ABSTRACT

In June 1998, the US Department of Energy (DOE) National Transportation Program (NTP) entered into a Cooperative Agreement with the ATR Institute (ATRI), a University of New Mexico research organization affiliated with the School of Engineering. The NTP supports the DOE transportation infrastructure, and coordinates transportation activities for all non-classified shipments of hazardous materials, including radioactive and mixed wastes, for all DOE programs. In addition, the NTP provides information about non-classified shipments to the NTP’s Internal and External Stakeholders. The Agreement between NTP and ATRI provides for the development and operation of the National Transportation Resource Exchange Center (T-REX), a unique Virtual Library dedicated to providing information about the transportation of radioactive materials to DOE NTP stakeholders.

INTRODUCTION

The Problem

The ATR Institute (ATRI) at the University of New Mexico has developed the Transportation Resource Exchange Center (T-REX) under cooperative agreement DE-FC04-98AL78881 with the National Transportation Program (NTP) of the U.S. Department of Energy (DOE). The T-REX mission is straightforward in its simplicity: creating a single point source where Users can find the answers to the complex issues surrounding radioactive material transportation. See Figure 1 for the T-REX Home Page (www.trex-center.org)

The ATRI has identified five primary goals that must be met to fulfill the T-REX mission. These goals include:

- Provide pertinent informational materials to diverse audiences;
- Provide reference and research services.
- Develop training for utilizing the T-REX.
- Improve radioactive materials transportation information management and dissemination.
- Build relationships that promote user assistance in developing the T-REX.

The T-REX is the single-point source of information on the transportation of radioactive waste within the U.S. Department of Energy’s National Transportation Program. The T-REX has acquired a deeper understanding of the diverse roles filled by program stakeholders and the need to accommodate specific requirements in the T-REX service capabilities. The ATRI determined that a feedback mechanism between Suppliers and Users of radioactive materials transportation information is necessary for the T-REX Center to meet the needs of its different and diverse audiences. Such input would help the T-REX become a more efficient and effective link between the Producers, Users, and repositories of information related to the transportation of radioactive materials.
Most information centers, after a specified amount of time, determine the needs of the Users based on an analysis of User queries. By conducting a qualitative User-needs assessment, the T-REX identified User needs up-front. A second study was performed with a multitude of information Providers to determine where the needed information is housed. By taking these approaches at the onset, the design of the T-REX ensures that stakeholders easily obtain answers to their information searches.

The T-REX is a virtual single-point center that is a conduit between the Users and Providers of information related to the transportation of radioactive materials. Regardless of whether the information is sought for research, educational enlightenment or pure curiosity, users of resource materials fall into two broad categories: those that know what they want and where to get it, and those that do not. Those that know where to go for their needs will use T-REX when it can lead them to new or more detailed information. The primary Users of the T-REX, which are the primary stakeholders T-REX is designed to serve, are those that have questions, but are unaware of where the answers lie, or how to easily attain these answers.

**EVIDENCE**

The ATRI developed two tools designed to identify the gaps between user questions and information available. The two tools are: The T-REX User Needs Assessment and the National Transportation Information Resource Inventory.
To determine the prominent information needs of stakeholders of the NTP, a qualitative information needs assessment was conducted. Stakeholders were defined in two categories: 1) Internal stakeholders are DOE employees, DOE contractors, individuals at the national laboratories involved in the transportation of radioactive materials and other DOE-funded agencies; 2) External stakeholders are those with an interest in the transportation of radioactive materials, but not attached to the DOE. This includes state, local and tribal governments, special and public interest groups, other federal agencies, and public and private institutions.

The T-REX User Needs Assessment was proposed in the late summer of 1998 to the DOE Communications Topic Group of the Transportation External Coordination Working Group (TEC/WG). The recommendations from the topic group were incorporated into the assessment. The TEC/WG supplied input and advice during the Fall of 1998. The study commenced in October 1998 and concluded in January 1999.

The T-REX identified eighty-four individuals that are representative of the Internal and External stakeholders to participate in the User Needs Assessment. All but two of the interviews conducted for the assessment occurred by telephone. Forty-one of those interviewed were External stakeholders and thirty-seven were Internal. Each of the stakeholders participating in the needs assessment received an introductory letter explaining the T-REX and the purpose of the User Needs Assessment. They were asked to reflect upon their individual needs and were told they would be contacted within a ten-day period for their input. As promised, the T-REX contacted each of the stakeholders and questioned them about their functional areas related to the transportation of radioactive materials, information use and coordination, wants and needs in securing relevant information, as well as their perceptions concerning availability and accessibility of needed information. Interviews typically took between fifteen to forty-five minutes, depending on the specific areas of importance to the respondent.

