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Literature Searches and Literature Reviews for Transportation Research Projects

How to Search, Where to Search, and How to Put It All Together: Current Practices

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How to Search, Where to Search, and How to Put It All Together: Current Practices

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Preface

Research projects sponsored by state departments of transportation (DOTs) routinely require a literature review as part of the research effort. The literature review is a critical portion of the research process in any field of inquiry and an important component of the final research report. For the researcher, a literature review helps to clarify the scope of the research project by creating a narrative of what is and is not known in the field and where there are areas of dispute. For the customer of the research and other readers, the review also provides valuable context, establishes the researcher's expertise, and relates the findings of the project to what is already known.

However, investigators tasked with developing literature reviews for transportation research projects may not always be aware of the importance of the literature review or have an adequate understanding of the necessary steps for producing a high-quality review. This may lead to the submission of literature reviews that are incomplete, unfocused, poorly explained, or otherwise inadequate. Minnesota DOT Research Engineer Alan Rindels raised this issue during the 92nd Annual Meeting of the Transportation Research Board, recounting his own experience receiving inadequate literature reviews. He presented his concerns to both the Standing Committee on Conduct of Research (CoR) and the Standing Committee on Library and Information Science for Transportation (LIST) and requested the committees' assistance in addressing the problem.

A working group, comprised of members from both committees, identified four components to address this issue:

1. *How* to conduct literature searches;
2. *Where* to search for transportation information;
3. How to *put it all together* as a quality literature review; and
4. *Definitions* for related terms.

LIST Chair Roberto Sarmiento led work on the first two components of the project with teams from LIST and the Transportation Division of the Special Libraries Association (SLA). Susan Sillick, CoR member and LIST co–research coordinator, led work on the third and fourth components. Together the two coordinated the entire project. For the third component, Minnesota DOT Research Director Linda Taylor supported the preparation of a synthesis of accepted practices on writing a literature review, carried out by consultant CTC & Associates, LLC.

This e-circular is the result of a 2-year collaborative effort by more than 50 individuals. The publication is aimed at all transportation researchers, including university investigators, graduate students, consultants, and practitioners at state and federal transportation agencies. The e-circular also will be useful to sponsors of research when conducting initial literature searches and evaluating literature reviews to determine the quality of the products received.

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PUBLISHER'S NOTE

PART I

Literature Searches
How to Search

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WHAT IS A LITERATURE SEARCH?

Merriam-Webster defines a literature search as "the methodological investigation of all published sources for information bearing on a usually scientific or technological subject." (For a discussion of *literature sources*, see Appendix E of this e-circular. For a discussion of *literature reviews*, see Part II. For definitions of related terms, see Appendix F.)

A literature search is not just one search, but rather is a series of searches conducted across all possible resources. The final result of a literature search is a list of resources that have been identified as relevant to the subject matter and that inform the literature review.

A literature search differs from an informational or reference search, which is a search for simple facts, personal or professional contact information, or data. The results of a literature search are compiled and structured to help the researcher understand the scope and breadth of the literature on a topic, as well as the potential relevance of specific works. There is no perfect literature search. However, there are techniques that can be employed to maximize both the efficiency of a search process and the benefit to the researcher.

Searching is an iterative process that

- Seeks citations and possibly other information;
- Collects relevant material;
- Merges and refines overall results; and
- Structures the results to add value.

Despite the Merriam-Webster definition, a literature search may not be confined to the published literature, and may extend to things that are not literature and possibly not even published in the traditional sense. These sources include but are not limited to

- Videos;
- Blog or other Internet posts;

- Information in e-mails or other correspondence especially from known experts on a topic;
- Data and images;
- Products in process, including preliminary products such as research proposals, research summaries, and interim or progress reports; and
- Slide shows or poster presentations on research findings.

There may be many degrees of literature searches, sometimes segmented by how fast it must be completed for the researcher or how thorough it needs to be. This points to the typical trade-off for a literature search: it can be done quickly, or thoroughly, but often not both.

WHY CONDUCT A LITERATURE SEARCH?

Whether conducting a literature search for your own review, or to inform the literature review of someone else, the literature search is seeking to comprehensively confirm what is already known on a particular topic. The results of a literature search, when reviewed, can

- Uncover a solution to a problem;
- Identify concurrent or previous work on the same topic;
- Validate a particular method;
- Provide a focus for investigations; and
- Confirm that further research is needed.

If you have been commissioned to conduct a search, your role may be at the beginning of the process, or you may be double checking that nothing critical has been missed in the original literature search. Both roles are important and the same six steps of a literature search will apply.

SIX STEPS OF A LITERATURE SEARCH

Step 1. Define the Search Topic and Scope

The time spent considering responses to the questions in this initial step will positively influence the efficiency and outcome of the search itself.

Most literature searches begin with a research idea or need. Begin by turning this idea or need into a series of questions.

What is the ultimate goal of the literature search?

- What question are you trying to answer?
- What problem are you trying to solve?
- Express this idea or need in a sentence or two. Write this down. This is your search topic and will define all the rest of the steps of your literature search.

How thorough should the literature search be? Is the goal

- To find a few key articles on this topic?
- To locate only items on topic that are freely available online or easily accessible?
- To conduct a comprehensive search for all published items on this topic, regardless of ease of accessibility or cost?

Who is the client?

If conducting the search on behalf of another client, make sure to consult with the end user before starting on the search. Each individual may have a different perspective on the topic and its parameters.

Are there date parameters in terms of the relevance of material?

- Will only items dating from last the 5 years be of interest? From the past 10 years? From the past year only?
- Transportation research has been conducted for many decades. Will historical material be applicable?

Are there geographic parameters in terms of the relevance of material?

- Is only material from within a particular jurisdiction or region relevant?
- Is international material relevant?
- Are there jurisdictions likely to have produced material with more applicability than others due to climatic, political or socioeconomic conditions?

Are there language parameters in terms of relevance of material?

- Is the reader proficient in languages other than English?
- Are there languages other than English for which material might be relevant in terms of content and accessibility?
- Translation is rarely pursued in most transportation research. Will information that cannot be accessed in English still be useful?

Are there format parameters in terms of relevance of material?

- Are both trade magazine articles and peer-reviewed research studies relevant?
- Is there time to read comprehensive research reports or are journal and conference papers likely to be a more useful and time-efficient source?
- Would nonconventional or unpublished materials such as presentations, working papers, blog posts, etc., be appropriate?

Are there any known examples of the type of information being sought?

- Are there any particular authors or organizations that have produced relevant material?
- Is an example of a relevant or appropriate document already on hand?

If conducting a comprehensive search, would a pilot search, retrieval, and review of selected items be useful?

Feedback before expending time on the full search can greatly assist the eventual outcome. Although this is particularly pertinent if conducting the search on behalf of another client, a pilot search can also help refine the topic for those conducting their own search.

Step 2. Choose the Resources to Search

A complete literature search can and should incorporate several resources. Resources for a literature search include Internet search engines, databases, and library catalogs. Part II of this e-circular, Literature Resources, provides an annotated list of the most pertinent resources in the transportation field.

