USABILITY TESTING FOR THE ENERGY INFORMATION ADMINISTRATION'S INFO-CENTRIC WEB SITE

Colleen Blessing, Howard Bradsher-Fredrick, Herbert Miller, Renee Miller, Robert Rutchik

Abstract:

In the fall of 2000, the Energy Information Administration (EIA) launched a new "info-centric" design of its Web site[1]. The info-centric design organized EIA's information by energy topic or channel rather than by the agency's organizational structure.

The redesign was the product of cognitive testing on the previous EIA Web site and an EIA Joint Application Development (JAD) session with participants from all parts of EIA who incorporated the results of the cognitive tests.

In May of 2001, EIA conducted additional cognitive tests on the info-centric site to determine if users found information more easily and with greater confidence on the new site. This paper presents the results of those tests and an outline of a design for info-centric sites.

Keywords: cognitive testing, usability testing, participants, Web site, info-centric, paper-centric, channel

Purpose

This paper shows how EIA has applied cognitive testing principles to usability testing of its Web site in order to measure the agency's progress towards its goal implementing an "info-centric" Web site in which EIA's information is organized by energy topic not organizational structure or paper publications. The paper will discuss how the agency has used the findings from each test to improve its testing methodology and Web site in order to move towards its goal of an "info-centric" site. The paper will cover:

- Background of the EIA Web Site and Implementing an "info-centric" Site
- 1999 and 2000 Usability Tests
- May 2001 Usability Test
- Next Steps
- Summary

Background of The EIA Web Site and Implementing an "Info-centric" Site

In 1993 and 1994, the Energy Information Administration (EIA) began the move from a paper publication agency to a "paperless" or electronic disseminator of information. When EIA rolled out its Web site in July 1995, the philosophy was to get information and data on the site and "out there" quickly. Visual Web site design and the organization of material on the site

[1] John Pearson and John Weiner, "A More Info-centric EIA," paper presented at the semi-annual meeting of the American Statistical Association Advisory Committee on Energy Statistics (Washington, DC, October, 1999).

to make it more usable for users would be addressed later. Now that the site has gone from a little over 5,000 user sessions in July 1995 to nearly 700,000 users sessions in May 2001, improved usability has become imperative.

Since 1995, EIA has collected Web site statistics and systematically categorized and studied user calls and other feedback. Using this information, EIA has twice made major redesigns to its home page in attempts to allow customers to more easily and quickly find the information for which they are looking. In early 1999, EIA decided to modify the design and organization of its Web site from a "publication centric" design that reflected the agency's organization structure to an "information-centric" design. EIA's goal:

> Our [Web] processes have been systematically designed to make it easy for customers to obtain, understand, and use our information conveniently for their purposes. From their vantage point, EIA appears seamless. For example, to find the information they need on our Web site, customers will not need to know how EIA is organized, on which surveys the data were collected or which individuals to call. If they want to talk directly with an EIA person, they can easily contact people familiar with the information they seek.[2]

EIA's long-term plan was to redesign its Web site, beginning with the Home Page and moving to the second and lower level pages, around this principle.

1999 and 2000 Usability Tests

Literature Review and Methodological Guidance

To start the process of turning this principle into reality, EIA asked its Web Cognitive and Usability Evaluation Team to test the [then] current EIA Web site and future designs to determine:

- The ability of users to locate information on the EIA Web site.
- Whether users unknowingly locate incorrect information when performing specific searches.
- Why users locate incorrect information.
- The navigation behavior of users.

For guidance in formulating possible experimental designs to test the EIA Web site, the Team reviewed the available literature on usability. Specifically, we looked at:

- *Research on the Canadian Statistics Area of the Statistics Canada Website,* (http://www.statcan.ca) presented by Phase 5 Consulting Group Inc. and sponsored by Statistics Canada. In this 1997 study, Statistics Canada conducted an evaluation of their Web site to describe the interactions of their users with the site and to identify any issues regarding content, structure, or organization that caused users problems in

[2] Ibid., p. 1.

locating information. They completed a total of 97 think-aloud interviews[3] with a seven-minute limit on each exercise. EIA, after experimenting with other approaches, would adopt the think-aloud approach with a time (ten minutes) limit on each exercise.