The other T-REX tool, the National Transportation Information Resource Survey, provided the data needed to determine the extent and type of information available by Providers. Responding to this design necessity, the T-REX national inventory of information providers included specialized libraries, reading rooms and academic institutions. The providers were invited to participate in a ‘national transportation information resource inventory’ of both DOE and non-DOE information repositories. A questionnaire requesting basic data and operational characteristics about the repository was developed. The questionnaire was also provided to the TEC/WG Communications Topic Group for comment, and a final survey was developed after receiving their input. Approximately two hundred and seventy surveys were mailed to the information repositories. The results of the survey were compiled and presented to the TEC/WG at their semi-annual meeting in mid-January of 1999.

In the most basic sense, these two tools told the T-REX what and where information related to radioactive material transportation is available, and which information is the most highly prized by the Users. The coupling of the Provider survey and User needs assessment ensured that the T-REX has the answers to User questions before they are asked, thus allowing for a useful search by the stakeholders.

**RESULTS**

**Identifying User Information Needs**

All interviews were transcribed, numbered and coded for analysis. Internal stakeholder informational topics that emerged were:

- State, federal and international regulations related to radioactive materials transportation;
• Interpretation of regulations;
• DOE orders;
• Shipping program information including manifests, characterization, packaging and routing;
• Responsibilities for the different aspects of transporting materials;
• Future shipping projections;
• Availability of packaging;
• Accident and incident statistics for a variety of levels of materials, modes and geographic areas;
• Lessons learned and historical background of shipping programs, and
• Outreach efforts by the DOE.

External stakeholder responses also include, in addition to those described above, the following:

• DOE decisions on routing and programs;
• New transportation protocols;
• Individual county and state regulations;
• Entities responsible for shipping;
• Environmental assessments and impact statements;
• Access to real-time graphic mapping and monitoring of shipments, Cultural information related to
effective communication with tribal governments;
• Radioactive materials and waste news articles provided in a real-time manner, and
• Training materials and/or training kits.

**Building an Ontology**

At both the Emergency Management Web site and the Office of Civilian Radioactive Waste Management Web site, many terms used to express transportation or transportation-related activities were also collected and recorded. These terms were reviewed to understand which activities of transportation are carried out by, and are most relevant to, Internal DOE stakeholders. Some DOE transportation programs and offices do not have Web sites, and conflicting information sometimes exists across DOE transportation Web sites. T-REX continually assesses the findings and continues to develop the ontology, a logical data design and an overview of the customer base.

**Tracking**

The T-REX Web site was launched in July 1998. Shortly after, Linkbot Pro tracking software was purchased and installed to make Web site analysis more comprehensive and efficient. Linkbot Pro produces 19 graphical reports detailing major Web site problem areas and includes a topographical site mapping feature that allows assessment of the structure and density of the Web site. The software scans the entire site and checks for problems such as broken links, slow pages, orphaned pages, stale content, poor HTML syntax, deep pages, broken anchors or missing metatags. Linkbot Pro is set to automatically scan the entire Web site each Monday. Weekly, Staff reviews the reports for nonfunctioning hyper-links and edits the links so the site remains fully functional. Figure 2 shows a screenshot of the Linkbot Pro Web Site Analysis of hyperlinks and a graphical analysis of the Web site is presented in Figure 3.
Fig. 2. Linkbot Pro Web Site Analysis

Fig. 3. Linkbot Pro Web Site Graphical Analysis
WebTrends Log Analyzer software was installed on the server. It rapidly processes Web site log files and produces comprehensive reports in real-time mode. Attached is a sample report (Attachment 1). The Web hits to the T-REX pages continue to increase and as of 30 September 1999, there have been 2509 visits to the T-Rex home page. The report option offers includes the following broad categories: General Statistics, Resources Accessed, Visitors and Demographics, Activity Statistics, Technical Statistics, Referrers and Keywords, Browsers and Platforms.

Transportation of Radioactive Materials (TRAM)

Information Technology (IT) has evolved into an essential component to achieve several missions of the NTP and its parent organization, the DOE. As such, IT is a key organizational tool for attaining strategic goals, enhancing efficiency, and reducing costs. Within the T-REX Virtual Library, the TRAM Search Engine is designed to be the IT component that provides instantaneous results when a user queries the system for the DOE people or organizations that possess expertise or specific information regarding any aspect of the transportation process. Figure 4 displays the Home Page of the TRAM (http://trex-center.org/thetram.asp).