Internet Search Engines

- Include Google and many others;
- Cover all subjects;
- Are free;
- Retrieve many results;
- Are useful for finding grey literature;
- Include full text of some literature;
- Offer no guarantee that the information will remain unchanged or still be available in the future; and
- Provide no quality control of the information found.

Databases

- Include the Transportation Research International Documentation (TRID) Database, but there are many others;
- Provide a level of quality control to their content;
- Cover information on a specific subject area;
- Are sometimes subscription based, which limits access; and
- Are useful for locating academic literature.

Library Catalogs

- List library holdings, either for an individual library or many libraries, such as WorldCat;

- Include monographs and theses;
- Are free, but may be limited to specific audiences;
- Rarely include full text of materials; and
- Typically exclude individual journal or conference papers.

There may be relevant materials outside the core transportation resources listed in Part II. Resources in the fields of education, medicine, law, and human factors areas may be applicable to transportation research. To locate these sources, consider which disciplines may have a connection with the topic, and which aspects (legal, political, environmental, behavioral, etc.) of the topic are of interest.

Not all resources are publicly available or online. Librarians, especially those who specialize in the transportation field, are likely to be the best source of information about new databases or changes to existing databases. Some databases have restricted access, often offering access for a fee. University, corporate, or public librarians may have access to these subscription databases and may also have other sources of information, such as contacts with other libraries and library professionals, that can help provide resources free of charge or at a reduced cost.

Transportation Research International Documentation Database

TRID (http://trid.trb.org) and Google Scholar (http://scholar.google.com) are two of the most comprehensive resources available for finding transportation-related literature. Although there are similarities and overlaps in coverage, they each offer unique features.

TRID is an integrated database with combined records from TRB's Transportation Research Information Services Database and the OECD's Joint Transport Research Centre's International Transport Research Documentation (ITRD) Database. TRID provides access to more than 1 million records of transportation research worldwide. TRID also includes all records from the Research in Progress (RiP) Database (https://rip.trb.org/).

Searching TRID Each record in TRID is indexed by a trained professional using terms from the Transportation Research Thesaurus (TRT) (http://trt.trb.org/trt.asp?). The basic search mode for TRID is a keyword search box on the home page.

The keyword search will look for the search term in all of the indexed TRID fields: title; abstract; notes; index terms; subject areas; authors; project managers or principal investigators; serial; corporate authors; publishers; and funding or performing organizations. Full-text search is not available in TRID.

A drop-down feature allows the search to be limited to the title, author name, agency, serial or conference title, or index term field. The basic search can also be limited to exclude research in progress or records without full-text links.

The Advanced Search feature allows users to search one or multiple fields. Search results can be limited by subject area, language, publication type, source, or date.

Viewing Results The results screen displays the top 25 results by publication date, with the most recent appearing at the top of results. The sort order can be changed by selecting the desired option from the drop-down menu. Search results in TRID provide a preview of the abstract and links to the full text if available from other web sites. The full record can be accessed by clicking on the title.

TRID allows searchers to mark records and then print, e-mail, save, or share them via social media.

Special Features The TRID homepage also includes links to

- Recently published records;
- Recently added records;
- Advanced search features;
- Search history;
- Site help;
- Rich site summary (RSS) feeds;
- Recent records by mode;
- Hot topics; and
- Recent TRB publications.

Google Scholar

Google Scholar is a subset of the Google Internet search engine that provides access to scholarly literature across many disciplines. Sources include publications from academic publishers, professional societies, digital repositories, and universities. Case law also is included.

Searching Google Scholar Google Scholar's basic keyword search works much like the standard Google search. Searchers enter words or phrases in a single search box. Google Scholar will search for the keywords anywhere within the full text of the document. The search engine does not have a thesaurus feature and the searcher cannot limit their search to a specific discipline.

Google Scholar's Advanced Search allows searchers to

- Search for exact phrases;
- Specify that at least one of the words from a set must be in each result;
- Specify that all the words from a set must be in each result;
- Exclude words from the search;
- Limit search to only the title of the article;
- Search for a specific author;
- Specify a particular journal; and
- Limit search by article date range.

Viewing Results Google Scholar presents results by relevance. This relevance ranking takes into account the full text of each document, as well as its source, author, and how often and how recently it has been cited in other scholarly literature. Each search result provides the title of the paper or book, the authors, the source, year, and domain of the online version. An excerpt of the article is also shown, with the search terms highlighted. The frequency of citation, related articles and a link to all available versions are also included.

By clicking on a record's link, you will access the full-text directly or be taken to the publisher's site. Records can be saved individually to a user library and an alert can be created so that future documents matching the search criteria are emailed to the user.

Special Features Google Scholar also includes a feature called Scholar Settings, which allows searchers to

- Choose the display language;
- Choose the languages of the results;
- Make results open in a new window;
- Specify the citation manager of your choice for exporting link; and
- Set the Library Links feature to show library access links for up to 5 libraries.

Deciding Between Google Scholar and TRID

Since both TRID and Google Scholar offer strengths and drawbacks, a comprehensive literature search uses both resources. TRID often will return fewer but more relevant results than Google Scholar, because it only searches transportation-related sources and because searchers can use the TRT to identify index terms. Google Scholar, with its broad source coverage and full-text searching, may be the preferred starting point when the topic of interest is covered outside the field of transportation or when it is important to locate all mentions of a specific topic.

Step 3. Choose Search Terms

After topics are defined and well understood, and the resources to search are chosen, it is time to select search terms. To choose search terms, look again at the search topic that was developed in Step 1. List words that describe the topic first. Then

- Think of synonyms, plurals, and different word endings (e.g., climate and climatic) for these words.
- Consider technical, local, and international terminology as well as acronyms and abbreviations that are related to these words.
- Take spelling variations into account (e.g., behavior and behaviour).
- Check on the availability of a thesaurus, subject headings, and index terms from the search resource and look up related terms.

The resulting list will be the initial search term list. The list of search terms may very likely expand as the search progresses. When creating your list of search terms, especially consider the following:

- **Acronyms.** A given acronym can have different meanings for different audiences. CMS, for example, is used for changeable message sign, but it can also be used for content management system.
- **Diacritics.** Diacritics are marks above or below characters. Examples include the words façade and naïve. Some databases may have algorithms to counter these issues and others may not. Consider searching using a word with its diacritic and separately without it. For example, search both façade and facade.
- **Country-specific terminology.** Keep in mind that your search may need to encompass international material. For example, a heavy vehicle is referred to as a truck in the United States, Canada, and Australia, and as a lorry in the United Kingdom and Ireland. Like

diacritics, some, but not all, databases will have implemented synonym capabilities to deal with these variances in international terminology.

Step 4. Compile the Search Strategy and Run the Search

Defining the relationships between search terms and combining them are critical steps in the search process. This is called developing the search strategy. Keep track and document every search strategy used so that searches can be easily replicated or modified later.

Your first search should be for the help pages of the database, search engine, or catalog that you are using. Reading the information available on how search works in that resource could save you a tremendous amount of time.

How terms are linked in a search strategy can significantly affect the outcome of a search. In order to create an effective and efficient search, it is worthwhile to put some time into developing a search strategy instead of simply adding any potential words into a single search field. Acquiring a few basic search skills will help to improve the quality of the results.

