation-related expertise.

3.3 Post-Session Questionnaire

The Post-Session Questionnaire asked the participants to rate their subjective experience with the website on seven dimensions using 6-point scales (see Appendix D). Except for Question 5, higher ratings indicated positive responses and lower ratings indicated negative responses. For Question 5, which asked the users how detailed the information on the site was, a rating of 1 indicated too little detail and a 6 indicated too much detail. Table 5 shows the mean ratings and *SDs* of the Post-Session responses. For these summaries, we omitted responses from the participants who chose more than one number on the rating scale. This included Question 1, where 2 participants gave more than one answer and Question 5, where 3 participants gave more than one answer.

Table 5. Post-Session Questionnaire Means and Standard Deviations

Post-Session Questions	Mean	<i>SD</i>
Q1. How easy was it to find the information you were looking for?	4.4	0.8
Q2. How well did you understand the information once you found it?	4.8	1.0
Q3. How easy was it to navigate between the different pages or sections of the site? For example, did you ever get lost or did you always know where you were?	4.9	1.2
Q4. How consistent was the design and layout of the site? For example, did different pages of the site look and behave about the same way?	4.9	1.0
Q5. How detailed was the information on the site? For example, were there times when the site could have provided more information? Or were there times when the site provided so much information that it was “information overload?”	3.9	0.8
Q6. How well could you read the text information on the site? For example, were the fonts too small or too big? Were the color combinations readable or unreadable?	4.8	1.1
Q7. How satisfied are you with the site overall?	4.7	0.8

The overall ratings indicated that the participants thought it was fairly easy to find information on the site and that they understood information once they found it. The participants also found it fairly easy to navigate between pages on the site and found the design of the site to be consistent. They indicated that there was somewhat too much detail, but that information on the site was fairly readable. Finally, they indicated that, overall, they were mostly satisfied with the site.

When evaluating the data by level of aviation expertise, we found no statistically significant differences ($p > .05$) for each question between the users with different levels of expertise. There were, however, a number of interesting trends in the data. The trend for the ratings on information comprehensibility indicated that expert users found the information to be more comprehensible than moderate users. In turn, moderate users found the information to be more comprehensible than novice users. When evaluating design and layout consistency, the trend was that expert users were the least satisfied with the design consistency, with novice users being the most satisfied, and moderate users falling in the middle. For the ratings on the level of detail, expert users gave the highest ratings (i.e., slightly too much detail), with novice users giving the lowest ratings (i.e., slightly too little detail) and moderate users falling in the middle (i.e., an appropriate level of detail).

3.4 Usability Issues

Using the comments and questionnaire ratings made by the participants and observations made by the ERPs, we compiled a list of usability issues for the fly.faa.gov website (see Table 6). The researchers then used the following rating scale to individually rate the severity of each usability issue on the list (adapted from Nielsen, 2003).

- 0 = I don't agree that this is a usability problem at all
- 1 = Minor/cosmetic problem only: not necessary to fix, should be given lowest priority
- 2 = Usability problem: small benefit from fixing, should be given low priority
- 3 = Moderate usability problem: moderate benefit from fixing, should be given medium priority
- 4 = Major usability problem: important to fix, should be given high priority
- 5 = Usability catastrophe: extremely important to fix, should be given highest priority

When rating the severity of each problem, we considered the following factors:

- **Frequency:** Is the problem very common or very rare?
- **Impact:** How easy is it for the users to overcome the problem when navigating through the website?
- **Persistence:** Can the users overcome the problem once they know about it, or will the problem bother users repeatedly?

Table 6. Usability Issues and Severity Ratings

#	Issues	Mean Severity Rating	SD
Usability Catastrophes			
None	None		
Major Usability Problems			
1	Many users had trouble understanding the difference between delay types, such as departure, arrival, and destination-specific delays.	4.3	0.5
2	The users noted that there was too much information and clutter on the detailed Airport Status Information pages.	4.3	0.5
3	The website uses too many air traffic acronyms and jargon.	4.0	0.0
4	The View by Region map was confusing to the users who were not familiar with FAA regions. In addition, people not well versed in geography were not able to independently determine which region contained a particular state.	4.0	0.0
Moderate Usability Problems			
5	The users were not always aware of the different methods available for accessing delay information on the website.	3.3	0.5
6	Many users did not know the correct three letter identifiers for airports.	3.3	0.6
7	City name searches in the Search by Airport text box led to an intermediate results page that listed multiple airports in the search results. Sometimes the information for one airport was presented twice. In other cases, the order of the search results did not make sense and better matches were located lower in the results list. This was confusing for the participants.	3.3	0.6
8	User spellings and the parsing of the search field by the search engine affect the Search by Airport method. In some instances, the correct spelling does not work, but a misspelling does. Other times, common misspellings do not work.	3.3	0.6
9	Once the users access a region, they have difficulty identifying states solely by their shape.	3.3	1.1
10	Using the Search by Airport method results in information being displayed in a new pop-up page, but if the View by Major Airport method is used, the site displays the same information on the current page.	3.0	0.0
11	The users did not realize that the blue and white arrow buttons next to View by Region , Search by Airport , and View by Major Airport indicated Go , Search , or Submit .	3.0	1.0
12	The participants selected items from drop down lists next to View by Region and View by Major Airport and expected the requested page to load upon selection without the user having to click on arrow buttons.	3.0	1.0
13	Under Site Map , the gray text does not look like a link, and it changes to blue once clicked. This does not follow standard web conventions.	3.0	1.0

(table continues)

Table 6 (continued). Usability Issues and Severity Ratings

#	Issues	Mean Severity Rating	SD
Minor Usability Problems			
14	Use of the ATCSCC acronym was confusing to the participants (e.g., the ATCSCC FAQ link).	2.6	0.6
15	The website did not provide the users with information on where they were in relation to the entire site.	2.6	0.6
16	The participants did not realize that they could search for an airport using a city name.	2.6	0.6
17	The map refreshes at a regular interval to update the website with new information. If the user is in the middle of typing or selecting from a drop-down list during a refresh, selected or typed information is lost.	2.6	1.1
18	Although the tooltips on the map are useful for displaying delay information, many users were unaware that the dots on the map were also clickable.	2.3	0.6
19	Using the most common display resolution setting, the legend is not visible and several participants did not realize that they could scroll in the browser to access the legend.	2.3	0.6
20	On the Site Map page, the set of links listed under the heading Products does not match the set of links on the Products page.	2.3	1.1
21	Under FAQ , the Site Map lists links for Acronyms and Airline Websites . This list is inconsistent with the information displayed on the FAQ page.	2.3	1.1
22	The participants assumed that the color coding on the map legend, Green-Yellow-Orange-Red-Black, related to the severity of the delay. This was not true for orange, which simply indicates departure delays.	2.0	0.0
23	Several participants attempted to click and drag the map as they would with Yahoo or Google maps, which is not an enabled function on this site.	2.0	0.0
24	The participants inferred from the home page title, Flight Delay Information , which is also repeated on the title bar, that the website provided flight delay, not airport delay information.	2.0	1.0
25	The FAQ and Site Map links at the bottom of most pages take the users to the faa.gov website, but the ATCSCC FAQ and Site Map links at the top of most pages keep the user within the fly.faa.gov website.	2.0	1.0
26	The Site Map link lists web page links under several categories (e.g., Products, FAQ), but the link sequence does not match the sequence on other pages.	2.0	1.7
Minor Cosmetic Problems			
27	The participants complained about font sizes used in the browser and drop-down menus.	1.6	0.6
28	The questions on the ATCSCC FAQ page are colloquial in tone and writing style and may not reflect the actual, most frequently asked questions received from the users.	1.6	0.6
29	The blue and gray fonts made it more difficult for some participants to read.	1.3	1.5

After the researchers rated each issue on frequency, impact, and persistence, we averaged the ratings to obtain a consolidated severity rating for each issue. We also computed intraclass correlations (ICCs) to obtain a measure of interrater reliability (Cook, 2000). Although researchers have sometimes found poor interrater reliability for severity ratings (Hertzum, 2006; Nielsen, 1992), we found fairly good agreement on ratings of impact, $ICC(2,3) = .74$; persistence, $ICC(2,3) = .63$; and overall severity, $ICC(2,3) = .69$. The only ratings where raters seemed to have some disagreement were frequency ratings, $ICC(2,3) = .34$. Because problem frequency may be more related to intended use than problem impact and persistence, it is possible that raters may have considered different intended uses when making their ratings. The severity ratings provide an estimate of additional usability efforts needed and should help the program office and website developers establish priorities for future enhancements. Table 6 shows the severity ratings and orders the usability issues from those having the highest severity rating to those having the lowest severity rating. None of the issues were rated as a usability catastrophe.

