

**Communicating the Science and Technology of Safe RAM Transport**

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### **INTRODUCTION**

The prime goal of the Transportation Resource Exchange Center (T-REX) Web site and Virtual Library (<http://www.trex-center.org/>) is to establish a high-quality Web site to serve as a centralized information resource for the development and implementation of increased public engagement in policy discussions about radioactive material (RAM) transport. Thousands of metric tons of high-level radioactive waste—much of it in the form of spent nuclear fuel (SNF) which remain as by-products of the production of nuclear weapons, Navy reactor fuel, and electricity at nuclear power plant—await permanent disposal at over 70 sites across the US (1). Moving RAM and SNF from origination sites to new storage or disposal facilities takes place under public scrutiny. Public expression of concern can be substantial when RAM is to be transported. The general public's perception is that shipments of radioactive cargo are more dangerous than other kinds of hazardous shipments. Public documents and communication about these issues are often complex, highly technical, or legalistic and confounded by statutory overlap. Since T-REX's inception in 1998, its pages, content, and features continue to be determined by the information needs of diverse users.

### **One-Stop Source of Information**

Renewed attention to nuclear policy issues has increased the demand for available, timely, and accurate public outreach and information, which the T-REX Center provides. The research staff has included documents and other information from the US Departments of Energy and Transportation (DOE), the U.S. Nuclear Regulatory Commission (NRC), the US General Accounting Office, the Federal Emergency Management Agency (now a branch of the newly created US Department of Homeland Security), the national laboratories, state and tribal governments, governmental and nongovernmental associations, academia, and many other sources. The T-REX utilizes the latest methods of computer-mediated communication, risk communication, information mapping and management, and computer technology and visualizations to more plainly and clearly express information to internal and external stakeholders, while also maintaining a one-stop resource for related public documents and reports. The T-REX Search Tools page with links to a searchable database of documents, as well as a specialized database of organizations and people having a particular interest in RAM transport. T-REX's blending of textual and visual narratives—a Web site which has been specifically designed for information seekers, rather than 'Net surfers—can enhance information processing and reduce uncertainty about source credibility of information content online. Knowledgeable staff attends a toll-free helpline to assist users in need of information or expertise.

The T-REX Staff Can Help Users Four Ways:

- Email Website links to users so that they do not need to search the Internet;
- Provide facts and tips to users having difficulty in their information searches;
- Make sure users are aware of pre-existing information resources; and
- Answer information access questions by email, fax, phone, or paper.

### **T-REX as Honest Broker**

Housed at the ATR Institute (ATRI), University of New Mexico (UNM), T-REX acts as an honest broker for those who produce or transport RAM, as well as for regulators, Tribal governments, environmental groups, and the public. The T-REX Center is housed at a State Institution of Higher Learning. The T-REX staff are State employees who are not allowed to take sides in a policy debate and must abide by the State and the University's statutes and regulations regarding 'conflict of interest.' Thus, the staff at the T-REX is freed from the tyranny of any particular dogmatism and can focus on the scientific as well as social impacts of nuclear waste transportation. Moreover, Cooperative Agreement which the T-REX staff work under stipulates that the Virtual Library and Web site be neutral. Evidence of the neutrality of the T-REX Center can be found in the T-REX Newsroom (<http://trex-center.org/nuevo.asp>) which contains active links to US as well as international major media news articles, representing a wide variety of points of view. Over 3,500 headlines from 2003-current are included in this database covering all facets of the transportation of radioactive materials process. The news articles are updated five times weekly and archived in a database that is searchable by titles, media name (i.e., newspaper, television station) and State. The news stories are arranged chronologically by date, with the most recent or current date at the top and archived by month and year. Internal (DOE) and external (non-DOE) stakeholders' most visited news subjects are "environmental issues" and "current news regarding radioactive waste transportation." The News Headlines page/news archive is most frequently accessed T-REX feature. About 20 percent of online visits or hits on T-REX occur on the News Headlines pages.

### **COMPUTER MEDIATED COMMUNICATION**

The T-REX Web pages were designed with the awareness that the human mind runs on "associations." With one concept or symbol in its grasp, the mind snaps forward to the next mental junction or link that is suggested by the concatenation of thoughts (2). Also bound up with the communication of ideas from a linguistic standpoint is Whorf's (3) notion of "connection" to a common stock of conceptions and symbols, which, in the present day and age, must be intelligible to diverse users of the Web site. Association and connection are polar opposites which must be considered in the verbal and visual content of a Web site for information seekers. Nonlinear and dynamic, hypertext works by association—rather than indexing of ideas—and transcends the traditional, linear "words-on-paper" information display and processing (4). Hypertext refers to a document in electronic format which is linked to other electronic documents (5). The link enables readers to jump between documents even if the documents are on remote computers at a distance from one another. Ultimately, users visit Web sites for their content (6). Hypertext organizes textual information in a complex, nonlinear way, which facilitates an individualized and rapid exploration of large bodies of knowledge (2). The function of Web site design is to allow users to access the content.