Boolean Operators: And, Or, Not

Most databases and search engines support Boolean logic (Figure 1).

Boolean operators offer the searcher the ability to broaden or restrict a search, by connecting or limiting search terms. If a resource you are searching offers Boolean functionality, you may do the following:

- Retrieve specific search results by using the "and" operator. "And" generally retrieves fewer results than "or."

> Example:
>
> *pedestrian* AND *bridge* will ONLY retrieve items that contain both words, but not limited to the phrase "*pedestrian bridge*"

- Broaden the search using the "or" operator. You are more likely to use this functionality in a search when you are aware of similar terms for a concept, e.g., " 'active transport' or 'sustainable transport.' "

> Example:
>
> *pedestrian* OR *bridge* will retrieve items that contain either *pedestrian* or *bridge*

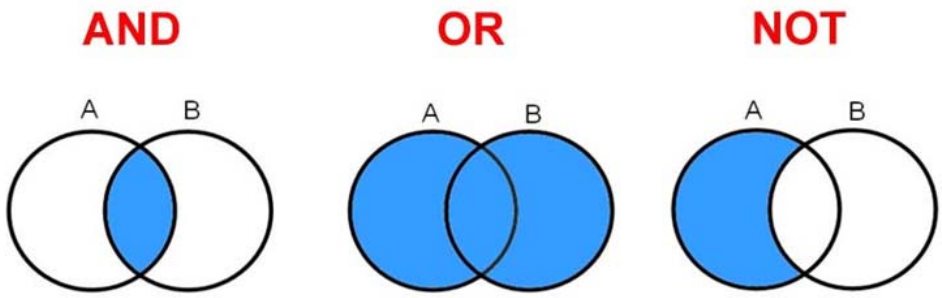

FIGURE 1 Boolean logic.

- Exclude certain terms using the NOT operator.

> Example:
>
> *pedestrian* NOT *bridge* will ONLY retrieve items that contain the word *pedestrian*, excluding those that also have the word *bridge* in them

- Most search engines allow more than one Boolean operator to be used in the same search. Use parentheses to control the order in which the search terms are combined.

> Example:
>
> (*pedestrian* OR *walker*) AND (*bridge* OR *footbridge*) will retrieve items that use either pedestrian or walker in the same record as either bridge or footbridge.

Advanced Search Tips

Most databases and library catalogs offer advanced search functions. Consult "Advanced Search" and "Search Tips," to see what options are offered. Consider how your particular search might benefit from using these options.

Some of the most common advanced search options are described below. Keep in mind that not all databases offer all options and different databases may use different symbols or terminology for these options.

Exact Phrase Searching

Exact phrase searching only retrieves two or more words, in the exact order they are typed, with no words between them. This eliminates many false hits, especially if the search words are fairly

common occurrences. Exact phrase searching is often (but not always) done by using quotation marks.

> Example:
>
> *"pedestrian bridge"* will ONLY retrieve items that contain the phrase *pedestrian bridge*. *Pedestrian friendly bridge* will not be retrieved.

Exact phrase searching may also deliver more results than you anticipate, even when you believe you are refining a search. For example, the federal law in the United States known as the Clean Air Act has namesakes in at least two other countries. A Boolean not might be useful to you here if your search is country specific.

Note that words (and other symbols) can also occur in the middle of your exact phrase.

> Example A:
>
> An exact phrase search in the Title for *"wooden pedestrian bridge"* will miss the report containing *"wooden suspension pedestrian bridge"* in the Title as the word *"suspension"* occurs in the middle of your search phrase.

> Example B:
>
> A search for *"wooden pedestrian bridge"* will also miss those items that contain the phrase *"wood pedestrian bridge"*

When constructing an exact phrase search, think about what you might be including and what results you might be excluding.

Truncation

Truncation broadens the search by including all word endings. The common symbol for truncation is an asterisk (*****). However, $, %, ?, and others are also used in certain search engines. Always consult the Help screen, if available, for the specific search engine you are using to make sure you are applying the right symbol.

> Example:
>
> *wood** will retrieve *wood*, *woods*, and *wooden*, etc.

Truncation can be useful, but needs to be used with care.

> Example:
>
> *bridg** will retrieve *bridge*, *bridges*, but it will also retrieve *bridging*, *bridgit*, and *bridget*, etc.

Wildcards

Wildcards are used to substitute a symbol for one character. The symbol for wildcard is often (but not always) a question mark (?).

> Example:
>
> *travel?ing* will retrieve *traveling* and *travelling*, but not *travel*, and *travels*, etc.

Proximity Searching

Proximity searching allows the searcher to specify how close together two words must appear within a retrieved item. Each database may have its own rules for dealing with proximity searching, but many use the operator "near". In some, the number of words is prespecified; others allow the searcher to specify how many words can appear between the two terms.

> Example:
>
> *wooden* NEAR2 *pedestrian bridge* will retrieve *wooden pedestrian bridge* and *wooden suspension pedestrian bridge*

Controlled Vocabulary Versus Keyword Searching

One of the best ways to retrieve precise search results is to learn when to use controlled vocabularies versus keyword search. Keyword searching is often the default mode for search engines and databases. In keyword searching, a searcher enters the search terms that they developed in Step 3, and the engine searches for any occurrences of the term or terms in predesignated fields. Controlled vocabularies, on the other hand, are developed to help organize knowledge. Investigating the controlled vocabulary for the specific database can help target results. The advantages and disadvantages of controlled vocabulary versus keyword searching are described below.

Controlled Vocabulary

Controlled vocabulary may also be referred to as subject areas, descriptors, thesaurus, or index terms.

Advantages to controlled vocabulary include:

- A list of subject terms may help a user find an appropriate search term for their topic.
- It can provide a searcher with suggested terms for narrower, broader, or related topics.
- Using appropriate subject headings for a topic will retrieve all items in the database indexed under that topic.
- Using index terms helps the searcher avoid the need to think of every possible synonym or alternate spelling of their search terms.

Disadvantages include:

- Recently coined terms, including new topics and jargon may not yet be included in the list of subject terms.
- When a database does not provide a thesaurus or list of subject terms, the existence of a controlled vocabulary might not be obvious.

Keywords

Keywords are search terms chosen by the searcher.

Advantages to keywords include:

- Will retrieve items containing new terms, distinctive words, and jargon.
- If the appropriate subject heading, descriptor, or identifier for a topic is unknown, the searcher can conduct a keyword search first and look at a relevant item for the appropriate controlled vocabulary term.

Disadvantages include:

- You may retrieve many items that are not relevant to your topic.

- In order to retrieve more relevant items, use a variety of terms. For example, to retrieve items about movies, a keyword search must include terms like films, cinema, and motion pictures.

Example:

A keyword search for *pedestrian bridges* will retrieve items that contain those words but not necessarily having *pedestrian bridges* as a topic.

In TRID, for example, a search for *pedestrian bridges* in the Keyword field retrieved 2,158 records. Searching *footbridges,* which is a preferred term for *pedestrian bridges* in TRT, the controlled vocabulary used in TRID, in the Index Terms field retrieved only 1,157 records. However they all cover *footbridges* as a topic.