4. DISCUSSION AND OUTCOMES

The primary output of this assessment is the consolidated list of usability issues and the accompanying severity ratings provided in this report (see Table 6). In the following sections, we will discuss the issues in detail, show how the data support the issue ratings, and present suggestions and design recommendations that should help resolve these issues. Because many of the issues were related, we chose to organize the discussion section conceptually and not by severity rating. To allow someone to cross-reference an issue in the discussion section with its severity rating in Table 6, we have included the relevant issue numbers in the title for each section. Because fly.faa.gov is a public website, mitigation techniques such as training are not generally available. Most usability issues we identified in the report will need to be resolved by changing the user interface or by providing additional help on the site. Therefore, user interface design standards and best practices drive these suggestions. The program office has final authority regarding whether to change, and how to change, the site based on our recommendations. In some cases, we have developed simple prototypes to demonstrate potential design concepts that the program office could use to resolve some of these issues.

4.1 Delay Type Confusion

4.1.1 Departure, Arrival, Ground Stop, and Other Delay Types (Issue 1)

The primary purpose of fly.faa.gov is to provide travelers with airport delay information. However, the different delay types confused the participants who took part in our assessment. The difference between delay types (e.g., departure delays, arrival delays, and destination-specific delays) was not readily apparent to many participants. For example, Question 2 on the User Script asked the participants to look for delay information for travelers flying from Portland International Airport to Memphis International Airport (MEM). Although there were no delays for arrivals at MEM, there was a general departure delay at MEM due to en route volume that was causing departure traffic to experience gate hold and taxi delays between 16 minutes and 30 minutes in length. Only 40.6% of the participants in the assessment gave the correct answer to this question, and those who gave an incorrect answer pointed to the en route volume as the cause of the delay, indicating that they did not understand which delays were relevant for them.

We believe it is important that the site provides users with the information they want, but without requiring them to understand complex air traffic concepts. Comments made by some participants specifically indicated that they did not understand ground delay programs or how a ground delay program might affect their flight. They assumed if there were no departure delays at their departure airport, there would be no delays on their departure flight. We recommend that the website avoid presenting these difficult concepts to the public. Instead, the website should present information about delays in a less technical manner. For instance, instead of referencing ground delay programs or gate holds as the cause of a delay, the website could indicate that congestion caused the delay. Instead of saying that LOW CIGS caused a delay, the website could indicate that poor visibility caused the delay. For users seeking more detailed information, the website could provide additional information, on additional pages, about a ground delay program or the specific cause of a low visibility event.

Because the participants were not always able to identify which delays were relevant for them, we recommend that the site provide some capability that allows users to easily access pertinent delay information. For example, the site might allow users to input their departure and arrival airports or click on city pairs, which would then generate a single report on the relevant delays for air traffic traveling between that particular city pair. The site could also use this function to present information about delays at other airports that may indirectly impact flight delays at arrival and departure airports.

4.1.2 Flight Delays versus Airport Delays (Issue 24)

Some participants inferred from the home page title, **Flight Delay Information**, which also repeats on the title bar of the web page, that the website provides flight delay, not airport delay information. Although the site does try to make this distinction clear, users with standard display settings must scroll to find this information, and the site does not highlight it very well.

Because users are unclear about the concept of airport delays and are unsure of how airport delays affect their individual flight, we recommend that the site change its home page title to make it more obvious that the purpose of the website is to provide airport delay information, not individual flight delay information.

4.2 Airport Status Information Pages

4.2.1 Clutter (Issue 2)

Several users pointed out that there was too much information on the typical **Airport Status Information** page. The information was very dense, used too much text, and was not well organized. In many instances, the participants had difficulty finding and understanding which delays were relevant for them. Displaying too much information can be problematic when users are in a hurry to find information (see Figure 7). Users may scan too quickly and get lost in the text. They may read the wrong line, overlook information, or see a big block of text and give up.

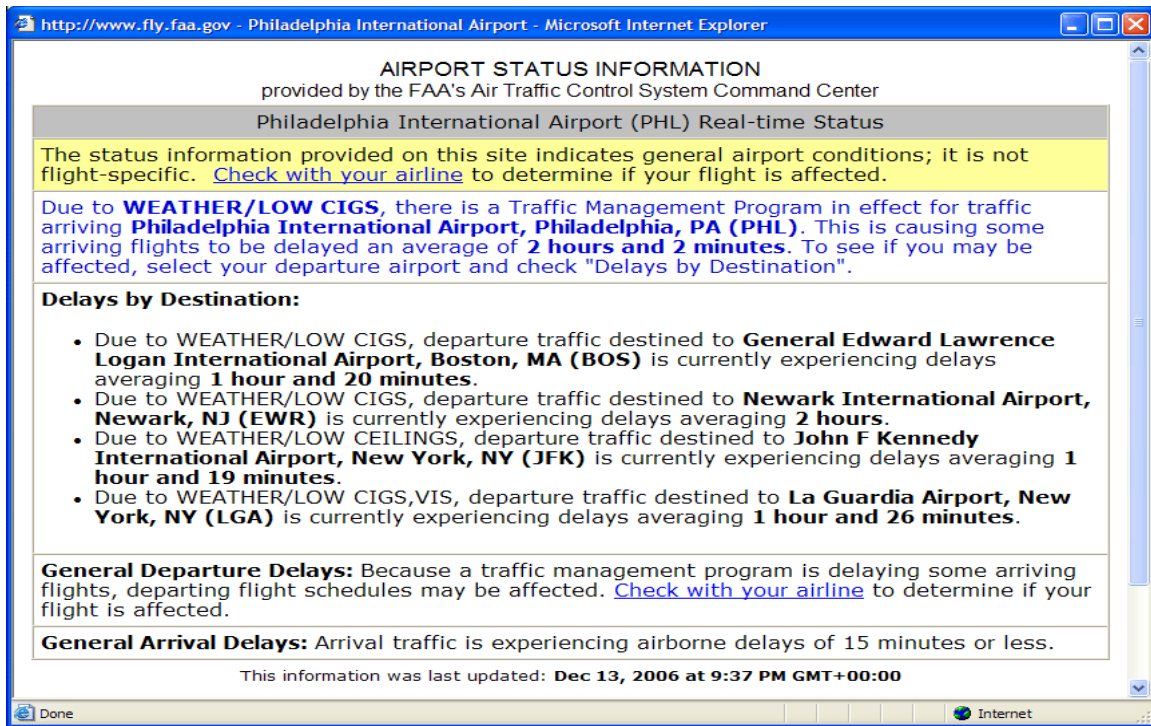


Figure 7. A cluttered **Airport Status Information** page.

4.2.2 Redundant Information (Issue 7)

The clutter problem is compounded when different information for a single airport appears in multiple places on the same page. For example, Figure 8 shows that the **Airport Status Information** page contains two delays each for Newark International Airport (EWR), La Guardia Airport (LGA), and Philadelphia International Airport (PHL) under the heading **Delays by Destination** (the red highlights are not present on the actual site but are added here to highlight the usability issue). To determine which delays were relevant for them, travelers flying from Waterloo Muni Airport (ALO) to LGA would have to understand three things. First, they must understand that even though there are no general departure delays for ALO, there are destination-specific delays for travelers going from ALO to LGA. Second, they must realize that the **Delays by Destination** list contains two pieces of relevant delay information for travelers going to LGA, although the site does not list the two pieces of information consecutively. Third, they must determine whether the weather/wind delay (of 3 hours and 10 minutes) and the en route weather delay (causing traffic to be held until 4:15) are consecutive or contiguous delays.

AIRPORT STATUS INFORMATION
provided by the FAA's Air Traffic Control System Command Center

Waterloo Muni Airport (ALO) Real-time Status

The status information provided on this site indicates general airport conditions; it is not flight-specific. [Check with your airline](#) to determine if your flight is affected.