### **Interplay of Content and Design**

Writing for the Web or content authoring requires a new style that is optimized for online readers who frequently scan text and who need very short pages with secondary information relegated to supporting pages (7). The writer must be succinct, but the text need not be without personality. The text should be easily scanned by the human eye. The computer screen is harder to read. Reading from a computer monitor is 25 times slower than reading from printed paper. But it is easier for people to scan or skim a Web page's contents if the page has less white space

(8). Hypertext should be used to split up long information sequences into multiple pages. Information should be presented in an inverted pyramid fashion that serves up information in little chunks of one idea per paragraph and begins with the conclusion. Each chunk should have no more than 100 words maximum, but each chunk should make sense on its own (5). The Internet is actually the network of networks permitting access to computers and their contents around the world, while the World Wide Web is the entire system of sites and their content files accessible by browser from anywhere in the world. A Web page is not a brochure. The Web is good for only two kind of information seeking: hit and run (or scan and move on) and downloading (copying a file—either text, graphics, or whole software application—from another Web site). Good content authoring requires a fundamental understanding of the way in which networks like the Internet operate from a *communication* standpoint.

### **Usability**

Although the World Wide Web is constantly changing, it is ruled by usability. If the information seeker cannot find the information sought, the user will look elsewhere or become discouraged and stop looking. Response times for downloads should be predictable. The speed and maneuverability of any Web site depends on the abilities of its slowest readers (5). A mere one-tenth of a second is about the maximum for having users feel the system is reacting systematically (7). Pages should load within ten seconds or less. Otherwise, users turn their attention to other tasks while waiting for the computer to finish. In addition, text on specific Web pages, was tested to determine the Flesch Reading Ease and the Flesch-Kincaid Grade Level to improve the readability by members of the lay public.

### **Assessing Usability**

The T-REX Web site has been tested for usability and ease of navigation from before the site went live to the present. Throughout the planning and design phases of T-REX and as T-REX continues to evolve, the T-REX has been assessed for usability. In addition, the T-REX undergoes evaluative assessment by the T-REX staff routinely. The instrument is an assessment tool which asks about the presence of some basic elements that the T-REX staff thought were important to include. The T-REX staff approached usability from the standpoint that not only should these elements be present, they should be readily apparent to potential users. If the presence of these elements was not readily noticeable, the T-REX staff reexamined the paths to the elements and also reevaluated aspects such as placement on the page, font size, type, and color. Periodic usability testing is important because even the most aesthetically pleasing Web site can be difficult to use.

### **Usability as Credibility**

The Web has been called the great equalizer because anyone can put up a site—with the result that there is no easy way for users to be able to tell whether a Web site is reliable. Users do not know who to trust on the Web. Great Web design can go along way to establish the credibility of the site. The visual appearance, easy navigation, professionalism, and quick downloads are some crucial factors in how credible the Web site is perceived to be. In creating a Web site on a subject as potentially fraught with controversy as the transport of radioactive materials, the T-REX staff took special steps to ensure credibility by basing the design and features of the Web site of the information needs of potential users.

## **Design for Functionality**

Nielsen (7) estimated that 90 percent of all commercial Web sites have poor usability and the cause is generally either poor structure or poor writing (lack of clarity or correct usage). Users need an obvious, clear model of the information space that can be provided by a well-defined structure (8). The usability of any Web site depends on what the designers *and* the users are trying to accomplish. In the case of the T-REX Center, users are seeking information, not surfing the Internet. Therefore, the design of T-REX necessarily had to follow function. The kinds of items on Web sites generally used to attract users who are surfing, such as sites with slow-loading graphics, splash screens, sound effects, and music, are in direct conflict with the goals of users who are on the Internet for information retrieval.