- *Facilitating Statistical Information Seeking on Websites: Intermediaries, Organizational Tools, and Other Approaches*, a report to the Bureau of Labor Statistics in August 1998 by Carol Hert. This study builds on the prior work done by Gary Marchionini and Carol Hert. It investigated user groups of the Fedstats Web site and the tasks attempted by end-users and intermediaries.

- The team also studied, *Web Site Usability: A Designer's Guide*, by Jared M. Spool of User Interface Engineering. This study describes how well information-rich Web sites actually work when people use them to find specific answers.

American Statistical Association (ASA) Advisory Committee on Energy Statistics Test and Advice

The first test the Team conducted was at the 1999 American Statistical Association (ASA) Advisory Committee on Energy Statistics meetings.[4] The purpose of the ASA Committee is to provide EIA with technical advice on survey methodology and modeling issues. All participants were familiar with EIA data; some were familiar with the EIA Web site. The team wanted the ASA Committee to provide advice on which of two experimental designs, a focus group format or an individual think-aloud format, would be optimal for usability tests.

At the end of the exercise period, committee members made a number of suggestions.

- Use the "think-aloud approach." It will provide richer information.
- Phrase the test questions as people would normally ask them, rather than using EIA jargon.
- Videotape the tests.
- Cut down the length of the introduction protocol; it is too long and too formal.
- Revise a demographic survey in which the Team asks participants about their level of Web expertise and familiarity with energy terms prior to the exercises.

Based on the results of the tests of the ASA committee and their advice, the team decided to use the "think aloud" approach for EIA testing. We also incorporated most of the other suggestions into its testing design.

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[3] In the think-aloud procedure, test participants are asked by the interviewer to say what they are thinking, feeling, and doing during the test. Hence "think-aloud."

[4] Colleen Blessing, Howard Bradsher-Fredrick, Renee Miller, Robert Rutchik, Antoinette Ware-Martin "Cognitive Interviewing: Applications to Evaluating the Energy Information Administration's Web Site," paper presented at the annual meeting of the American Statistical Association (Baltimore, MD, August 1999)

July 1999 Test

The next test of the EIA Web site was conducted in July 1999[5]. Seventeen participants were tested. Each was given four consecutive exercises in which they were asked to find a particular piece of data on the EIA Web Site and a maximum of ten minutes to complete each exercise. The participants were a mix of EIA and DOE employees and industry, the media, and the general public. The tests were conducted at the Bureau of Labor Statistics (BLS) cognitive lab, a makeshift cognitive lab at EIA, and private homes.

Methodologically:

- The think-aloud procedure worked.
- Phrasing the questions in common English, instead of agency jargon, made them understandable to the participants.
- Ten minutes provided sufficient time to complete an exercise.

Substantitively, several common themes emerged:

- EIA uses a lot of technical terms, creating its own language, making it difficult for users to find the information they need.
- Search strategies were nearly as varied as the number of participants.
- The team also observed, and some participants said this explicitly, that the larger type for the links on the right side of the pages signified to them that EIA placed more importance on that information than on the links on the left with smaller type. (This was not EIA's intention.) This is consistent with, for example, Dillman's work on survey designs that "words, numbers, and graphic symbols can be increased in size to attract the respondent's eyes, or decreased in size to avoid commanding the respondent's attention.[6]"

Findings to the debriefing questions (Attachment 1) were:

- The respondents were asked if they were confused while using EIA's site. Several responded that the site was confusing rather than their being confused by the site.
- Participants reported widely varying degrees of confidence that they found the correct information.
- Participants who reported being "totally confident" did not necessarily find correct answers, while some subjects who chose the neutral response, "in between," did in fact locate some correct answers.