Delays by Destination:

- Due to WEATHER/WIND, departure traffic destined to **General Edward Lawrence Logan International Airport, Boston, MA (BOS)** is currently experiencing delays averaging **1 hour and 46 minutes**.
- Due to WEATHER/WIND, departure traffic destined to **Newark International Airport, Newark, NJ (EWR)** is currently experiencing delays averaging **2 hours and 17 minutes**.
- Due to WEATHER/LOW CIGS, departure traffic destined to **John F Kennedy International Airport, New York, NY (JFK)** is currently experiencing delays averaging **4 hours and 3 minutes**.
- Due to WEATHER/WIND, departure traffic destined to **La Guardia Airport, New York, NY (LGA)** is currently experiencing delays averaging **3 hours and 10 minutes**.
- Due to WEATHER/SNOW, departure traffic destined to **Chicago Midway Airport, Chicago, IL (MDW)** is currently experiencing delays averaging **1 hour and 9 minutes**.
- Due to WEATHER/SNOW, departure traffic destined to **Chicago O'Hare International Airport, Chicago, IL (ORD)** is currently experiencing delays averaging **1 hour and 10 minutes**.
- Due to WEATHER/WIND, departure traffic destined to **Philadelphia International Airport, Philadelphia, PA (PHL)** is currently experiencing delays averaging **3 hours and 38 minutes**.
- Due to WEATHER/WIND, departure traffic destined to **Teterboro Airport, Teterboro, NJ (TEB)** is currently experiencing delays averaging **1 hour and 3 minutes**.
- Due to WEATHER/TSTMS, departure traffic destined to **Newark International Airport, Newark, NJ (EWR)** will not be allowed to depart until at or after 4:15 pm CST.
- Due to WEATHER/TSTMS, departure traffic destined to **La Guardia Airport, New York, NY (LGA)** will not be allowed to depart until at or after 4:15 pm CST.
- Due to WEATHER/ENROUTE WX, departure traffic destined to **Philadelphia International Airport, Philadelphia, PA (PHL)** will not be allowed to depart until at or after 4:15 pm CST.

General Departure Delays: Traffic is experiencing gate hold and taxi delays lasting 15 minutes or less.

General Arrival Delays: Arrival traffic is experiencing airborne delays of 15 minutes or less.

This information was last updated: **Dec 01, 2006 at 9:55 PM GMT+00:00**

[Glossary of Air Traffic Management Terms](#) - A table containing definitions and/or descriptions of many common Air Traffic Management acronyms.

[CLOSE WINDOW](#)

Figure 8. A current **Airport Status Information** page.

We recommend simplifying and reorganizing the page to make it easier to find and understand the information. For example, the page could use a tabular layout arranged in columns by arrivals and departures. Much of the text information is not useful, creates clutter, and can be removed.

The distinction between general departure delays and destination-specific delays is not clear to users and should be de-emphasized or eliminated. Finally, all delay information of a particular type for one airport should be consolidated. Presenting two sets of delay information for one airport, especially if the data are inconsistent, is very confusing. The website should avoid using too much technical detail regarding the causes of delays. It might instead use icons or graphics (e.g., clouds with snow, clouds with rain) to depict weather or other causes of delays. The website could still offer links to additional information for advanced users. Figure 9 depicts a page using a tabular format that is substantially less cluttered than the pages depicted in Figures 7 and 8. Figure 10 makes use of icons to depict airport delays.

AIRPORT STATUS INFORMATION provided by the FAA's Air Traffic Control System Command Center		
Waterloo Muni Airport (ALO) Real-time Status		
The status information provided on this site indicates general airport conditions; it is not flight-specific. Check with your airline to determine if your flight is affected.		
Departure Delays		Arrival Delays
Are you flying to:		Arrival traffic is experiencing airborne delays of 15 minutes or less.
Airport	Delay	
Logan International Airport, Boston, MA (BOS)	1 hour 46 minutes	
Newark International Airport, Newark, NJ (EWR)	2 hours 17 minutes	
John F. Kennedy International Airport, New York, NY (JFK)	4 hours 3 minutes	
LaGuardia Airport, New York, NY (LGA)	3 hours 10 minutes	
Chicago Midway Airport, Chicago, IL (MDW)	1 hour 9 minutes	
Chicago O'Hare International Airport, Chicago, IL (ORD)	1 hour 10 minutes	
All other airports	Delays of 15 minutes or less	
This information was last updated: Dec 14, 2006 at 3:26 PM GMT+00:00		
Glossary of Air Traffic Management Terms - A table containing definitions and/or descriptions of many common Air Traffic Management acronyms.		
CLOSE WINDOW		

Figure 9. A possible redesign of the **Airport Status Information** page.







AIRPORT STATUS INFORMATION provided by the FAA's Air Traffic Control System Command Center			
Waterloo Muni Airport (ALO) Real-time Status			
The status information provided on this site indicates general airport conditions; it is not flight-specific. Check with your airline to determine if your flight is affected.			
Departure Delays		Arrival Delays	
Are you flying to:		Arrival traffic is experiencing airborne delays of 15 minutes or less.	
Airport	Delay		
Logan International Airport, Boston, MA (BOS)	1 hour 46 minutes		 Snow
Newark International Airport, Newark, NJ (EWR)	2 hours 17 minutes		 Thunderstorms
John F. Kennedy International Airport, New York, NY (JFK)	4 hours 3 minutes		 Congestion
LaGuardia Airport, New York, NY (LGA)	3 hours 10 minutes		 Emergency
Chicago Midway Airport, Chicago, IL (MDW)	1 hour 9 minutes		 Equipment Outage
Chicago O'Hare International Airport, Chicago, IL (ORD)	1 hour 10 minutes		 Construction
All other airports	Delays of 15 minutes or less		
This information was last updated: Dec 14, 2006 at 3:26 PM GMT+00:00			
Glossary of Air Traffic Management Terms - A table containing definitions and/or descriptions of many common Air Traffic Management acronyms.			
CLOSE WINDOW			

Figure 10. A possible redesign of the **Airport Status Information** page using icons to depict delay causes.

4.3 Acronyms and Jargon (Issues 3, 14, and 25)

When the site provides specific information about the cause of delays, it uses too many aviation-specific acronyms and jargon. It was clear from comments, that several participants had problems understanding abbreviations such as *CIGS*, *VIS*, or *VOL*. Aviation specific acronyms, abbreviations, and jargon are difficult for the general public to understand. Moreover, the glossary is difficult to find. The average user of the website may not even be aware that it exists.

Even when we asked the participants to find the definition of three aviation-related terms and gave them an unlimited time to do so, 16 % were unable to find the definition for at least one of the three terms. Although the site provides a link to the **Glossary of Air Traffic Management Terms** page on the **Airport Status Information** page (see Figure 8), the participants often did not view **Airport Status Information** pages. Instead, they viewed delay information for each airport from the main map, using only the tool-tip rollover. These participants never saw the link to the **Glossary of Air Traffic Management Terms** on the **Airport Status Information** pages.

Researchers noted that even when the participants saw the link to the glossary repeatedly on **Airport Status Information** pages, they could not remember the location of the link when they needed it to answer User Script questions. Many participants accessed the glossary through the **Products** page, even though they had presumably seen the link on **Airport Status Information** pages as many as 12 times throughout the course of the assessment.

We recommend eliminating the use of specific, aviation-related terms, acronyms, and jargon when they are not necessary. The site should establish overall categories (e.g., weather, congestion, equipment outages) that it could use in place of terms like *CIGS* or *VIS*. This would eliminate unnecessary detail, simplify the site, and make it more understandable for the general public. Again, the site could provide links if advanced users needed a greater level of detail.

The participants also found the use of the *ATCSCC* acronym to be confusing (e.g., **ATCSCC FAQ**, **ATCSCC Home**). The site appears to use the *ATCSCC* acronym to differentiate between internal links and external links, because the **Frequently Asked Questions** and **FAA.gov Home** links take users to faa.gov pages, but the **ATCSCC FAQ** and **ATCSCC Home** links keep the user within the fly.faa.gov website. Occasionally, we found that the participants were not sure how to return to the fly.faa.gov home page because they would look for a link that said **Home**, but, instead, the link at the top says **ATCSCC Home** (see Figure 11).

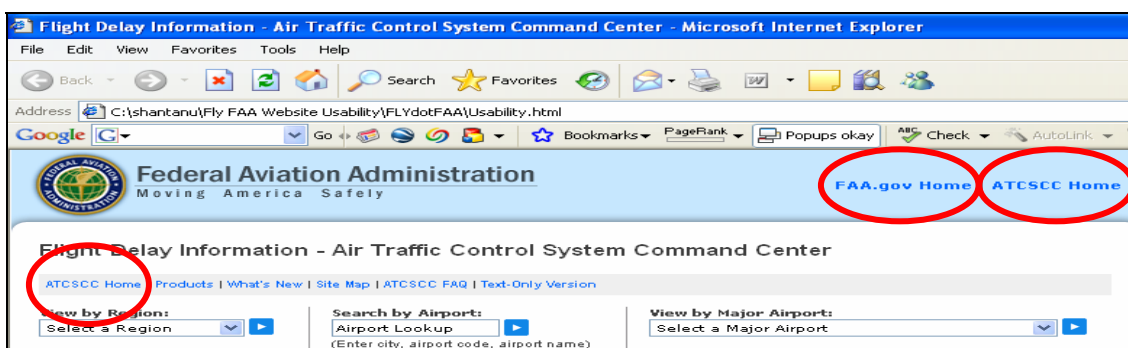


Figure 11. Top view of the fly.faa.gov home page with ATCSCC Home and FAA.gov Home links highlighted.