As information seekers, T-REX users do not attempt to grasp the Web site's overall layout in their information quest; their search tends to take a focused approach. To meet the needs of diverse users, the design intent about active links is to make them highly descriptive, yet simple enough so an information seeker is able to pursue an information path through the Web site. Clear navigational aids are required to enhance application utility and user satisfaction. Vague or redundant link language is confusing and frustrating to users. Descriptiveness and "differentness" regarding where links lead aid Web site navigation. Browser link color is also tied to successful navigation. If a Web designer uses underlined blue text for links the user has not followed and underlined purple text for links that have been followed, the reader will not have to relearn this aspect of Web site navigation when they encounter a new site. To make the T-REX Center more functional, such design decisions were made regarding the appearance of links, explanations as to where users can go/where each link will lead, identification of the user's current location, a site map of the information architecture, and creation of easy-to-use, searchable databases. Virtual librarians and information specialists at the T-REX Center have worked collaboratively with the Virtual Library's database developers throughout the life of the T-REX to create a state-of-the-art Web site.

## **Tracking**

Special tracking software was installed to perform comprehensive Web site analysis. The software scans the site and checks for online problems, such as broken links, slow pages, orphaned pages, stale content, poor HTML syntax, deep pages, broken anchors or missing meta-tags. Reporting software was installed on the server to process Web site log files and produce comprehensive reports, including: general statistics, resources that are accessed, visitors and demographics, activity statistics, referrers and keywords, browsers and platforms.

To make the T-REX Virtual Library more functional, and user-centered, decisions were made regarding the following:

- The appearance of links,
- Explanations as to where users can go/where each link will lead,
- Identification of the user's current location,
- A site map of the information architecture, and
- Creation of easy-to-use searchable databases.

## **FORMATIVE AND EVALUATIVE RESEARCH**

Because stakeholders are a diverse group of individuals with varying knowledge and expertise, the T-REX Center was designed and is maintained to meet their differing needs. Several innovative features were created and implemented to maximize user friendliness and application utility of the T-REX, based on information obtained from stakeholder information needs assessments conducted *before* the T-REX Center was created, and later, as an ongoing process of evaluative research.

### **Assessment of Stakeholder Information Needs Regarding RAM Transport**

Prior to the creation of the T-REX Web site, two research tools were developed to identify the gaps between potential users' questions and the information that was available regarding stakeholder issues. *The T-REX User Needs Assessment* assessed the information needs and preferences of potential users who were internal and external stakeholders. The study began in October 1998 and ended in January 1999. The individuals interviewed were all DOE NTP internal or external stakeholders. An 'internal stakeholder' is defined as an individual within the DOE with a need (or want) for information related to the transportation of radioactive materials or waste. An 'external stakeholder' is defined as a member of a public interest groups, state, tribal and local governments, contractors and the general public with a need (or want) for information related to the transportation of radioactive materials or waste. The samples of internal and external stakeholders represented the assumed general stakeholder audience for T-REX. Different assessment instruments were created for the internal and external stakeholders, because it was assumed that they needs for information and potential uses of the information would vary.

Thirty-seven of the participants were internal stakeholders, and 41 were external stakeholders. Participants were interviewed about their daily work experiences, information use, wants and needs in securing information, and the availability and accessibility of information. Within the Internal category, the breakdown of respondents were: national labs-two (2); DOE public outreach-two (2); DOE traffic managers-twelve (12); and DOE other-twenty (20). The DOE Other category includes engineers, scientists, attorneys and program analysts, among others. Within the External (non-DOE) category, rail industry-one (1); trucking industry-four (4); contractors-five (5); public interest groups-fifteen (15); and federal, state, local or tribal governmental representatives-twenty-one (21). The breakdown of the levels of the twenty-one governmental respondents was: federal-four (4); state-eleven (11); county-one (1); city-four (4); and tribal-one (1). The sample was a convenience or judgmental sample, that is, the respondents were selected based on convenience (easiest to obtain), access (capable of examination).

### **Information Needs of External Stakeholders Based on the User Needs Assessment**

External stakeholder information needs included:

- DOE decisions on routing and programs,
- Transportation protocols,
- County, State, and Tribal regulations,
- Entities responsible for shipping,
- Environmental assessments and impact statements,
- Access to real-time graphic mapping and monitoring of shipments,
- Cultural information related to Tribal governments,
- News articles provided in a real-time manner, and
- Training materials and/or kits.

## **Information Needs of Internal Stakeholders Based on the User Needs Assessment**

Internal stakeholder information needs included:

- State, federal and international regulations,
- Interpretation of regulations,
- DOE orders,
- Shipping program information including manifests, characterization, packaging, and routing,
- Responsibilities for the different aspects of transport,
- Shipping projections,
- Availability of packaging,
- Accident statistics for a variety of materials, modes and geographic areas,
- Lessons learned from shipping programs, and
- Outreach efforts by the DOE.