Fig. 4. The Home Page of the TRAM (http://trex-center.org/thetram.asp)

The logical data design of the TRAM is based on the results of the user assessment and provider survey. Many design features were built into the TRAM database architecture and search engine capability in order to satisfy a variety of information access problems reported by DOE Stakeholders. Information
usability difficulties, missing content and information overload were dealt with by various TRAM elements.

Nine information usability problems were addressed by database features built into the TRAM. These information problems and their corresponding solutions are outlined in Table I.

Table I. Information Problems and the Corresponding TRAM Features to Address the Issues

<table>
<thead>
<tr>
<th>Information Problem Type</th>
<th>TRAM Feature to Address Issue</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information hard to get</td>
<td>All information available about the organizations involved in the transport of radioactive materials on the Internet can be found in the TRAM.</td>
</tr>
<tr>
<td>Information hard to use</td>
<td>The TRAM is searchable on four levels: Major function of the group, minor function, scope of work and Internal/External DOE status.</td>
</tr>
<tr>
<td>Information too voluminous or lengthy</td>
<td></td>
</tr>
<tr>
<td>Information too fragmented</td>
<td></td>
</tr>
<tr>
<td>Information not flexible/searchable</td>
<td></td>
</tr>
<tr>
<td>Information apparently does not exist</td>
<td>The limited keywords supplied by the TRAM will guide Users through performing more precise searches than if Users were to conduct searches through free keyword terms.</td>
</tr>
<tr>
<td>Information never collected</td>
<td></td>
</tr>
<tr>
<td>Information collected in the wrong units</td>
<td></td>
</tr>
<tr>
<td>Information is classified</td>
<td></td>
</tr>
</tbody>
</table>

Eight areas of subject matter reported by Stakeholders to be either absent from the Internet, or difficult to locate on the Internet, were added to the TRAM. The various ways in which this information was incorporated into the TRAM is outlined in Table II.

Table II. Stakeholder Information Problems by Content and the Corresponding TRAM Features to Address the Issues

<table>
<thead>
<tr>
<th>Information Problem by Type of Content</th>
<th>TRAM Feature to Address Issue</th>
</tr>
</thead>
<tbody>
<tr>
<td>State, Federal and International Regulations</td>
<td>Searchable by organizations that create, enforce or interpret Laws and Regulations at the International, National, State or DOE Site levels.</td>
</tr>
<tr>
<td>DOE Employee Database, searchable by Responsibility and/or Expertise</td>
<td>Searchable by area of expertise and provides individual contact information when the expert is located.</td>
</tr>
<tr>
<td>Future Shipments</td>
<td>Searchable by Waste Generators and DOE sites. These groups frequently have a projected shipments component on their Web sites.</td>
</tr>
<tr>
<td>Packaging Availability</td>
<td>Searchable by organizations that develop, test, certify or track packages.</td>
</tr>
<tr>
<td>Accident/Risk Data</td>
<td>Searchable by organizations that analyze incidents, assess safety, risks or health effects and improve safety.</td>
</tr>
<tr>
<td>DOE Decisions on Routes and Programs</td>
<td>Searchable by organizations that determine routes, enforce route requirements and maintain historic or predict future shipments by route.</td>
</tr>
<tr>
<td>Information Problem by Type of Content</td>
<td>TRAM Feature to Address Issue</td>
</tr>
<tr>
<td>----------------------------------------</td>
<td>-----------------------------</td>
</tr>
<tr>
<td>A List of Identified Shippers</td>
<td>Searchable by carriers in the areas of air, sea, truck, rail or inter-modal in conjunction with the levels of [DOE] site, state, national or international shipments.</td>
</tr>
<tr>
<td>Materials/Funding Available for Training</td>
<td>Searchable by Emergency Management Training according to the levels: [DOE] site, state, national, or international.</td>
</tr>
</tbody>
</table>

To enhance navigability, TRAM developers created a page layout design that helps the user from getting lost within the site. These elements of the TRAM page layout include:

- the TRAM name and logo on every page, with the logo linked to the homepage;
- straightforward, simple headlines and titles on each page that clearly explain what each page contains;
- structuring page sections using a layout instead of long vertical lists;
- maximizing the use of hypertext on all pages - not creating long pages;
- employing mouse overs (brief written explanations of all link buttons that appear when the mouse is resting over the button) to help the user predict what information will be provided if that link is selected, and
- having a search capability on each page.