Two questions in the script asked the participants who they would contact to obtain information about the status of an individual flight and why an individual airport was closed. We expected the participants to access the **ATCSCC FAQ** page to find the answer to this question. For the first question, which the participants could answer using information elsewhere on the site, 78.1 % answered it correctly. For the second question, which the participants could only answer using information on the **ATCSCC FAQ** page, only 34.4% of the participants found the correct answer. The participants were not sure what *ATCSCC* meant and spent a considerable amount of time hovering over other links, trying to find the **FAQ** page.

Because the general public is familiar with the standard convention of calling pages **FAQ** and **Home**, we believe it is unnecessarily confusing to elaborate the titles for these links by calling them **ATCSCC FAQ** or **ATCSCC Home**. We recommend changing these link titles to **FAQ** and **Home**. Only links to external **Home** or **FAQ** pages should have their titles elaborated to differentiate them from internal links.

4.4 Searches

The website provides several options for finding airport delay information. For example, users can find airport delay information for John F. Kennedy International Airport by using the tooltips on the primary map, by clicking on the dots on the primary map, or by using the **View by Region**, **Search by Airport**, or **View by Major Airport** methods.

4.4.1 Understanding Search Options (Issues 5 and 18)

Although the website provided several methods for accessing the same information, it was not always clear to the participants which method to choose or how to best use the method. For example, the tooltips rollovers on the main **Site Map** displayed delay information, but some users were not immediately aware that the dots were clickable. They did not realize this capability existed until they hovered over an airport with a delay, when the tooltip explicitly informed the user to **Click for more info**. We recommend providing users with examples or a quick tutorial in the **Help** that briefly explains the available search methods. Also, the site could provide a **Click for more info** link on all of the tooltips.

4.4.2 View by Region Maps (Issues 4, 9, and 23)

The participants who were not familiar with FAA regions found the **View by Region** maps to be confusing. The participants indicated that they often got lost when looking for airports that were not on the main U.S. map because they were not able to determine the relationship of regional maps to the main U.S. map. Users may not know U.S. geography or FAA regions well enough to determine which states belong in which regions. This becomes especially difficult for states, such as Ohio, that lie at the edge of a region. Once users identify the appropriate region for a particular airport, they may still have difficulty identifying a state within a region solely by its shape. These issues make the **View by Region** method difficult for the general public to use.

Our data support the comments of the participants. Question 5 asked the participants to find delay information for the Burlington, VT International Airport, which is not available on the main map or the **View by Major Airport** menu. Only 71.9% of the participants found the correct answer for this question, indicating that the participants had some difficulty finding

information when they needed to drill down on the maps. Although the participants could have answered this question using the **Search by Airport** method, when they looked for this information using the **View by Region** method, they were often unable to find it. In Question 8, we specifically asked the participants to use the **View by Region** method to find delay information for Cincinnati/Northern Kentucky Airport and Detroit Metropolitan Wayne County International Airport. Only 81.3% of the participants answered this question correctly. Although this was an improvement in performance from Question 5, a large portion of participants still were not be able to use this method correctly. Question 12 was the final question where the participants might have used the **View by Region** method to find delay information for Tulsa International Airport. For this question, 90.6% of participants were able to find the correct answer. This suggests that after completing all 12 questions, the participants either improved in their ability to use the **View by Region** method or elected to use the **Search by Airport** method.

We have several recommendations that could alleviate some of the issues related to the use of the **View by Region** method. First, the site could place an outline around the different regions or use color coding to highlight the different regions on the U.S. map to orient users to which states belong in which region. One participant suggested displaying split portions of the main U.S. map on the same page to better orient users. To orient users geographically, the site could label states, both on the main U.S. map and on the smaller regional maps. Another option is for the site to offer users a drop-down list that lists the various airports by state.

The participants who appeared to have good geographic knowledge encountered a different problem when searching for information on airports not appearing on the primary map. Many of these users tried to click and drag the map or perform other styles of progressive zooming as they would with Yahoo! Maps or Google Maps. Because the general public comes to the site having had experience with other online maps, they want and expect maps to offer similar functionality and may become frustrated when they do not. Given the familiarity of users with other online maps, zooming capabilities may be a useful enhancement.

4.4.3 Initiating Searches (Issues 11 and 12)

The blue and white arrow buttons next to the **View by Region**, **Search by Airport**, and **View by Major Airport** methods do not suggest **Go** or **Search** or **Submit** to many users. For example, when some participants selected items from drop-down lists next to the **View by Region** and **View by Major Airport** methods, they expected the requested page to load upon selection without having to click on the arrow button. For many users, selecting something from the drop-down menu is equivalent to hitting enter. The participants made comments like “I sometimes would forget to click the **Go** arrow,” or “In drop boxes, maybe make the screen change when the option is selected instead of clicking the arrow.”

We recommend changing the blue arrow action button label to “**Go**,” to clearly indicate that users must click the button to initiate an action (see Figure 12 for an example). **Go** is more informative than a simple arrow, will make the functions easier to understand, and corresponds to the designs currently used on the faa.gov website. Though some users requested that the **View by Region** and **View by Major Airport** drop-down lists not require clicking the additional **Go** button, this could violate web accessibility guidelines. Despite its potential benefits for some users, we do not recommend this solution.

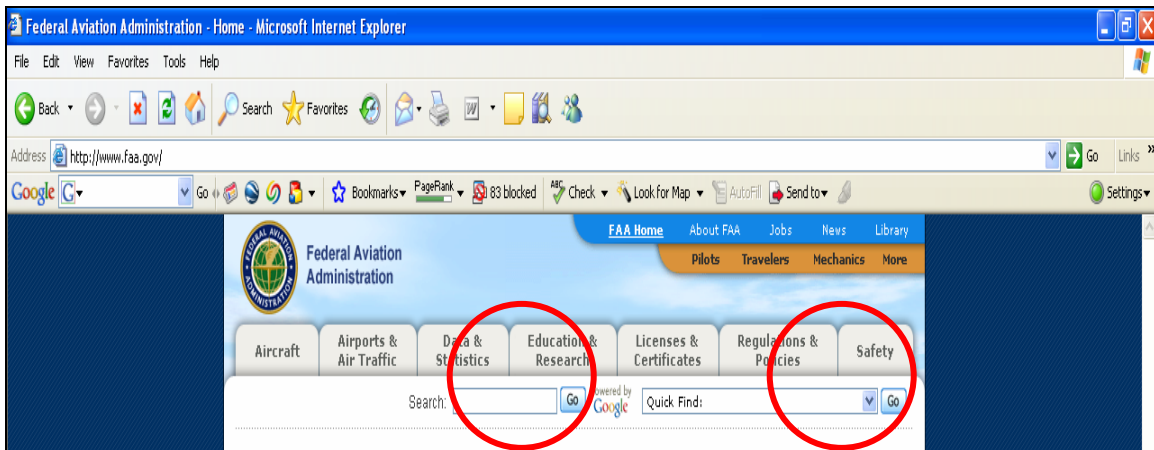


Figure 12. A screenshot of the faa.gov website showing search fields and drop-down lists with labeled action buttons.

4.4.4 Using Three-Letter Identifiers for Searches (Issues 6 and 16)

Using the three-letter airport identifier is an efficient way to obtain delay information about an airport. Three-letter identifiers label the airports on the main U.S. map and typing a valid three-letter identifier into the **Search by Airport** text box will take the user directly to the details page for that airport. As indicated by participant comments and by the Background Questionnaire, not all participants knew the correct three-letter identifiers for airports. For this reason, the site should emphasize that the **Search by Airport** text box accepts regular airport names and city names. Although the **Search by Airport** text box has a label indicating that users should enter the city, airport code, or airport name information in the field, we recommend that the fly.faa.gov website provide examples to highlight the different search options (see Figure 13 for an example).