[5] Ibid.
[6] Don A. Dillman, Mail and Internet Surveys: The Tailored Design Method, 2nd Ed. (New York: John Wiley & Sons, Inc.), p. 106.

2000 Tests

As a result of the July 1999 test, EIA realized that substantial changes were needed to improve the site. A Joint Application Development (JAD) session was held with participants from all parts of EIA. From this session, the "all roads lead to Rome" principle emerged. We wanted there to be several ways to find any particular piece of information.

Based on that principle, we designed a new home page. Before doing formal laboratory testing of an on-line prototype, the Web Usability Team conducted two prototype tests of the new home page at EIA's March 2000 National Energy Modeling System Conference in Crystal City, Virginia. EIA tested 69 people. The first test displayed to participants two paper designs. One was a "clean" screen with only the information headings, or channels, displayed. The second design listed all the subheadings under their channels. In the second test, EIA showed participants an electronic mockup of the design with subheadings to see if people would notice them and if they liked them. The Web team found that participants preferred a mouse-over version in which users placed the cursor on or channels to show a pop-up menu of the choices under that channel.

Encouraged by and building upon the NEMS tests, EIA decided to develop the on-line prototype of the Home Page with mouse-overs and to test it formally. The tests were conducted in July 2000 at the Bureau of Labor Statistics Cognitive Lab. EIA tested 15 participants. They were a cross section of EIA data users: Media (4), associations (3), library (1), government (2), academics (4), and research (1). The setting was:

- Participant and interviewer in an office with a workstation.
- Participants were asked to find answers on the EIA Web site to four consecutive randomly selected questions with a ten-minute maximum to answer each question.
- EIA note takers behind the one-way mirror in order to observe without being a distraction.
- Videotaping of the session, with the participant's permission.

Findings:

- Most users who had used the current EIA site preferred the new Home Page design
- Most users realized the "meat" of the page was in the middle, the Channels.
- Users seemed able to select an appropriate first button very easily.
- More people were successful in finding the correct answers in this test than in the July 1999 test.
- Data appears to support a positive view of the new design. There was a much higher correlation, r-squared = 0.42, between participants expressing confidence that they found the right answers and actually finding them than in July 1999, r-squared = 0.10.

May 2001 Tests

EIA implemented the new Home Page in October 2000. EIA also redesigned the second level pages to have the same look and feel as the Home Page, in short to make navigation more transparent. The purpose of the May 2001 tests was to evaluate the effectiveness of the new design.

Methodology

The Web Usability team used the same methodology that it had used in the previous year's tests. Like the 2000 tests, the 2001 tests were conducted at BLS Cognitive Lab. Again, they were videotaped, with the participants' permission, and team members observed carefully and took notes. Also, as with the 2000 tests, 15 participants were tested. Though not randomly selected, they were, the team believes, a cross section of EIA users. The team recruited participants at:

- The 2001 National Energy Modeling System Conference (an EIA-sponsored conference)
- From personal contacts
- Media (an increasing consumer of EIA data)
- Bureau of Labor Statistics volunteer list
- New EIA employees

The breakdown of participants was 9 non-EIA Federal and an EIA employee plus a consultant, an oil company person, an undergraduate student, and one each from the trade press and a state agency. Participants were given four or five randomly selected exercise questions, with a ten-minute maximum to answer each question (Attachment 2). Total interview time (including debriefing) was 35 to 55 minutes.

Findings

First, participants navigated through the Home Page and second level pages more quickly than in the previous tests. Several reported, unprompted, that they like the info-centric approach. The participants also reported themselves to be:

- Slightly less expert in using the Internet than year 2000 participants. However, the team thought that they actually showed more expertise in using the Net than 2000 users. Maybe this shows that, though people are becoming more familiar with the Internet, the bar of what is Net expertise is higher.
- Slightly more familiar with the energy industry and energy terms than the 2000 participants

The percent of correct answers and unanswered questions was instructive.