Several TRAM development activities refined the search results of the TRAM in order to increase the relevancy of information provided to Users. The TRAM data-collection phase narrowed the scope of the database and search engine to locating Internal DOE Stakeholder organizations for Users. Data classification procedures include examination of a DOE organization’s mission statement, strategic plan, projects/programs page, and information products prior to categorizing the DOE organization in the TRAM. Next, the work that the organization performs was classified according to the major and minor work functions built in the TRAM database. Key word menus were developed, using these same major and minor work functions, to help Users narrow their search fields before initiating the search.

The continual addition of appropriate Internet links to the database has brought the total number of Internal DOE and External DOE organizations housed in the TRAM to 803. The key pieces of information included about each organization are Home Page, a T-REX Tip (a concise description that distinguishes the work of one organization from a similar organization), General Background, Historical Background, Transportation Background, Information and Resources, Selected Information Products, Corporate Affiliations, and Contacts.

The ATRI staff created T-REX Tips for each organization. Staff also compiled brief descriptions of the information that the user can expect to find upon selecting the link to the background, information products, affiliations or contacts of that particular organization. Because some organizations do not have all eight pieces of information published to the Internet, the total number of links available within the TRAM is 3500.
EXPECTED RESULTS

Ongoing Information Mapping

The fields of Web site design and Web site usability are relatively new, with a growing body of literature emerging since the late 1980s to mid 1990s. The usability of a Web site depends on what users are trying to accomplish: surfing, doing research, shopping, or downloading software. Web site usability also depends on the organization’s goal for creating the website: marketing a service, selling merchandise or providing information to employees, shareholders, or customers. But whatever the goal, information is the central theme. The more a Web site helps people find the information they are seeking, the more usable the site is. Usability rules the Web because users experience the usability of a site before they ever commit to using it. Good website usability requires clear navigational aids. Overuse or inappropriate use of graphics can detract from the usability of a website. Usability testing is important because even the most aesthetically pleasing site can be very difficult to use.

Great differences exist between websites that are effective for users who are on the Internet for entertainment versus users who are on the Internet for information retrieval. Clear links within a website are critical since users never attempt to learn the structure of a Web site. Even with a variety of techniques, making comparisons between the information on two or more different Web sites is problematic for users. The kinds of items that web designers place on Web sites to attract users who are surfing or on the Internet for entertainment are in direct conflict with the goals of users who are on the Internet for information retrieval. Website usability testing has shown that graphics and animation are considered “visual noise” by users who are seeking information.

The research also has shown that text links are always examined and considered by users before users examine image links, if the users examine image links at all. Links that help the user predict what information lays behind the link were described as the most useful by test participants. Links that are labeled vaguely, or multiple links on one page that seem to contain the same information, were described as confusing. Moreover, preliminary website usability research has shown that when users get lost or confused at a website, they continue to go forward. Users do not know where or why they had gone wrong and users do not seem concerned to discover where or why they got lost. There is no evidence that users ever attempt to understand the layout of a site. Therefore, the links on every single page have to be highly descriptive and yet made simple so users may pursue a path through the website. Successful links must help the user predict where the link will lead as well as differentiate one link from all the others on the same page.

Preliminary Web site usability research has demonstrated that users struggle to make comparisons between information sets found on the Internet. Users try to rely on their memories and consistently fail. Users write down information on scraps of paper before they proceed to the next site, users print out many pages from the Internet and users, who are able to do this, open two browser windows and toggle back and forth between sites to look at several pieces of information simultaneously. These various techniques prove tedious and frequently users give up trying to make comparisons altogether after a brief period.

The degree of usability is dependent on Web site design. Because users of a site will determine the successfulness of a site, website design must focus on the user-centeredness. User-centered design is the practice of designing products whereby users can perform required use, operation, service and supportive tasks with a minimum of stress and a maximum of efficiency. Web design requires decisions about the following:
• the appearance of links,
• how to explain where users can go and where each link will lead,
• a visualization of the user’s current location, and
• the information architecture of the website.

User-centered design is an evolutionary process whereby the final product is shaped over time and utilizes input from typical users in all phases of the product development cycle as well as the life of product ownership. This is true even if the product is information. The design team must make principled decisions based on data gathered from real users. In contrast to traditional design methods that typically solicit user input only as the product nears completion, user-centered design solicits feedback continuously throughout product development. Designers and information specialists must cooperate with database developers from the initial product definition through the product release and throughout the life of the product.