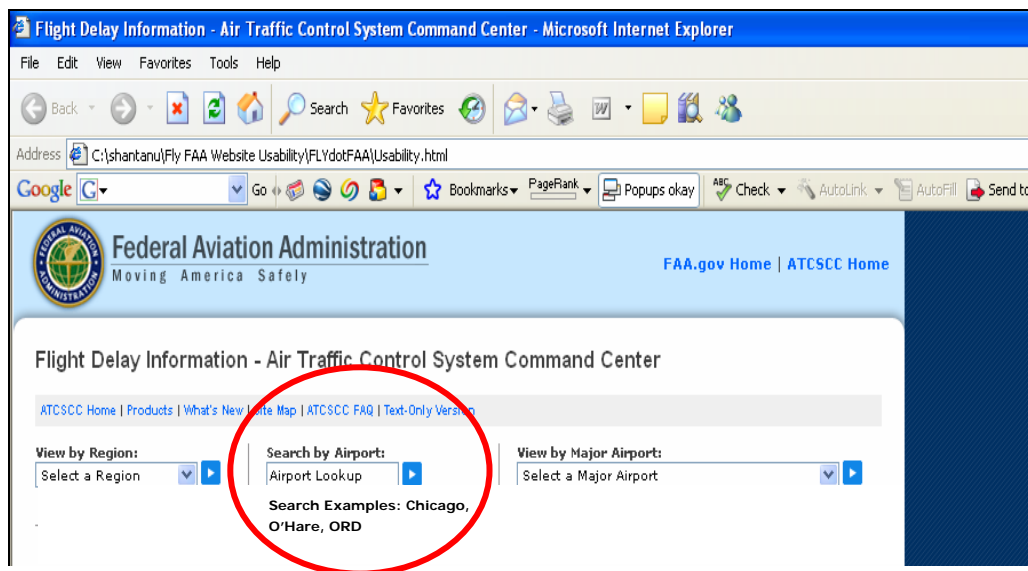


Figure 13. Providing examples to facilitate the use of the **Search by Airport** search method.

4.4.5 City Names Redundant with Airport Names (Issue 7)

City name searches cause the site to generate an intermediate results page that sometimes lists multiple airports in the search results. For example, a search for Chicago results in two airports, Midway and O’Hare International, listed once under **City Name Matches** and once under **Airport Name Matches** because the name of the airport contains the word *Chicago* (see Figure 14). This results in the website displaying redundant information to the users, which may be confusing because users may not realize that both links will take them to the same information. In this assessment, some participants using the **Search by Airport** method questioned researchers about why the site listed an airport twice and how to determine which link was the correct link. We recommend that the **Airport Lookup Search Results** page consolidate search results and list airports only once in any search results list (see Figure 15).



Figure 14. The results page for a **Search by Airport** search for *Chicago*.

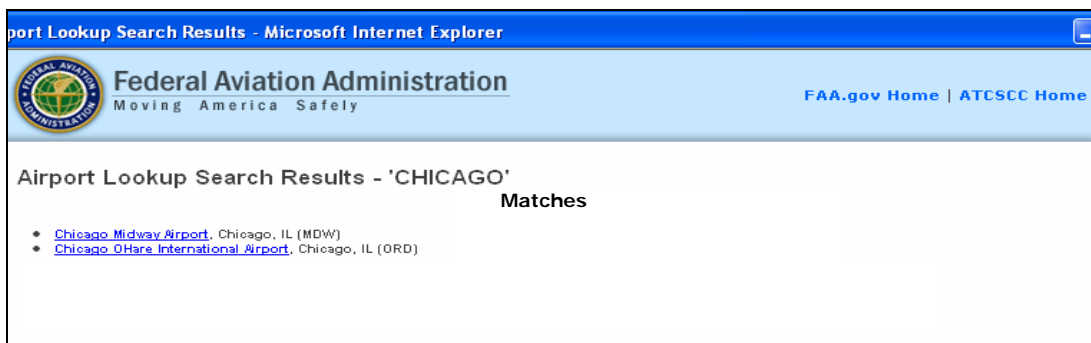


Figure 15. A simplified results page for a **Search by Airport** search for *Chicago*.

4.4.6 Ordering of Search Results (Issue 7)

The site does not always logically order search results for the user. The site sometimes lists best matches last in the list of search results. For example, when a user types *San Jose* in the **Search by Airport** text box, *San Diego* comes out on top (see Figure 16). This is because the three-letter code for San Diego airport is SAN, and the site lists airport code matches first. However, users are accustomed to looking at the first few entries on the list for the best matches. We recommend ordering search results so that the site lists complete matches (i.e., the result containing both *San* and *Jose*) first, preferably listing only complete matches when one exists (see Figure 17).

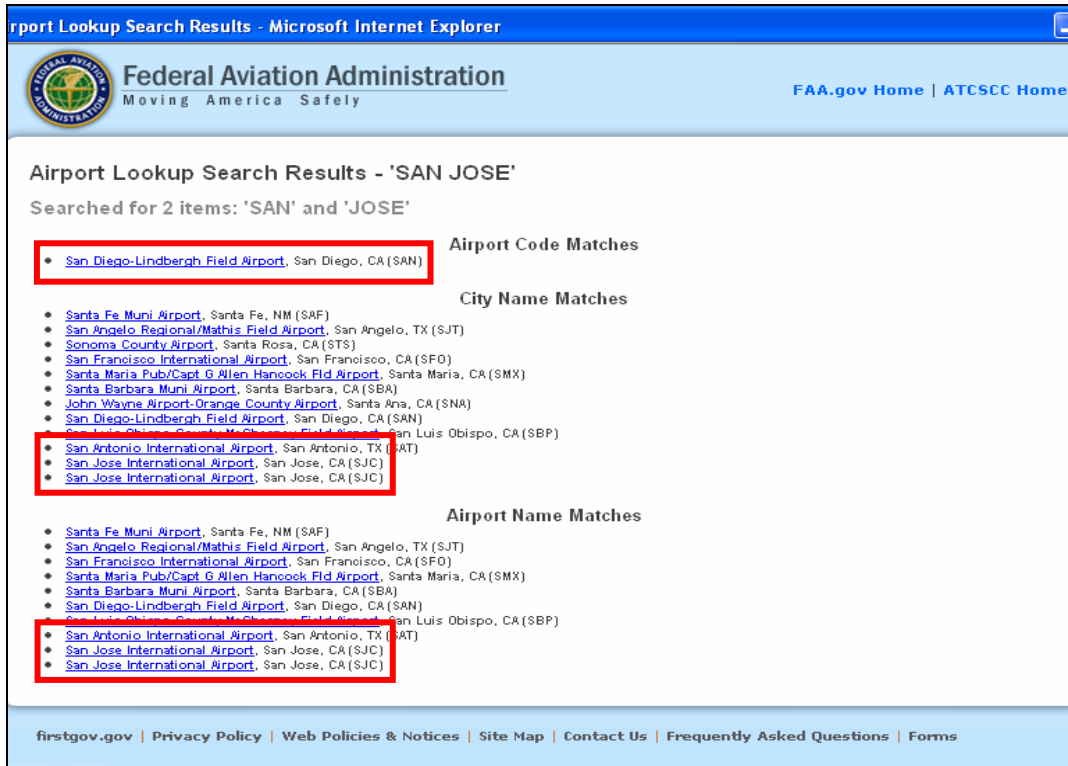


Figure 16. The results page for a **Search by Airport** search for *San Jose*.



Figure 17. Suggested results page for a **Search by Airport** search for *San Jose*.

4.4.7 Spelling Issues (Issue 8)

User spellings and misspellings can affect the **Search by Airport** method. In some instances, the correct spelling does not work, but a misspelling does. For example, typing *O'Hare* does not return any results, but *Ohare* does. Typing *LaGuardia* returns no results, but *La Guardia* does. However, the search results seem to suggest that LaGuardia Airport might be located in Louisiana because of the match between the *La* in *LaGuardia* and the abbreviation for Louisiana. In addition, common misspellings do not produce any results, even when the system could provide reasonable guesses about what the user intended. For example, *Newyork* does not produce any search results. The researchers noted that the participants became frustrated and confused when the site did not return any search results for correct spellings or reasonable misspellings. The search should always result in a hit when the correct spelling is used, should provide “best guess” search result even when users make spelling mistakes, and should ignore spacing errors.

4.4.8 Search Anomalies (Issues 10 and 17)

4.4.8.1 Pop-Up Page Consistency

When users access information using the **Search by Airport** method or when they click on the color-coded dots on a map, the website displays the search results or the **Airport Status Information** page in a pop-up window. However, when users access information using the **View by Major Airport** method, the site displays the same information in the current browser window rather than in a pop-up window.

During the assessment, some participants accidentally closed the browser completely by clicking the **Close** button when the site presented search results in the main browser window. These participants became accustomed to results appearing in a pop-up window where they could close the window in that manner. When, instead, search results appeared in the main browser window, they still reacted as if they were in a pop-up window and accidentally closed the site and the browser.