Field Searching

The information in databases is organized into fields. Common fields include title, author, abstract, and index terms (or subject headings). A keyword search that searches all fields is prone to pulling up irrelevant results. In many cases, it will retrieve results containing words anywhere in the record, including authors, publishers, etc. Limiting your search to particular fields can allow you to retrieve more relevant results. When search terms are also names or in common usage, such as s*now, society, control*, this may not necessarily assist your search outcome.

Example:

The word *crane* can refer to materials handling equipment. It is also a bird and a common last name. A keyword search, especially one that searches most of the fields of a record, will result in many records that are irrelevant to the subject of equipment.

In TRID, for example, searching for *crane* or *cranes* as a keyword results in 1,655+ records. Using the controlled vocabulary index term C*ranes* results in only 741 records, most of which are related to the subject of materials handling.

On the other hand, if you limit your search to too few fields, you may be missing many documents on your subject that simply don't have your word (or phrase) in that field. This is especially true for searching in the title field for news and trade publications. These publications

often have eye-catching titles that do not reflect the subject of the article. Here are some examples: Make the Tough Call, Tough Cell, Taj Mahal of Paving, and A Start for Stops.

In these cases, it is often a good idea (especially if you get zero results on your first try) to modify your search term by running it in other fields. Entering search terms in the abstract field can be a useful way of picking up relevant articles while reducing irrelevant ones.

Some databases, such as TRID, have a keyword search option that searches across several common fields. In the case of TRID, these fields include title, abstract, notes, index terms, subject areas, record accession numbers, authors, publishers, project managers, principal investigators, funding agencies, and performing agencies.

Errors Happen

No system is perfect and sometimes a database accurately describes an article or other work that has a misspelled word in the title. Other times, the article could have been indexed with a typographical error. Either way, this could affect search results. Consider searching multiple fields to mitigate this problem.

Step 5. Review the Search Results

A literature search is usually not complete after the first set of results has been retrieved. These first results should be reviewed in order to determine if more searching is necessary, and whether the search strategy needs modification. Review the initial results of the search by skimming titles, abstracts, and keywords or subject areas. Then organize the citations into three categories:

- Definitely related to your topic.
- Possibly related to your topic.
- Not related to your topic.

The search results that are in the “definitely related” category can be the base for further searches. Use these relevant results to identify keywords, index terms, or subject headings that have been assigned to those items. Run the search again, using the most relevant keywords, index terms and subjects headings.

Note any recurring authors that appear in the definitely related category and conduct an author name to identify other relevant research by top authors they may have published on the topic.

There is no need to reinvent the wheel or start from scratch. Use the list of works cited by a particularly relevant item as a resource for other relevant works on a similar topic.

Too many results in the “not related” category? Not enough results in the definitely related category?

If the initial results are not what you expected or if no relevant results were found, refine the search strategies.

Questions to ask yourself include the following:

- Are the right sources being searched?
- Are the most-relevant search terms (synonyms, truncations) being used?

- Have Boolean operators been used correctly? (Remember that "and" will narrow the search and "or" will broaden the results.)
- Have an overwhelming number of results been retrieved? If so, consider simplifying the search to include fewer terms.
- If the topic is very new or very narrow, the possibility is there may not have been much published. If this is the case, consider
  - Broadening the focus of the topic.
  - Looking more closely at the "possibly related" category of results. You may find articles that are tangentially related to your topic.
  - Consulting sources other than online resources.

Looking Beyond Online Resources

Online databases and catalogs contain a wealth of information. However, not everything is available online, and a thorough literature search should at least consider the following:

- Relevant information may be found as a component of a larger document and may not be indexed separately (e.g., a table within an article or a chapter within a book). Do not immediately discount more general material in your search results.
- Some documents may exist only in print format. Depending on the breadth of your search, time to locate and review documents should be factored into the search schedule.
- Transportation professionals or subject experts are often happy to share their expertise (or even a copy of their paper) if you approach them directly.
  - If you do make interpersonal contacts that provide useful information, it is a good idea to retain their contact information (phone numbers, e-mails, and other notes).
  - Recording personal names and dates of such transactions offers transparency of your search strategy and the ability for it to be repeated or built upon at a later stage. It also allows that material to be referenced within any authored document that may be produced. Such references can be considered personal communications or referenced in a similar way, depending on the citation style used.

Knowing When to Stop

The world of research is always in motion and scholars are always generating new content, so there will never be a time when the research landscape is complete. Knowing when to stop is subjective and is often based on time constraints. Some things to consider when deciding when a search is complete are:

- The law of diminishing returns and Pareto Principle (sometimes called the 80–20 rule) should be considered. In the case of a literature search that means continued searching in the same locations using the same techniques is not time well spent, simply because most of the relevant citations have already been found.
- An initial, focused effort of 3 to 5 h of proper searching may yield 80% of all relevant citations that can reasonably be located using sound techniques in the proper sources. Spending another 10 to 20 h on the search may yield more relevant citations, but possibly only another 5%

to 10%. Due to the very nature of research and publication, it is not realistic to expect to find 100% of relevant research on a topic, regardless of the amount of time spent.

- Finding the same citations over and over in your search results, or new articles presenting concepts or findings very similar to what you have already uncovered suggest it may be time to stop.
- Some relevant citations may never be found due to indexing errors, timing, and-other variables the searcher cannot reasonably overcome.
- There are always research projects in progress, and new articles, conference papers, and technical reports in the publication pipeline, some of which may never be published. It typically does not make sense to delay at literature search so that new content can be generated, but makes more sense to gather what is available at that moment in time. Some databases allow users to set up alerts notifying them when new results that match the saved search topic are published.

Step 6. Organize the Results

When you start finding useful resources, collect them. For each useful item, record full bibliographic information: title, author, year of publication, journal title, and volume number (if applicable). The bibliographic details are called a "citation" or "reference," and provide details needed to assess whether a document is worthy of review, and to help locate it. You may also wish to keep notes about the content and relevance of resources and other details, such as what database was used to locate them or libraries where they might be housed. Keeping good records helps you locate relevant resources at a later date.

Bibliographic Management Software

Having a complete and correct record of citations saves time and helps avoid frustration if you want to locate resources later. For an extensive or ongoing search, consider using a bibliographic management tool to organize your results and retrieved items.

Bibliographic management software allows you to keep track of citations by creating a personal database of references. Records can be collected or created for books, book chapters, journal articles, dissertations, recordings, web pages, letters, manuscripts, and many other types of documents. These records can be entered manually or imported directly from many library catalogs and commercial databases.

Once a record has been entered into the bibliographic management tool, you can search for all records on a specific topic or by a certain author, quickly generate bibliographies of all or selected records, and format references in a specific bibliographic style while using word processing software. You can also add relevant notes to citations and attach copies of full-text documents to citations.

Although there are dozens of reference management products, three of the most popular among academic researchers are EndNote (www.endnote.com), Reference Manager (www.refman.com), and Refworks (www.refworks.com).