## **Overall Results of the User Needs Assessments**

Based on the Overall Results of the Internal and External User Needs Assessment, potential users wanted the following:

- Very specialized information;
- Searchable databases on the Internet and/or being emailed links versus all other modes of information access;
- The capability to obtain some national-level information, as well as state-, county-, city-, route- or site-level information on a variety of topics; and
- Real-time updates of regulations, orders, laws, shipments, nuclear news and public outreach efforts, and preferred it to be available in an electronic format.

## **Assessment of Library Resources on RAM Transport**

The second research tool, *The National Transportation Information Resource Survey*, assessed specialized libraries, DOE reading rooms, and academic institutions to identify what documents and kinds of information were available and where they were housed. The written assessment determined the extent and types of information available by information providers. The results of the written assessment were compiled in mid-January 1999.

## **Toward Building an Ontology**

The provider survey and user needs assessment helped to ensure that the T-REX Center has the answers to user questions. In the most basic sense, the results produced by these two research tools informed the T-REX designers of what information related to radioactive material transport is available, as well as the categories of information that are the most highly prized by users. To build an ontology, the T-REX staff collected, recorded, and reviewed terms used to express transportation-related activities from online sites to determine which activities were carried out by or relevant to T-REX users. Users and potential users of all knowledge level generally knew or could identify the specific subject of the information they were seeking. The T-REX organized elements and features around the subjects.

## **Other Means of Obtaining Input from Potential Users and Web Site Design Ideas**

The T-REX staff attended conferences and workshops on Web design, and conducted a thorough review of literature on Web site design for information seekers, rather than Web site users who were just browsing. The T-REX staff examined features on a variety of other Web sites—both nuclear and non-nuclear—and noted features or elements that were helpful as well as those which made information searches more difficult. T-REX staff found that one of the features that made a difference in the overall ease of navigation was the degree of functionality of search tools within a Web site. Further, the instructions for use of the search tools studied very widely from very poor to excellent. T-REX staff found that some of the more valued or important pieces of information that an information seeker needed to know were: (1) why no search results came back and (2) a clear explanation of what could be done within the keyword search or advanced search to get results that would include the type of information that was being sought. The T-REX staff attended environmental and nuclear conferences and workshops and got direct feedback about T-REX from other attendees. In addition, the staff gained many insights into user information needs and navigation as users called the T-REX hotline for ready reference and library services to assist them in their information searches.

### **Subjects Pages**

The transportation of radioactive material is a complex process. T-REX has broken this process into smaller subject categories based on input from the user assessment data. A broad range of subject categories were compiled, including: 'Carriers,' 'Economics,' 'Education/Training,' 'Emergency Management,' 'Environment,' 'Health,' 'International,' 'Laws/Regulations,' 'Materials,' 'Packaging,' 'Public Participation,' 'Recursos en Español' ('Resources in Spanish'), 'Routes,' 'Safety,' 'Spent Nuclear Fuel Casks,' 'States,' 'Students/Teachers,' and 'Tribal.'

A T-REX Annotated Bibliography Series has been compiled using annotated bibliographies in an ongoing series that are searchable on the Web site. These selective lists of works (documents, articles, fact sheets) are compiled upon a common theme. Annotated Bibliographies in the series include: 'Rail and Intermodal Transport' on the Carriers subject page, 'Routes' on the Routes subjects page, 'Risk Communication' on the Safety and Risk subject page, 'Native American Issues' on the Tribal subject page and 'RAM Transportation Security' which can be found at <http://trex-center.org/sabot.asp>.

### **SPECIALIZED DATABASES, FEATURES, WEB PAGES AND SERVICES**

Research and other types of interactions with stakeholders, such as staff participation in workshops, conferences, and symposia, as the result of user queries and staff perceived public need, have lead to the development of special Web pages, search engines, and features that Web site users can access to facilitate their online quest for information at the T-REX Center.

### **Databases with Search Engines**

The Transportation Resource Exchange Center Index (T-REXDEX) is a virtual, searchable index with over 2,500 documents housed in the T-REX Virtual Library. The TRAM database, which also is virtual and searchable, provides information related to over 500 individuals and groups (governmental and non-governmental) involved in RAM transport. The TRAM provides a brief description of the group's major work functions, minor work functions, geographical scope, and a designation identifying it as either internal or external to DOE.

### ***State-Specific Pages***

Recently, the T-REX Center also added State-Specific Web Pages with a US map, and includes the following kinds of information for each of the fifty states:

- State fees charged for the transport of radioactive materials, with a link to the state code.
- Responsible state agencies involved with the transport of RAM and links to their Web pages.
- State designated routes narrative.
- Low-level waste compact information. If the state is a member, a link to the Compact legislation is provided.
- Links to recent to media stories regarding radioactive waste in your state.
- Maps of each state with the US Department of Transportation routes or state-designated routes (in process).
- State Offices of Homeland Security.
- State Offices of Tribal/Indian Affairs (not BIA).
- Links to Non-Governmental Organizations and other stakeholder groups interested in radioactive waste (in process).
- Recent state/regional news headlines.
- Low-level waste compact membership information.