We recommend that the site be more consistent in how it returns search results and **Airport Status Information** pages. Users quickly become confused when the site uses different conventions for similar actions. If the standard convention of the site is to bring up search results in pop-up windows, then the site should bring up all search results in pop-up windows.

4.4.8.2 Refresh Impact on Searches

The main U.S. map on the fly.faa.gov home page refreshes at a regular interval to update the website with new information. However, if a user is in the middle of typing or selecting an entry from a drop-down list during a refresh, the selected or typed information disappears. The researchers observed this problem frequently during the assessment. We recommend programming the site so that it retains typed or selected information during a refresh.

4.5 Font and Color Coding Issues (Issues 13, 22, 27, and 29)

On the **Site Map** page, unvisited links appear in gray text without underlines. To many users, this coding did not suggest that these were links. Once a user visits a page the link color changes to blue on the **Site Map** page. This is confusing because both the visited and unvisited links are blue on other pages in the site. The standard web convention and the convention used by faa.gov is to use blue for unvisited links and purple for visited.

The participants also complained that the website used a font size that was too small, particularly for the drop-down lists like **View by Major Airport**. Although users have the option of changing the font size for regular text in the browser page using options of the browser (e.g., in Internet Explorer, click **View** → **Text Size** → **Larger**), changing the font sizes for drop-down lists and similar controls requires changes at the operating system level, which may be too cumbersome for the average user. Finally, some participants made comments regarding the blue and gray fonts and the difficulty of reading blue text on a white background. This may be true for some users; however, blue on white is an established web convention and is required by the FAA branding guidelines.

We believe the two most pressing issues regarding font size and font color are the nonstandard use of blue for visited and gray for unvisited links on the **Site Map** page and the font size of drop-down list items at standard display settings. We recommend changing the **Site Map** page so that it applies the color convention for links used in other areas of the fly.faa.gov site to this page. We also recommend implementing coding that identifies the user's browser type and optimizes the font size for that user's display settings.

The color coding (green, yellow, orange, red, and black) of the dots representing airports on the map provides site users with a quick overview of the delay status at different airports. However, the participants assumed that the site used a continuum of color coding (i.e., Green < Yellow < Orange < Red < Black) related to the severity of the delay. Although this is true for most of the colors, this is not true for orange, which simply provides an indication of destination-specific departure delays.

We suggest using one continuum for departure delays and one for arrival delays. Alternatively, the site could use color as an indication of the severity of the delay but use a symbol as an indication of the type of delay (e.g., arrival = circle, departure = square). However, users would still need to click on these icons to obtain more detailed information about airport-specific departure delays.

4.6 Legend Issues: Legend Visibility (Issue 19)

With the use of the most common display resolution setting of 1024 x 768 (Refsnes Data, 2006), the main U.S. map graphic covered almost the entire page and the legend for the map dot colors is not visible (see Figure 18). Several participants did not realize that they could scroll in the browser to access the legend.

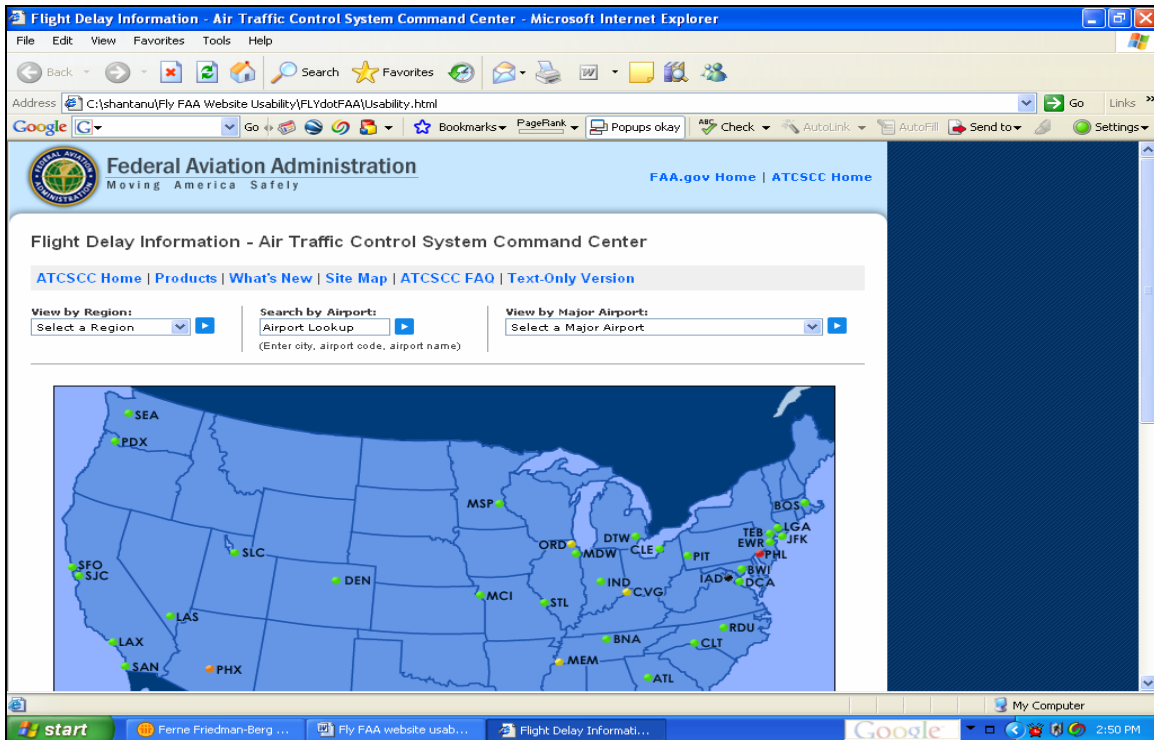


Figure 18. Home page at a display resolution of 1024 x 768.

We recommend changing the layout of the fly.faa.gov home page so that the legend is viewable to users regardless of their display settings. One approach is for the site to detect the user's display settings and locate the legend accordingly. Alternatively, the map graphic could include the legend, adding it over the ocean or in Canada on the map. At some screen resolutions, extra space to the right of the main page is also available.

4.7 Consistency Issues: Labels, Links, and Pull-down Menus (Issues 20, 21, and 26)

There are a number of consistency issues on the website. First, the set of products listed on the **Site Map** page does not match the list of products found on the **Products** page (see Table 7). For example, the Computerized Voice Reservation System is spelled out on the **Site Map** page but abbreviated as e-CVRS Reservation on the **Products** page. Also, there are several products that appear on one page and not on the other.

Another issue is that the sequence of site navigation links at the top of each page is **ATCSCC Home, Products, What's New**, and so on; whereas the sequence of navigation links on the **Site Map** page is **ATCSCC National Airport Status, Products, and FAQ**.

Table 7. Product Listings on the **Products** and **Site Map** Pages

Products Page	Site Map Page
Advisories Database	Advisories Database
Airline FSM Training Sign-up	Airline FSM Training Sign-up
Airport Arrival Demand Chart	Airport Arrival Demand Chart
Aviation Information System	Aviation Information System
Central Altitude Reservation Function	Central Altitude Reservation Function
^a e-CVRS Reservation	^a Computerized Voice Reservation System
Current Reroutes	Current Reroutes
Current Restrictions	Current Restrictions
^a General Overview of the ATCSCC	^a Information about us
^a ATCSCC Tour	^a Take a Tour of the ATCSCC
Operational Information System	Operational Information System
Route Management Tool	Route Management Tool
Runway Visual Range	Runway Visual Range
^a RVSM/DoD Priority Mission Site	^a RVSM
S2K	S2K
Special Traffic Management Program (e-STMP)	Special Traffic Management Program (e-STMP)
^b Chicago O'Hare (Ord) Arrival Reservation Program	^c ARO, ^c CARF, ^c CDM, ^c ETMS, ^c FILO, ^c IOP, ^c NOCC,
^b EDCT Lookup	^c NOTAM, ^c NSST
^b GAAP	^c Presentations
^b Glossary of Terms	^c S2K+5 Products
^b National Playbook	
^b TFM Learning Center	
^b Traffic Management for Flight Ops Personnel	

^aInconsistent titles. ^bProducts available only on the **Products** page. ^cProducts available only on the **Site Map** page.

Many pages have a link to the glossary but use different titles for the links. The glossary link on the **Site Map** page is titled **Acronyms/Glossary of Terms**. This same link is titled **Glossary of Terms** on the **Products** page and **Glossary of Air Traffic Management Terms** in the **Airport Status Information** pop-up page. We recommend that the site maintain consistency in the order of links, title of links, and contents of product listings, as these things are repeated throughout the site.