Some databases, such as TRID, allow users to share and organize their results using tools and social networking options directly from the search interface. They may also offer subscriptions to RSS feeds. By subscribing to an RSS feed, updated information that meets your search criteria will be automatically downloaded to your computer. Alerts such as Google Alerts

work in a similar way by e-mailing updates of the latest relevant results of the search to the researcher. Alerts and RSS feeds allow a searcher to continue to access the latest research on their topic long after they have completed their initial search.

Finding a Full-Text Document

Once you have identified some search results as potentially relevant, you may want to access the full text of the document. Some databases provide links to full text or provide selective links. The full text can also be located by using

- Local or university library catalogs;
- E-journals with subscriptions;
- WorldCat (www.worldcat.org);
- Interlibrary loans and document delivery services; and
- Direct contact with authors, publishers, and sponsoring agencies.

Practical Tips from Transportation Librarians

- Consider whether the resource you are looking for is the only solution. If a thesis is unobtainable, perhaps a journal article leveraged from that study might also be suitable.
- Transportation organizations change their names—sometimes often! Make sure that you have the latest version of the name for current research; use older versions when doing historic research.
- More is not always better. Strive for quality rather than quantity.
- Sort citations in ways that will help those conducting the literature review. You may choose to sort them in order of importance, year, publisher, or author.
- The Virginia DOT Research Library has created three tiers of deliverables: the fast-tracked search, a comprehensive search, and an annotated bibliography or synthesis report known as a research synthesis bibliography or RSB.
- Leverage the work already done by others. If you finally find that "perfect document" on your topic, consider flipping to the back to see if it has references (sometimes called "works cited" or bibliography) for a list of other potentially relevant sources.
- Zero in on the most unusual term in your search, sometimes searching with only that word, or that word plus one more.
- A dead link may not be a dead end. Try the Wayback Machine (www.archive.org).
- Never forget that there are two English languages. If you forget one, you'll miss out on a lot.
- Before you decide that nothing exists on your topic, ask the librarian. A librarian can find what is buried in the Internet or in books or magazines.
- If you find something that is close to or exactly what you are looking for, look at keywords and phrases from the abstract for that item and re-use them in further searching.
- As databases grow to include more and more records, it becomes increasingly important to know precise ways to search them in order to reduce the number of irrelevant results.

- When you encounter a relevant resource online that isn't free to access, ask your organization's librarian. Chances are good they can borrow or obtain it for free from another source.
- Several transportation libraries have created Google Custom Searches. Some of them include:
  - Transportation Meta Search: https://www.google.com/cse/home?cx=006511338351663161139:hovexomtgsw.
  - State DOT Search Engine: https://www.google.com/cse/home?cx=006511338351663161139%3Acnk1qdck0dc.
  - Public Transit Agencies: http://www.google.com/coop/cse?cx=012995479145342077058%3Aipxox2lxkha.
  - University Transportation Center Search Engine: http://www.google.com/coop/cse?cx=010809592348763093458:3jsikrwi874.
  - U.S. State Public Utilities Commissions: https://www.google.com/cse/home?cx=004890854172713559008:3vjc7enw1du.
  - Local technical assistance program (LTAP) and Tribal Technical Assistance Program (TTAP) Center Search Engine: https://www.google.com/cse/home?cx=010809592348763093458:r3i0biypw1u.
  - Metropolitan Planning Organization (MPO) Search Engine: https://www.google.com/cse/home?cx=006511338351663161139:ktu1nltiojg.
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PART II

Literature Reviews
How to Put It All Together

PATRICK CASEY
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Despite its importance, the literature review is a relatively poorly understood component of research, and many authors in a number of fields have lamented the poor quality of literature reviews submitted for publication (*1–3*). Research agencies, professors, and others with research administration responsibilities often expect that researchers understand the importance and expectations for a literature review when, in fact, there is often little focus on it or dialogue about its intended contribution in a given research project.

This document, drawing from the literature surrounding the topic, aims to summarize the characteristics of effective literature reviews and approaches for writing them. The intended audience is principal investigators and their teams who conduct research for transportation agencies and who are expected to deliver a literature review as part of each research project.

The *literature search* and *literature resources* are treated in Part I and Appendix E, respectively, of this e-circular.

DEFINITION AND PURPOSE OF A LITERATURE REVIEW

The literature review is a critical portion of the research process in any field of inquiry and an important component of the final research report. For the researcher, a literature review helps to clarify the scope of the research project by creating a narrative of what is and is not known in the field and where there are areas of dispute. For the customer of the research and other readers, the review also provides valuable context, establishes the researcher's expertise and relates the findings of the project to what is already known.

In the case of transportation research, identifying the hallmarks of a good literature review is complicated by the wide range of business functions and research subject areas falling under the jurisdiction of federal and state transportation agencies. What might be a good approach for a literature review in pavement research and related materials sciences may be inappropriate for a literature review related to psychology and human factors in safety research. In addition, the applied nature of most state-sponsored research often means the project scope is already well-defined by the customer and not as open-ended as some academic research.

It is important to remember what a literature review is *not* (*4*). A bibliography, for example, is merely a list of published works with author, publisher, date, etc. An annotated bibliography includes a summary or evaluation with each work, but it is still not a literature review, though it may be a useful step and a separate product of value for both the author and reader.

A literature review is not a list but rather a narrative, organized by topic, with connections between papers made as appropriate. Within each topic of the literature review, cited

works should be given prominence according to their importance and relevance rather than being presented equally (*5*):

> A good literature review comprises a flowing, easy-to-understand narrative, written in the author's own style. Each topic should be discussed in turn and, while it is often appropriate to discuss the literature on each topic in chronological order, this should not be done slavishly. The topics are then combined in a chapter that should be well organized, and gives the reader a brief, yet reasonably complete picture of the status of the research in the subject area reviewed (*5*, p. 55).

A properly researched and written literature review performs many important functions for a research project. Several sources have outlined the value that a literature review provides to both the researcher and the reader:

- **Informing research.** Conducting a literature review should help a researcher understand what is and isn't known about the research topic, according to a University of Toronto tutorial (*6*). This process should help identify areas of controversy and questions that require further research. It can also help the researcher avoid approaches that have been tried unsuccessfully (*1*, *7*). In an editorial about the quality of literature reviews, Webster and Watson (*3*) argue that

> Extending current theories or developing new theories will create directions for future research. However, extending or developing theories is a difficult task and is often the weakest part of a review. Nonetheless, it is the most important part of a review and generally needs the most elaboration (*3*, p. xix).

- **Providing context.** According to Washington et al. (*5*), a literature review should summarize the current state of research for the reader and provide an overview of previous works on related topics.

> It is not sufficient to simply report the findings of each author. The findings must be placed in context, and connected so that the state of knowledge on each topic emerges. In doing the review, the writer should have gained insights in the subject area that are not apparent to a person not undertaking a thorough review. These insights should be shared with the reader (*5*, p. 55).

The significance of each of the previous studies cited, and their relevance to the current study, should be clear (*5*). The overview should also justify the significance of the current research (*1*). The literature review should define what is and is not within the scope of an investigation, report and critically examine claims made in existing literature, and synthesize the literature to present a new perspective (*2*).