- Percent of correct answers dropped from 54 percent in 2000 to 40 percent in 2001. In 2001, we used many of the questions on which subjects performed poorly on the 2000 testing, so this lower success rate was not a surprise.
- Percent of all questions left unanswered increased from 15 percent to 35 percent.
- The 2001 participants were much more aware of obtaining correct or incorrect answers than the 2000 participants. As reported, the correlation between participants' actual number of correct answers versus their reported "confidence that they found the correct information" was r-square = .68. This is surprisingly high and much higher than last year's .32. Maybe the large number of unanswered questions can partially explain this.

Finally, the average time to answer a question was 6 minutes and 38 seconds. This varied from 3 minutes and 15 seconds for "What was the projected price of gasoline this summer" and 4 minutes and 19 seconds for "How much profit did U.S. oil companies make in 1999" to 10 minutes and 26 seconds for "How much electricity was generated from solar energy in the United States in 1993?"

Another finding of note was that "all roads do not necessarily lead to Rome." Earlier, the report discussed that one of the guiding principles in the Channel design of the EIA Web site was that "all road should lead to Rome;" that there should be multiple paths to the same data. Several users explicitly noted that they were considering several ways to begin their search. Yet, all roads still did not lead to Rome on the EIA site. For example: If you click forecasts >natural gas, you go to a different place than if you click natural gas> forecasts.

The Team's most important finding was at the third and lower level pages. Web users expect to find information fast. Our participants had problems quickly finding the information they were asked to look for. The reason appeared to be because the pages often were paper publication pages transposed onto the Web. Looking for and viewing information on a Web monitor is fundamentally different from looking for and viewing it on a printed page in a paper publication. The tests demonstrated this problem in several ways:

- Participants often found text reports when they wanted a table. Encountering text when looking for a table, they were often stymied, frustrated, and confused. "Expecting a table. It is here somewhere."
- Many participants said there was too much text to read and that the paragraphs were too long. "Reading text is hard to do.[7]"
- Participants reported that reading was made even harder by:
  - "Creative wallpaper" backgrounds
  - Lack of high contrast between the text and background
  - Small, almost unreadable, font sizes

[7] Paul Muter, "Interface Design and Optimization of Reading of Continuous Text," H. van Oostendorp and S. de Mul, Eds., *Cognitive Aspects Of Electronic Text Processing* (Norwood, N.J.: Ablex Publishing Corporation, 1996). Muter cites research that says reading from a videotex terminal is about 28 percent slower than reading from paper.

- Participants did not like text tables with lots of horizontal and vertical scrolling. For example, they could not remember row and column headings and would have to scroll back to the top of a table to see if the column heading there was for the total they had found at the bottom of the table.
- Participants would get to a page, especially through the search, and not know where they were. There was no context, like there would be for a printed report. There was no table of contents, index, executive summary, or title page for the data. Participants also noted that in many places on the site the lack of context was reinforced by:
  - The titles of tables and graphs (and even text sections) not being intuitive
  - Jargon words not being defined
  - Acronyms not being spelled out
  - The source of the data not being cited
  - Links to supporting or explanatory information not being supplied

Participants, often unsolicited, made a number of recommendations to make navigation quicker, data extraction easier, and tables and graphs more "stand alone." The latter is a necessity for presenting data on the Web. There is often only one table or graph on the screen at a time. Users view it independently of others on the site. To make Web pages, particularly tables and graphs, more "stand alone" or self-explanatory than paper publication ones:

- Use bullets, headers, high lights, jump links into documents.
- Put column totals and current data points at the top of table, rather than the bottom. On paper you can see the whole page and your eye can go to the total at the bottom. This is often not so on Web.
- Do not use text tables.

Implementing these suggestions would help EIA achieve compliance with Section 508, an amendment to the Rehabilitation Act of 1973. Section 508 requires that the public and Federal employees with disabilities have access to, and the use of, electronic and information technologies in a way comparable to individuals without disabilities. For example, "creative wallpaper" behind low contrasting text would not be in compliance with Section 508.