Also, in the **View by Major Airport** pull-down list, a few airports use the possessive *s* in the listing, but most do not. For example, the site lists Houston, New York, and Las Vegas as Houston's George Bush Intercontinental, New York City's La Guardia, New York City's John F Kennedy Intl, and Las Vegas' McCarran International. However, none of the other airport listings use the possessive *s* in their listings. We recommend that the site not use the possessive form for any of the listings in the pull-down list.

4.8 Other Issues (Issues 15 and 28)

Some text on the **ATCSCC FAQ** page is too informal in tone and writing style. This may not convey the image to the public that the ATCSCC intends.

Also, the FAQs may not reflect the true set of the questions most frequently received from users. Keeping a useful list of frequently asked questions requires continuous monitoring of incoming user questions along with the regular addition of new ones to the website as they are asked. We recommend that if the site wishes to maintain a **FAQ** page, the program office should assign personnel the responsibility for keeping the set of questions up to date so that it truly reflects the questions asked by visitors to the site.

Finally, the website does not provide information on where the user is in relation to the entire site. For example, when a user performs a search using the **View by Region** method, there are no links to lead the user back to the home page. Many websites provide links, known as “breadcrumbs,” that show the pages the user visited before the current page. Breadcrumbs help users understand where they are in the overall site and provide a quick method for them to return to previous locations. We recommend that the site provide users with some indicator of where they are on the site in relation to the fly.faa.gov home page.

4.9 Potential Future Capabilities

Participants requested several capabilities that are not currently available on the fly.faa.gov website. Although we do not know the feasibility of adding these items to the website, we believe it is useful for the website developers to have this information for future updates.

- The site is geared towards the general public and the aviation community, two user groups with different levels of knowledge and experience. Therefore, it may be useful to have two entrances into the site, one for the public and one for users who need more detailed information (e.g., pilots, airlines).
- A number of participants expressed an interest in having access to weather information, either within the site or via a link to an external weather site. For example, some participants suggested having a page showing a weather radar of the nation, links to weather forecasts for individual airports, or a link to external weather maps.
- Some participants stated that they would be interested in having access to more information about aviation security. Providing links to the average security processing time at airports may be useful for travelers.
- The participants commented that if travelers are looking for airport information, it would be helpful to have links to the web pages of major airports, similar to how the site provides links to the websites of major airlines. The site could have a separate page of links to airports, or there could be a link to a specific airport displayed on the **Airport Status Information** page in response to a specific airport query.

5. CONCLUSION

Subjective reports indicated that the participants were generally satisfied with the fly.faa.gov website, and objective data revealed that they could successfully complete most tasks using the site. However, based on analyses of task performance and user comments, researchers identified a number of human factors issues with the website. After identifying the issues, we rated each issue in terms of its impact on the site's usability, discussed each issue in detail, identified supporting data when appropriate, and provided recommendations for improving the usability of the website. Many of these changes should be straightforward to implement and could further increase user satisfaction and the usability of the fly.faa.gov website.

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Acronyms

ALO	Waterloo Muni Airport
ATCSCC	Air Traffic Control System Command Center
ATL	Hartsfield-Jackson Atlanta International Airport
CIGS	Ceilings
CVG	Cincinnati/Northern Kentucky International Airport
e-CVRS	Computerized Voice Recognition System
ERP	Engineering Research Psychologist
EWR	Newark International Airport
FAA	Federal Aviation Administration
FAQ	Frequently Asked Question
HFREG	Human Factors Research and Engineering Group
IAH	George Bush Houston Intercontinental Airport
ICC	Intraclass Correlation
LGA	La Guardia Airport
MCO	Orlando International Airport
MDW	Chicago Midway Airport
MIA	Miami International Airport
MEM	Memphis International Airport
NAS	National Airspace System
ORD	Chicago O'Hare International Airport
PHL	Philadelphia International Airport
SAN	San Diego International Airport
<i>SD</i>	Standard Deviation
VIS	Visibility
VOL	Volume
WJHTC	William J. Hughes Technical Center

Appendix A

Statement of Ethics and Informed Consent



www.fly.faa.gov Usability Assessment Statement of Ethics & Informed Consent

Nature and Purpose of Activity

Thank you for volunteering to serve as a participant in a usability assessment of www.fly.faa.gov. As you may know, this website is used by the FAA, the aviation community, and the traveling public to obtain status information about airports. As part of its commitment to making the site useful and effective, the Air Traffic Control System Command Center, which maintains the site, has asked us to conduct a usability assessment. We are Engineering Research Psychologists from the NAS Human Factors Group, located at the FAA William J. Hughes Technical Center.

The purpose of this activity is to assess the usability of the website www.fly.faa.gov. That is, how effectively can people use the site to obtain information they need? Is it easy to find information or is it difficult or slow? Is the information presented clearly or is it confusing? Can people who are not aviation experts use the site too?

During the assessment, we will ask you to use the site to complete several common tasks, such as finding the operating status of an airport. We will observe you while you do the tasks, ask questions, and collect your feedback.

Who is Eligible to Participate?

Any adult employee of the federal government who knows how to use a computer and a web browser may participate. No knowledge of the FAA or air traffic control is required. Employees with medical conditions that preclude them from using a laptop computer for 30 minutes may not participate in the assessment.

Experimental Procedures

We will explain the procedures and your rights and responsibilities before you begin. You will first complete a background questionnaire to assess your knowledge of computers, websites, and aviation. Then you will follow a script to use different pages and features of the website using a laptop. After this, you will complete a questionnaire about your experiences using the site. Prior to the session, you will be briefed for 5 minutes on the purpose of the website. The entire session will last approximately 30 minutes.

Data Collection Methods

We will administer a background questionnaire before you begin the session and a usability questionnaire at the end of the session. During the session, one of the researchers will observe you and take notes on how the session is going. If you wish, you can identify problems or issues to the researcher during the session. In addition, we will use software to unobtrusively capture video of the screen as you complete the script. The video capture will record your actions on the screen such as moving the cursor, opening windows, and clicking on menus. It will not record your voice or your face.

Discomforts and Risks

You will use a laptop computer and a mouse to complete the script. The time required to complete the assessment is about 30 minutes. The amount of discomfort and risk inherent in this study is the same as 30 minutes of web browser usage as part of your job or at home. For some people, this may cause eyestrain or pain or discomfort in the wrist. If you have a medical condition where 30 minutes of continuous computer usage is likely to harm you, please do not participate in the study. You will work at your own pace and you may take breaks at any time. In addition, you may withdraw, for whatever reason, at any time during the session by simply telling one of the researchers.

Benefits

There is no direct benefit for your participation. In general, users of this website can expect a benefit of a website that is easier to use and more effective.

Participant's Responsibilities

Please complete the script and respond to the questionnaires to the best of your ability. If there is something you do not understand, please ask a researcher. In addition, to avoid biasing the results, please do not discuss the study with other potential participants until the study is completed in about 30 days.

Participant's Assurances

Researchers from the NAS Human Factors Group maintain strict standards regarding participant confidentiality and informed consent in all our activities. Our standards are based on the *Ethical Principles in the Conduct of Research with Human Participants* by the American Psychological Association and are structured around four main principles:

- Your participation in this study is completely voluntary. You may withdraw from this assessment at any time without consequence. If you feel you must withdraw for whatever reason, please inform us immediately. In addition, the human factors engineers may terminate your participation if they believe this to be in your best interest.
- Your responsibilities will be clear. We will explain everything to you and answer all your questions.

- Your identity will be kept anonymous. Your responses will be identified by a code known only to you and the psychologists conducting the assessment. Your identity will be kept separate from the data you provide. To facilitate this, please do not write your name or any other identifying marks on the questionnaires. Please do not share your participant code with anyone other than the human factors engineers. Your name will not be associated with any data contained in any report or briefing.
- The data you provide will be kept confidential. The *raw* data collected in this assessment will become the property of the NAS Human Factors Group. The raw data will be analyzed by specialists from this organization and its contractor employees. The raw data will not be made available to other organizations without your permission. The *aggregate* data from this assessment will be presented in briefings and reports made by the group. These data will take the form of averages, standard deviations, and other statistics.

If you any have questions about this study or need to report any adverse conditions you may contact the human factors engineers. You may also contact Dr. Earl Stein (609) 485-6389, the NAS Human Factors Group Manager, at any time with questions or concerns.

I have read this consent document. I understand its contents, and I freely consent to participate in this study under the conditions described. I have been offered a copy of this consent form.