- **Establishing authority.** A well-done literature review demonstrates the researcher's familiarity with the current state of knowledge and research in a given field (*1*). There is some evidence that poorly written literature reviews can undermine the validity of the research in readers' minds. In their study of Australian dissertation review practices, Mullins and Kiley (*8*) found that a poor literature review will make reviewers more critical as they examine the rest of the thesis.

The purposes of a literature review in a specific transportation research project should be based on that project's objectives and clearly spelled out for the investigator, ideally as the result of a dialogue with the sponsoring agency. Appendix D: Draft Specification Language provides a framework for the two parties to define specific deliverables formally or informally.

TYPES OF LITERATURE REVIEWS

As detailed by Cooper's taxonomy (*9*), literature reviews may be comprehensive, representative, or concentrated on pivotal works. The research problem statement and the detailed scope of the research project should clearly indicate what is sought from the literature review and promote a common understanding on the part of the agency and investigator before the work begins. Does the agency requesting the research desire a broad review of nearly all applicable literature on the topic to give background and historical perspective? Or is the interest narrower, perhaps focused on a particular time frame or specific subproblem of a larger issue?

While all literature reviews support research, their specific functions and relation to that research vary. Several methods of classifying literature reviews have been proposed. These classifications inform the research and writing of a literature review.

Cooper (*9*) described an influential taxonomy scheme created to classify literature reviews. The structure was based on interviews with 14 education and psychology scholars and a survey of 68 researchers who had published reviews of research literature. Under this taxonomy, literature reviews can be classified based on the following:

- **Focus.** Reviews can focus on research outcomes, research methods, theories, and practices or applications. Most reviews will focus on more than one of these areas, although with varying levels of attention.
- **Goals.** Goals include synthesis, criticism, and identification of central issues. Nearly all reviews synthesize past literature, which encompasses generalizing from multiple specific instances, proposing explanations that can resolve conflicts between contradictions found in the literature, and closing gaps between theories or disciplines by creating a linguistic framework that can be shared.
- **Perspective.** Literature reviews can either present evidence neutrally or advocate for a specific position. Advocating for a specific position is not necessarily an indication of bias; it is possible for an author to fairly review and present conflicting evidence but still reach a conclusion about the correct interpretation and present it.
- **Coverage.** Reviews may be comprehensive (presenting all works relevant to the topic); comprehensive with selected citations (basing conclusions on all works relevant to the topic, but only presenting a selection of the most important works in the review); representative (presenting samples of the relevant material); or concentrated on central or pivotal works.
- **Organization.** Effective literature reviews can be organized chronologically, conceptually or methodologically. More details about organization options and the scenarios where each is most appropriate are presented in Step 5 of Writing the Literature Review.
- **Audience.** The audience for a literature review—whether specialized researchers, general researchers, practitioners, policymakers, or the general public—will affect the writing style and language used.

Webster and Watson (*3*) presented another classification scheme that divided literature reviews based on whether the subject is relatively mature or still emerging. In mature topics, a literature review analyzes and synthesizes existing literature, with the ultimate goal of proposing a model that extends that research. In emerging topics, a literature review presents the theoretical foundations of the research at hand.

Some research projects are scoped to consist primarily of the literature review, with little or no additional research. Two of the projects in Appendix A: Examples of Effective Transportation Literature Reviews are of this type:

- **Crack and Concrete Deck Sealant Performance** is essentially a review and synthesis of information from 39 relevant studies in support of the overall project's purpose of defining the current state of the art regarding bridge deck sealants and crack sealers. The appendix of the report includes an annotated bibliography summarizing each study discussed in the literature review.
- **Snow Removal at Extreme Temperatures** presents an extensive literature review in a 47-page appendix comprising more than two-thirds of the 72-page report. The literature review uses a topical organization to first provide an overview of the literature on deicing chemicals followed by a synthesis of studies related to various strategies for clearing snow and ice at extremely low temperatures.

Other research projects consist of engineering studies or other explorations in which the literature review may be a relatively small portion of the project intended to frame or inform the problem being addressed. The following two projects in Appendix A: Examples of Effective Transportation Literature Reviews are of this type:

- **Development of a Concrete Maturity Test Protocol** reports the results of extensive field and laboratory testing of several different test methods and equipment for determining concrete pavement maturity. The literature review reported in Chapter 2 of the report reviews current concrete maturity test methods, providing background for the field and lab studies.
- **Quality of Life: Assessment for Transportation Performance Measures** uses the literature review to provide context for the report by first assessing broader literature on the quality of life followed by a review of papers relating more specifically to transportation's effect on quality of life. The research effort itself includes a survey and focus groups, the results of which comprise the bulk of the research report.

WRITING A LITERATURE REVIEW

Writing a literature review can be broken down into several steps. Because the observations in this document are intended to cover a broad spectrum of transportation research topics, authors should adapt these observations to their specific situation and in consultation with the sponsoring agency. The steps are listed below, followed by a detailed description of each step.

Note that the procedure assumes a literature *search* has already been conducted. See Parts I and II of this e-circular for information on how to conduct a literature *search* and what *resources* to use in the search. Each step in the literature review writing process may inform a need to revisit and expand the literature search.

Preliminary Step: Conduct a Literature Search

1. **Determine the purpose of the literature review.** All literature reviews perform some basic functions: informing the research by clarifying what is and is not known about a topic, providing context by summarizing the current state of research on the topic, and establishing a researcher's authority by demonstrating his or her understanding of related existing research. However, literature reviews can fall into any number of subclassifications (*9*). Effectively positioning a review in that taxonomy requires a researcher to make some specific decisions:
   - What is the goal of the review? While all or nearly all literature reviews synthesize information, they may also analyze the existing literature to attempt to demonstrate which conclusions are warranted and which are not, or to identify issues central to a field, such as methodological problems that have blocked progress in a specific topic or areas of inquiry that have been or should be the focus of research.
   - Who is the audience? The writing style and language chosen will change, depending upon whether the literature review is aimed at specialized researchers, general researchers, practitioners, policymakers, or the general public.
   - What is the focus of the review: research outcomes, research methods, theories, or practices and applications? These topics are not mutually exclusive, and many reviews will address more than one of these areas with varying levels of attention.
   - What is the perspective of the review? A literature review may present information neutrally, or it may build a case for a specific position. (Note that this can be achieved without bias; an author should present conflicting evidence and interpret it fairly.)
2. **Determine the scope of the literature review.** The scope includes three major facets:
   - Defining the specific topic that the literature review will cover and topics that will not be covered.
   - Determining how comprehensive the review will be. It may be appropriate to seek all relevant works, a representative sample or only the significant works on a topic.
   - Defining the time period the review will cover. Literature reviews that seek to synthesize current knowledge often focus on recent research, while reviews that seek to demonstrate how a field has developed over time will naturally incorporate more historical research.
3. **Review the research.** While it is not generally necessary to read every piece of marginal literature in depth, thorough note taking that includes bibliographical information is critical to the research process (*10*). It is much easier and much less work to take notes of material that are not ultimately used in the literature review than it is to not make note of material that turns out to be needed.