American Customer Satisfaction Index

Support for the 2001 test findings also comes the *American Customer Satisfaction Index Survey* done for EIA in early 2001[8]. The ACSI survey conducted telephone interviews with 260 of EIA's information users. They asked about three areas of electronic services:

- Dissemination services
- Information quality
- Web Site structure

Of these three areas, the quality of the information on the EIA Web site scored the highest, with a calculated index rating of 83. In the ACSI survey, any score over 80 on a driver of

[8] American Customer Satisfaction Index, "Report on the Energy Information Administration," (April 2001).

satisfaction is considered a very strong score, an excellent score. Clearly, Web site users find the information to be very useful and accurate. Users gave a reasonably good rating to EIA for updating web pages with current information in a timely manner and for the variety of electronic information services, such as the Web site, listserv, references to experts and the help desk. The Web site structure scored about the same as dissemination, although users gave the lowest relative rating among the components to the effectiveness of the navigation tools on the Web, such as the search engine, the A to Z search, and menus, links, and other buttons[9].

ASCI concluded that "the organization and navigation of the Web site is the prime candidate for focusing resources, as it had the lowest score and does have a significant impact on quality.[10]"

Next Steps

EIA is at a crossroads in Web development in moving from paper/office-centric configuration to an electronic information-centric configuration. EIA's customers are weighing in heavily in favor of more consistent accessibility. They are telling our usability testers (us) that it is not good enough simply to have everything on the Web, because they still cannot find what they are looking for on our Web site many times.

To cross the Rubicon to a fully implemented info-centric Web site, EIA's Information Products and Services Committee, the EIA Committee that sets EIA Web site policy and manages the site, has developed a three-stage plan. Stage 1 will be changes, many developed from recommendations from our team's testing, that can be implemented easily before the end of the year.

Stage 2 will be changes that will be implemented in by the end of 2002. An example of this would be to develop a "My EIA" page, similar to "My Yahoo," that will give users the ability to create a custom information service.

Stage 3 will be fully implemented after the end of 2002. Its goals are to:

- Eliminate all "publications" except those called for the EIA Strategic Plan
- Replace "publications and tables" with information packages designed for specific user classes or make them customizable by individual users. For example, there would no longer by a Petroleum Marketing Monthly but a information topic called Gasoline

The complete transformation to an info-centric site where all roads lead quickly to Rome will not be easy. The plan will need to be a top priority with the agency in both words and resources. It will take money, time, a great deal of effort, and a fundamental change in how EIA thinks about structuring its data for dissemination.

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[9] Ibid., p. 9.
[10] Ibid., p. 10.

Summary

In the past EIA thought we were successful if we had all our data and information available electronically on the Web. Organizations that put statistical information on the Web can no longer just make a Portable Document Format (PDF) or text file of a paper publication, post it on a Web, and expect readers to find and extract information just like they did from the paper publication. Our usability research has helped illustrate that this definition of a successful Web site no longer is valid.

People read material differently on a computer monitor than from a paper publication. In a paper publication, when a reader wants to see a total, a unit of measure, a footnote, definition for a term, all he or she needs to do is scan to the top or bottom of the page or look in a glossary or appendix in the back of the publication. This is much more difficult on a computer monitor. Our team has seen these differences repeatedly in our usability tests.

Customer expectations are rising. Users are increasingly becoming aware that the process of reading and extracting information from a computer monitor is more difficult than from a paper publication and they want agencies and establishments to make their Web products Web-friendly. They want to see quickly and clearly on the monitor all the information they need. Presentation of the content is as important as the content itself.

The best way to know for sure how customers are using your site and how successful they are in finding information is to watch them work. EIA plans to continue to conduct usability tests to determine our progress in moving toward a user-friendly, understandable Web site.