### **New Pages Following 911**

Several new Web pages were developed to meet information needs after September 11, 2001. New Web pages about the NRC (<http://www.trex-center.org/nrc.asp>) and the International Atomic Energy Agency (IAEA), (<http://trex-center.iaea.asp>) were made based on user feedback. The NRC Web page was written containing introductory information about the NRC and what the agency does. The content was drawn directly from the NRC Web site and fact sheets. The content for T-REX's IAEA Web site was distilled from information on the IAEA Web site. Web pages regarding the transport of radioactive and hazardous materials along the US-Mexico (<http://trex-center.org/hazbord.asp>), and US-Canadian borders (<http://trex-center.org/canada.asp>), were also created after input from users of the T-REX Center. The information on the State Specific pages has been expanded to include State Homeland Security points of contact, inspection regulations, and maps. The North American Indian Tribes and Nations: Emergency Response Resources Page ([http://trex-center.org/tribal\\_ER.asp](http://trex-center.org/tribal_ER.asp)) was created because a number of Indian Tribes and Pueblos have lands which are transected by designated state routes.

### **Getting Past the Technical Jargon to Improve Readability of Content**

Because public documents and public communication about RAM transport are often complex, highly technical, or legalistic and confounded by statutory overlap, the T-REX staff created a Glossary of Common RAM Terms to assist the public with the basic terms and guide them to fuller and more technical glossaries. T-REX also has a searchable database of over 325 factsheets which are available at <http://trex-center.org/FSsearch.asp>.

### **Special Services**

Technical and Reference Services (Library Services) are provided (<http://trex-center.org/services.asp>). The staff answers user queries via e-mail, telephone, facsimile, or in person. Reference services also include assistance in the use of the T-REX Web site, the T-REXDEX and TRAM databases, and general reference and Web sources of information.

Because the T-REX Center is maintained by ATRI, UNM, the T-REX Center has access to

Waste Management Symposium 2005, Topic 7.2 - Contact Name: Nancy Bennett, ATR Institute, 801 University Blvd. SE, Suite 302, Albuquerque, NM 87106, (505)246-6435, fax (505)246-6001, [nbennett@unm.edu](mailto:nbennett@unm.edu)

UNM's collections and its other information services. T-REX staff can obtain other publication requests by using UNM's Online Computer Library Center Interlibrary Loan process. This capability provides users with access to 172 research databases, 51 of which have been deemed relevant to users of information regarding nuclear and radioactive materials transport. In total, these databases contain 85,719 records (including citations and full-text articles) for all search terms.

## **FUTURE PLANS**

Many new tasks to enhance and refine the Web site await the T-REX Center staff beyond the routine Web site maintenance and the expansion and updates of features, such as the Annotated Bibliography Series. A complete revamp of T-REX is slated to occur in 2005 with an emphasis on greater interactivity and visualizations for stakeholder who use T-REX. A search engine for the entire Web site will be created after the redesign of T-REX. Other State information to be added includes relevant State contacts, citizen groups, legislation, and State-related recent news items on RAM transport. Tribal points of contact and an information needs assessment of Tribal officials is in the works. Search engines for the entire Web site and for the News Headlines page are planned. All 'Quick Bibs' and relevant documents will be available to requesters on CD-ROM. They will be written as information gathering tools for the public, stakeholders, and government offices. A captioned pictorial depiction will be prepared to outline the planning process within the DOE's Office of Civilian Radioactive Waste Management. A new 'Subjects' page on the proposed Yucca Mountain Site is to be created. The T-REX staff is going to identify and assess educational products regarding RAM transport.

## **CONCLUSION**

There are no 'average' stakeholders. The people served by T-REX represent diverse publics and have varying levels of knowledge and interest, and differing perceptions, attitudes, and views of the world. The collection, organization, and dissemination of information on RAM transport to serve their needs are tasks which are both complex and time-consuming. As a mandate and a mission, the T-REX staff will continue listen to and learn from stakeholder feedback about their information needs, with the result that the T-REX Center implements ongoing changes and cutting edge innovations to fulfill those needs. *From a technical design standpoint, the T-REX Web site will evolve and grow in ways that facilitate the acquisition of individualized and rapid exploration of large bodies of knowledge about RAM transport as new software and hypertext technologies—as well as new generations of the Internet—emerge.*

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