   A University of Colorado–Denver tutorial (*11*) presents two approaches to note-taking:
   - The "*summarize-as-you-go*" *method*, in which the researcher writes complete sentences with citations that can be pasted into the literature review nearly verbatim. These notes should summarize a study's context, methods, findings, conclusions, and implications.
   - The "*note-basic-details*" *method*, in which the researcher captures more basic information about a study's context, methodology, findings, implications, and suggestions for future research, without trying to generate nearly publication-ready prose. Prevalent themes in individual studies should also be noted so they can be compared and organized when all studies have been reviewed.

The former method requires more work early in the process, while the latter requires more effort later. [Note: While a review of a paper *abstract* may be helpful in determining whether to include it in the literature review, it is not a substitute for reading the entire paper (*12*)]:

> A well-prepared abstract enables readers (*a*) to identify the basic content of a document quickly, (*b*) to determine its relevance to their interests, and thus (*c*) to decide whether they need to read the document in its entirety (p. 2).

4. **Evaluate the research.** Levy and Ellis (*4*) outline a six-step framework for processing the information gathered:

- *Know the material*. This step includes understanding the information in each cited work and the methodology used to reach its conclusions instead of simply identifying works that are relevant without describing their conclusions.
- *Comprehend the material*. This step involves demonstrating how the information in a source is significant and relevant to the subject of the literature review rather than simply repeating the information within the cited source.
- *Apply the material*. In this step, the review author identifies the major concepts of each work cited that relate to the study and organizes the information appropriately so it can support the story told by the literature review.
- *Analyze the material*. Analysis involves demonstrating why the information pulled from sources and presented in the literature review is important. The review author should make the value of the information explicit rather than simply presenting it and leaving the reader to draw conclusions.
- *Synthesize the material*. A literature review is a narrative, not a collection of facts, and synthesis is what turns it from the latter into the former. The narrative should effectively generalize the material while noting any gaps in knowledge and areas of dispute.
- *Evaluate the material*. The review author must distinguish between facts, theories and opinions in the works cited instead of simply presenting all material as if each source has equal supporting evidence and validity.

For each part of the framework (except "apply the material"), Levy and Ellis (*4)* present short excerpts from literature reviews that fail to achieve these goals as well as modifications that improve them.

5. **Organize the material and write the literature review.** A literature review may be an introduction to a study or a stand-alone piece. Either way, however, the author must remember that it is a narrative, not simply a listing of resources or an annotated bibliography. Organizing the content in a logical, thematic manner that supports the literature review's overall goals is the most critical part of this step. Poor organization is one of the most prominently cited shortfalls in literature reviews.

According to Washington et al. (*5*), the literature review should be organized by topic, with connections between papers made as appropriate. Within each topic, cited works should be given prominence according to their importance and relevance rather than being presented equally:

> A good literature review comprises a flowing, easy-to-understand narrative, written in the author's own style. Each topic should be discussed in turn and, while it is often appropriate to discuss the literature on each topic in chronological order, this should not

> be done slavishly. The topics are then combined in a chapter that should be well organized, and gives the reader a brief, yet reasonably complete picture of the status of the research in the subject area reviewed (Volume 1, p. 55).

There are several valid topical organizations, including:

- *Chronological*, which is useful to show how knowledge in a field grows and changes over time.
- *Descriptive*, which presents what several authors write about a specific topic, followed by analysis for that topic. This method highlights topical themes that make up the entirety of the subject.
- *Descriptive–analytical*, which is a variation of the descriptive organization. In this method, the analysis presents the similarities and differences among the sources for each topic rather than presenting them at the end.
- *Big-to-small-to-big*, which begins with the largest and most wide-ranging studies before progressing to smaller ones and then branches out to larger studies. This organizational method highlights how the results of broader studies differ from smaller ones and is particularly useful for empirically oriented reviews.
- *Methodological*, which groups studies by the methodologies they use. A brief analysis after each methodology shows what it does and does not cover, while a master analysis at the end compares and summarizes the findings.
- "*Big camps*," which is useful when there are distinct interpretations of a set of data. It can either present various topics and how the different camps' interpretations are similar and different for each, or present each camp and its interpretations of all relevant themes as a single unit.

According to Cooper (*9*) and the University of Colorado–Denver tutorial (*11*), literature reviews may also blend these methods as appropriate.

One common organizational method that many sources discourage is presenting literature author by author—that is, presenting the full content of one paper, followed by the full content of the next and so on (*3*, *13*). This type of presentation fails to truly synthesize the literature and show the relationships between various authors' work.

In the final formatting of the literature review it is important to consult the sponsoring agency's style guide, particularly regarding the format for citations in the references section and bibliography.

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APPENDIX A

Examples of Effective Transportation Literature Reviews

Crack and Concrete Deck Sealant Performance
Karl Johnson, Arturo Schultz, Catherine French, Jacob Reneson
Minnesota Department of Transportation
Report No. MN/RC 2009-13, March 2009. http://www.lrrb.org/media/reports/200913.pdf

The appendix of this report includes a thorough summary of each study cited in the literature review. The review itself, however, effectively synthesizes this raw information into a more useful form that supports the overall paper's purpose of defining the current state of the art regarding bridge deck sealants and crack sealers.

The literature review addresses bridge deck sealants and crack sealers in turn. Regarding deck sealants, it defines the two categories of sealants, the four performance measures used to evaluate sealants, and variables that affect performance such as concrete parameters and environmental conditions. The section on crack sealers discusses different types of sealers, their properties and application methods, performance measures, general trends in their effectiveness and variables affecting performance.

While there isn't a specific "Gaps in Findings" section, this literature review effectively notes these gaps throughout the review, identifying areas for nearly every topic that existing research has not investigated as well as noteworthy limits to specific research projects cited. Of particular note is how the review identifies a shortcoming with a widely used deck sealant evaluation procedure and a suitable method to compensate for it:

> It should be noted that the NCHRP Series II procedure, which is commonly used by vendors and state highway agencies to evaluate sealer performance, does not implement abrasion or freeze–thaw exposure to which sealers on bridge decks are frequently subjected. However, in determining the absorption properties of concrete sealers, a test was developed by Alberta Department of Transportation and Utilities which is essentially a modification of the NCHRP 244 procedure that incorporates abrasion (Kottke, 1987). Absorption is measured before and after abrading 0.04 in. off the faces of treated, cubic specimens to measure quantitatively the effect of abrasion on the absorption characteristics of sealers (p. 5).

The report clearly identifies the deck sealants and crack sealers that performed best for each of the performance measures, while noting how differences in test procedures can affect results. This provides useful information to support the report's overall conclusions and recommendations.

Snow Removal at Extreme Temperatures
Michelle Akin, Jiang Huang, Xianming Shi, David Veneziano, Dan Williams
Clear Roads Program, Minnesota Department of Transportation, March 2013. http://www.clearroads.org/downloads/Snow-Removal-Extreme-Temps-Final-Report.pdf

This report is immediately noteworthy for the thoroughness of its literature review in Appendix A, which makes up more than two-thirds of the report: 47 of 72 pages. Moreover, it includes international research and research from fields such as airports where snow-removal practices are different but potentially relevant to the work of state DOTs.