Attachment 1:
July Debriefing Findings

Feel About Site	N
Completely confused	0
Somewhat confused	7
In between	3
Most things made sense	6
Everything made sense	1

Confidence	N
Not at all	3
Not very	2
In between	6
Fairly	4
Totally	2

Ease of Searching	N
Very Difficult	3
Difficult	2
In between	7
Fairly Easy	4
Very Easy	1

Site Rating	N
One of worst	0
Not as good as most	4
About same	8
Better than most	3
One of best	2

Attachment 2:

Questions for May 1-3, 2001, Usability Test
BLS Cognitive Laboratory

1. How much energy was consumed in the United States in 1999?

   96.6 quadrillion Btus
   http://www.eia.doe.gov/pub/pdf/multi.fuel/aer1999/sec1_5.pdf

2. What was the price of electricity in Massachusetts in 1985?

   $24.34 (nominal dollars) per million Btus
   http://tonto.eia.doe.gov/FTPROOT/multifuel/037697.pdf

3. How much carbon dioxide was emitted in the United States from using coal to generate electricity in 1999?

   1,918,146 thousand short tons (11,295 + 6,547 + 1,900,304)

   http://www.eia.doe.gov/cneaf/electricity/epav2/html_tables/epav2t25p1.html

   1,787,910 metric tons

   http://www.eia.doe.gov/cneaf/electricity/page/co2_report/co2emiss.pdf

4. What percentage of oil used in the U.S. in 2000 was imported?

   49.6% 9.61 (net imports)/19.39 barrels per day
   54.4% 10.55 total imports/19.39
   55.6% (from petroleum page using total imports)

   http://www.eia.doe.gov/pub/pdf/multi.fuel/aer1999/sec5_5.pdf

   57%

5. How much electricity was generated from solar energy in the United States in 1993?

   0.9 billion kilowatthours
   http://www.eia.doe.gov/pub/pdf/multi.fuel/aer1999/sec8_7.pdf

6. What state had the highest residential electricity prices in 1999?

   Hawaii 14.30 cents http://www.eia.doe.gov/cneaf/electricity/esr/t12.txt

7. How much oil did Russia export in 1999?

3.96 million barrels per day http://www.eia.doe.gov/emeu/cabs/rusexp.html

8. How much electricity was generated using natural gas in the United States in 1999?

   565 billion kilowatthours

   http://www.eia.doe.gov/cneaf/electricity/epav1/elecprod.html#tab5

9. How much natural gas will be produced in the U.S. in the year 2020?

   About 30 (29.79 to be exact) quadrillion Btus
   http://www.eia.doe.gov/oiaf/aeo/images/figure_5.jpg

10. How much profit did US oil companies make in 1999?

    22.9 billion dollars Http://www.eia.doe.gov/emeu/perfpro/btab02.html

11. How much did the demand for electricity grow in California between 1990 and 1999?

    11.3 percent

12. What was the year of the highest gasoline prices in the U.S.?

    1981 /pub/energy.overview/monthly.energy/txt/mer9-4

13. How much oil was in the Strategic Petroleum Reserve in January 2001?

    541.7 million barrels

    http://www.eia.doe.gov/pub/oil_gas/petroleum/data_publications/weekly_petroleum_status_report/current/pdf/table03.pdfWhat was the average residential price for heating oil in the United States as March 19, 2001?

    $1.407 per gallon

    http://www.eia.doe.gov/oil_gas/petroleum/special/heating_update/heating_update.html

14. What percent of U.S. electricity was used in California in 1999?

    6.5 or 7 percent

    http://www.eia.doe.gov/cneaf/electricity/esr/t06.txt

15. What is the projected price for gasoline for this summer?

    $1.49 per gallon

    http://www.eia.doe.gov/emeu/steo/pub/special/summout/2001/summer_gas_outlook.pdf

16. How many commercial buildings were there in the Northeast in 1999?

    677,000 buildings

    http://www.eia.doe.gov/emeu/cbecs/char99/prelim1.htm#table1

Navigation Questions

17. What does “click for the text menu” mean to you?

    You get all the drop-down menus printed on the screen

18. What do you think you would get if you clicked on the A-Z button?

    A list of all major topic items