The first step in user-centered design is to create a clear, short statement of objectives to form the foundation of the site design. The statement will also be the tool used to analyze the success of the site.

Through the study of current Web design research, T-REX designers appreciate that new sites consistently fail unless the user can quickly grasp the purpose, the navigation techniques, and the superiority of a new site over an old. T-REX designers have incorporated the following core values in recognition of the fact that new Users scan and engage in a rapid decision-making process during interactions on the Internet:

1. The T-REX meets the information needs and inquiries of Stakeholders involved or interested in the transportation of radioactive materials. The Center collects, organizes, and provides information, facts, and statistics about DOE transportation activities nationwide.
2. The TRAM is the only online database that coordinates information about all Stakeholder organizations in the arena of transportation of radioactive materials and wastes. The TRAM Search Engine is unique in its ability to provide the datasets of Web site homepage, background, information products, corporate relationships, and contacts regarding all Stakeholder organizations.

The above values drive the all of the design elements in the T-REX. First of all, people need to stay at the T-REX Web site for a few critical minutes necessary to grasp the site’s format and abilities. Additional usability design elements have been included to keep Users with the T-REX. These are delineated as:

1. T-REX will become the single information point of the DOE National Transportation Program.
2. The T-REX will develop and implement a training program for interested stakeholders and other identified customers on the methods to best utilize and access the data and information collected and maintained by the T-REX.
3. The T-REX will implement an outreach component that will familiarize all those in the ‘nuclear materials transportation community’ about the services and information sources provided by the T-REX. This will include Internal DOE personnel, local and state governments and nongovernmental organizations.
4. The T-REX will continue to collect, organize and provide information, facts, and statistics concerning all DOE transportation activities related to radioactive wastes.
Ongoing Virtual and Print Collections Growth

The T-REX Library consists of books and reports, videos, and online documents. In 1998, the DOE NTP collection was moved from Germantown to the T-REX. Materials from the Office of Civilian Radioactive Waste Management were also transferred to the T-REX physical location in Albuquerque, New Mexico. The merged collections were indexed in an online database, T-REXDEX. Over 500 additional documents were identified during this fiscal year and added to the Web-searchable T-REXDEX. After locating the desired document in the T-REXDEX, the user can perform full-text searches on each of these documents. The T-REXDEX now contains over 5,000 documents. The scanning of printed documents into electronic files process is ongoing. Over 50,000 pages have been scanned, converted to searchable Adobe Acrobat PDF files, and placed on the server. Videos have been viewed and short abstracts written for each film. Staff continually identify and obtain additional documents, both hard copy and online.

The T-REX collection is also dynamically growing through the development of new on-line information products, based on User feedback and need. For example, the following information products were created and published to the T-REX Web site during the first half of the year 2000 as a direct result of expressed User need for this information:

- Risk Communication: An Annotated Bibliography of Sources for Stakeholders in the Radioactive Materials Transportation Process
- Considerations of Routes and Modes in the Transportation of Radioactive Material and Wastes: An Annotated Bibliography
- Recursos en Español - Resources in Spanish on the Transportation of Radioactive Material: Related Sites and Documents

CONCLUSION

T-REX is built on the assumption that the management of radioactive materials transport information for Internal and External stakeholders is like other bodies of knowledge. The collection, organization and dissemination of this information is a complex and time-consuming process. Individuals who are not professional researchers or scientists need information sources who provide reliable information, service, and support. T-REX is such an entity. T-REX will ensure that Users have what information they need to run their businesses, offices, or organizations as well as possible, with maximum efficiency and reliability. Many of the information applications within the T-REX are time sensitive, so Users are assured that displayed information is displayed in real time.

The T-REX is different from other information resources because its information design clarifies the complex process of transportation of radioactive materials and wastes. A broader based, more diverse range of Users can now quickly and easily to locate the pertinent information that they need regarding the shipment of radioactive materials. Establishing T-REX as a visible entity within the DOE complex is a critical goal for the upcoming year. Providing information about T-REX to audiences who potentially may have an interest in this material and conversion of non-Users to Users is the number one objective for achieving this goal. In the long run, the ultimate objective of the T-REX is that individuals who produce and create the information become patrons and those individuals who are already patrons will contribute documents to be included in the T-REX, thereby making information producers and information users synonymous.
FOOTNOTES

bIbid.
cIbid.
dIbid.

REFERENCES