Research Participant: _____ Date: _____

Investigator: _____ Date: _____

Witness: _____ Date: _____

Appendix B

Participant Background Questionnaire



www.fly.faa.gov Usability Assessment Participant Background Questionnaire

Participant Code: _____ Date: _____

INSTRUCTIONS

Thank you for participating in this usability assessment. This questionnaire is designed to collect information about your experience using computers, websites, and your knowledge of aviation. These data will be part of a usability assessment of the www.fly.faa.gov website. Please read the questions carefully and provide the most accurate and complete response you can. If you have questions or do not understand something, please ask a researcher. If you do not wish to answer a question, for whatever reason, please leave it blank. The information you provide is anonymous and will be kept strictly confidential as described on the Statement of Ethics and Informed Consent.

1. **What is your age?** _____ years

2. **Sex:** Male Female

3. **How often do you normally use a computer at work or at home?**
 - I never or almost never use a computer.
 - I use a computer a few times each month.
 - I use a computer a few times each week.
 - I use a computer nearly every day.

4. **How long have you been using computers at work or at home?**
 - Less than 1 year 1-4 years 5-10 years More than 10 years

5. **About what portion of your time is spent using the web?**

- I never or almost never use the web.
- I use the web a few times each month.
- I use the web a few times each week.
- I use the web nearly every day.

6. **How long have you been using the web at work or at home?**

- Less than 1 year
- 1-4 years
- 5-10 years
- More than 10 years

7. **Which computer operating systems do you use regularly at your job or at home?**

- DOS
- Windows
- Macintosh
- Unix
- Linux
- Other: _____

8. **What is the web browser you use MOST OFTEN? (please check ONLY one)**

- Microsoft Internet Explorer (version, if known: _____)
- Mozilla FireFox (version, if known: _____)
- Safari (version, if known: _____)
- Opera (version, if known: _____)
- America Online (AOL) browser (version, if known: _____)
- Netscape Navigator (version, if known: _____)
- Browser on my PDA or cellphone
- Other: _____

9. How often do you use www.fly.faa.gov?

- I have never used it.
- I use it only a few times a year.
- I use it several times a month.
- I use it one or more times every week.

10. What types of travel related websites do you use (check all that apply)?

- I do not use any other travel-related sites.
- Federal travel agent sites like Resx.com
- Commercial travel agent sites like Orbitz.com, Travelocity.com, Expedia.com
- Sites for individual airlines like United.com, NWA.com, SouthWest.com
- Air traffic sites like FlightExplorer.com, ATCmonitor.com, FlightAware.com
- Other type: _____

11. We are interested in your familiarity with some terms and concepts related to the National Airspace System. Please answer the following questions.

a) List the three-letter abbreviations for the following airports:

<u>Example:</u>	Philadelphia International Airport	PHL
	Los Angeles International Airport	_____
	Chicago O’Hare International Airport	_____
	Washington Dulles International Airport	_____
	Newark Liberty International Airport	_____

b) List the airports or cities associated with the following three-letter abbreviations:

<u>Example:</u>	MIA	Miami
<u>Example:</u>	MDW	Midway
	ATL	_____
	CVG	_____
	MCO	_____
	IAH	_____

d) In aviation terminology, what is a “low ceiling”?

e) List as many reasons as you can think of why a major airport might be experiencing delays.

Appendix C

User Script



www.fly.faa.gov Usability Assessment User Script

INSTRUCTIONS

Please use the website to complete each step below. Unless otherwise indicated, feel free to use any technique you choose to find the information in the site. In some cases, the step may ask you to complete the step using a particular function or method. If you are unable to perform a step or have any other concerns, please approach one of the Human Factors Engineers.

1. You are flying from Los Angeles International Airport, CA to Salt Lake City International Airport. Find airport delay information, if any.

- 15 minutes or less
- 16 to 45 minutes
- Greater than 45 minutes

Cause of delay, if any: _____

2. You are flying from Portland International Airport to Memphis International Airport. Find airport delay information, if any.

- 15 minutes or less
- 16 to 45 minutes
- Greater than 45 minutes

Cause of delay, if any: _____

3. You are flying from Denver International Airport to Philadelphia International Airport. Using the **Search by Airport** feature, find airport delay information, if any.

- 15 minutes or less
- 16 to 45 minutes
- Greater than 45 minutes

Cause of delay, if any: _____

4. You are flying from George Bush Intercontinental/Houston Airport to Chicago O'hare International Airport. Using the **Search by Airport** feature, find airport delay information, if any.

- 15 minutes or less
- 16 to 45 minutes
- Greater than 45 minutes

Cause of delay, if any: _____

5. You are flying from Newark International Airport to Burlington International Airport. Find airport delay information, if any.

- 15 minutes or less
- 16 to 45 minutes
- Greater than 45 minutes

Cause of delay, if any: _____

6. You are from flying from Las Vegas McCarran International Airport to New York John F. Kennedy International Airport. Using the **View by Major Airport** drop down menu, find airport delay information, if any.

- 15 minutes or less
- 16 to 45 minutes
- Greater than 45 minutes

Cause of delay, if any: _____

7. You are flying from Phoenix Sky Harbor International Airport to Dallas Fort Worth International Airport. Find airport delay information, if any.

- 15 minutes or less
- 16 to 45 minutes
- Greater than 45 minutes

Cause of delay, if any: _____

8. You are flying from Cincinnati/Northern Kentucky International Airport to Detroit Metropolitan Wayne County International Airport. Using the **View by Region** feature, find airport delay information, if any.

- 15 minutes or less
- 16 to 45 minutes
- Greater than 45 minutes

Cause of delay, if any: _____

9. You are flying from Pittsburgh International Airport to Washington Dulles International Airport. Using the **Site Map** feature, find airport delay information, if any.

- 15 minutes or less
- 16 to 45 minutes
- Greater than 45 minutes

Cause of delay, if any: _____

10. You are flying from New York LaGuardia International Airport to San Jose International Airport. Using the **Search by Airport** feature, find airport delay information, if any.

- 15 minutes or less
- 16 to 45 minutes
- Greater than 45 minutes

Cause of delay, if any: _____

11. You are flying from Orlando International Airport to Lambert-St. Louis International Airport. Using the **Search by Airport** feature, find airport delay information, if any.

- 15 minutes or less
- 16 to 45 minutes
- Greater than 45 minutes

Cause of delay, if any: _____

12. You are flying from George Bush Intercontinental/Houston Airport to Tulsa International Airport. Find airport delay information, if any.

- 15 minutes or less
- 16 to 45 minutes
- Greater than 45 minutes

Cause of delay, if any: _____

13. Using information available on the site, provide the definitions of the following aviation-related terms or abbreviations:

CIGS _____

MULTI-TAXI _____

VOL _____

14. Using information available on the site, who should a visitor contact to obtain information about the following:

Status of an individual flight _____

Why an individual airport was closed _____

Appendix D

Post-Session Questionnaire



www.fly.faa.gov Usability Assessment Post-Session Questionnaire

Participant Code: _____

Date: _____

INSTRUCTIONS

Please circle the number that best corresponds to your experience using the website during this assessment. Please use the comments section to identify items that were especially good or bad. If you have questions or do not understand something, please ask a researcher. If you do not wish to answer a question, for whatever reason, please leave it blank. The information you provide is anonymous and will be kept strictly confidential as described on the Statement of Ethics and Informed Consent.

1. How easy was it to find the information you were looking for?

1	2	3	4	5	6
Very difficult to find					Very easy to find

Comments: _____

2. How well did you understand the information once you found it?

1	2	3	4	5	6
Very difficult to understand					Very easy to understand

Comments: _____

3. How easy was it to navigate between the different pages or sections of the site? For example, did you ever get lost or did you always know where you were?

1	2	3	4	5	6
Very difficult to navigate					Very easy to navigate

Comments: _____

4. How consistent was the design and layout of the site? For example, did different pages of the site look and behave about the same way?

1	2	3	4	5	6
Very inconsistent					Very consistent

Comments: _____

5. How detailed was the information on the site? For example, were there times when the site could have provided more information? Or were there times when the site provided so much information that it was “information overload?”

1	2	3	4	5	6
Too little detail					Too much detail

Comments: _____

6. How well could you read the text information on the site? For example, were the fonts too small or too big? Were the color combinations readable or unreadable?

1	2	3	4	5	6
Very difficult to read					Very easy to read

Comments: _____

7. How satisfied are you with the site overall?

1	2	3	4	5	6
Very dissatisfied					Very satisfied

Comments: _____

8. What additional information would you like to see on the website?

Comments: _____