The literature review also represents a clear topical organization, first providing an overview of literature available on various deicing chemicals with a focus on their physical properties, and then reviewing various strategies for clearing snow and ice from roads at low temperatures.

Development of a Concrete Maturity Test Protocol
W. James Wilde
Center for Transportation Research and Implementation, Minnesota State University, Mankato
Report No. MN/RC 2013-10, April 2013. http://www.dot.state.mn.us/research/TS/2013/201310.pdf

Field and laboratory studies were undertaken to evaluate the applicability of the concrete maturity method to establishing criteria for opening portland cement concrete pavements to traffic. The field study included visits to18 paving projects in Minnesota over a 3-year period. At these projects, different sensor types were evaluated. In the laboratory study, 2-in. mortar cubes were tested to develop sensitivity analyses related to the proportions of cementitious materials, water–cementitious materials ratio, and other mix components.

The literature review chapter of the report summarizes and discusses the literature regarding (1) the maturity method in general and its use in concrete pavements in particular; (2) supplementary cementing materials; (3) maturity and flexural strength; and (4) various types of sensors for measuring maturity.

Quality of Life: Assessment for Transportation Performance Measures
Ingrid Schneider, Tian Guo, Sierra Schroeder
Minnesota Department of Transportation
Report No. MN/RC 2013-05, January 2013. http://www.dot.state.mn.us/research/TS/2013/2013-05.pdf

This report investigates a topic (the effect of transportation on quality of life) with relatively little published research and none that addresses the topic comprehensively. To provide context for the report, the researchers start with a broader assessment of research into quality of life. This assessment defines key terms relevant to the study as well as methodologies that have been used to measure and predict quality of life, with a number of demographic distinctions.

Connecting the literature to transportation requires something of a patchwork approach, collecting papers that illuminate some specific element of transportation's effect on quality of life to give as complete a picture as possible. Chapter 2 reports on the limited assessments that have been conducted as well as the strengths and weaknesses of their methodologies, organized by the specific factor investigated. In doing so, the literature review clearly delineates what is known and what is not known about the subject.

APPENDIX B

Tutorials on Writing Literature Reviews

There is no shortage of online tutorials for writing literature reviews. Most are produced by university libraries and aimed at student researchers working on theses; however, the principles are applicable to all researchers. The majority of these tutorials put more focus on searching for sources than on synthesizing the information into a useful literature review. Five of the more thorough and useful tutorials for the organizational and writing process are:

Literature Reviews: An Overview for Graduate Students
North Carolina State University Libraries, undated. http://www.lib.ncsu.edu/tutorials/lit-review/

This video includes a unique visualization of the process of organizing existing literature, with major works forming the core of a web and studies that respond or build on them. This web identifies and depicts relationships among sources and provides a framework for developing and connecting original ideas to the body of published literature.

Literature Review
Texas A&M University Libraries, July 23, 2013.
http://guides.library.tamu.edu/content.php?pid=225811

This website includes a lengthy video lecture on planning a literature review, searching for literature, assessing it and writing the review. It advises authors to consider their timeline and any standards they must follow in their planning process. It also recommends that authors determine criteria for papers that would be useful to cite in their research before beginning their literature search—defining details of the subject that are of interest and limiting by factors such as geography or time period. Existing literature reviews can be a useful resource by demonstrating what work has been done recently and by suggesting search methods and articles for inclusion. New literature reviews should not replicate previous ones, and if there is too much overlap, the focus of the review may need to be adjusted to focus on areas not already covered.

The Literature Review: A Few Tips on Conducting It
Dena Taylor
Health Sciences Writing Centre, University of Toronto, undated.
http://www.writing.utoronto.ca/advice/specific-types-of-writing/literature-review

This website offers a series of questions for researchers to help shape the literature review as they research and write it. Additional questions help to assess the validity of the books and articles they consider including in the review.

Writing a Literature Review and Using a Synthesis Matrix
Florida International University Center for Excellence in Writing, 2006.
http://writingcenter.fiu.edu/resources/synthesis-matrix-2.pdf

This presentation describes the synthesis matrix technique for organizing information. The synthesis matrix is a chart with the major ideas found in the literature labeling the rows and the individual sources labeling the columns. Individual chart entries list related information from each source. The technique is useful for clarifying patterns in the literature as well as areas where different sources agree and disagree.

Writing a Literature Review
University of Colorado Denver School of Public Affairs, undated

This four-part video series presents the elements of writing a literature review.

- Part I discusses basic organization. http://video.ucdenver.edu/users/ehowell /litreviewI.html.
- Part II specifies that literature reviews are a survey of research and discusses finding and noting representative studies. http://video.ucdenver.edu/users/ehowell/litreviewII.html.
- Part III goes into detail on finding and developing themes and organizing the literature review, including common organizational models. http://video.ucdenver.edu/users/ehowell /litreviewIII.html.
- Part IV discusses the introduction and summary of the literature review. http://video .ucdenver.edu/users/ehowell/litreviewIV.html.

APPENDIX C

Examples of an Annotated Bibliography

Bertini, Robert. 2012. *Introduction to Library and Literature Research for Transportation*. Portland, OR: Portland State University. http://web.pdx.edu/~bertini/pdf/research.pdf.

The Intelligent Transportation Systems Laboratory at Portland State University produced this guide for students conducting research. The guide includes specific resources available at the university and online, reference styles, notes on plagiarism and copyright, information about presenting research and instructions for writing literature reviews that include examples of good and bad organization.

Boote, David N., and Penny Beile. August–September 2005. Scholars Before Researchers: On the Centrality of the Dissertation Literature Review in Research Preparation. *Educational Researcher* 34(6): 3-15. http://eprints.rclis.org/16929/1/diss_lit_review.pdf.

From the abstract: A thorough, sophisticated literature review is the foundation and inspiration for substantial, useful research. The complex nature of education research demands such thorough, sophisticated reviews. Although doctoral education is a key means for improving education research, the literature has given short shrift to the dissertation literature review. This article suggests criteria to evaluate the quality of dissertation literature reviews and reports a study that examined dissertations at three universities. Acquiring the skills and knowledge required to be education scholars, able to analyze and synthesize the research in a field of specialization, should be the focal, integrative activity of predissertation doctoral education. Such scholarship is a prerequisite for increased methodological sophistication and for improving the usefulness of education research.

Cooper, Harris. 1988. Organizing Knowledge Syntheses: A Taxonomy of Literature Reviews. *Knowledge in Society* 1: 104-126. http://lgdata.s3-website-us-east-1.amazonaws.com/docs/577/213564/Taxonomy_of_Literature_Reviews_Article.pdf.

From the abstract: A taxonomy of literature reviews in education and psychology is presented. The taxonomy categorizes reviews according to: (*a*) focus; (*b*) goal; (*c*) perspective; (*d*) coverage; (*e*) organization; and (*f*) audience. The seven winners of the American Educational Research Association's Research Review Award are used to illustrate the taxonomy's categories. Data on the reliability of taxonomy codings when applied by readers is presented. Results of a survey of review authors provide baseline data on how frequently different types of reviews appear in the education and psychology literature. How the taxonomy might help in judging the quality of literature reviews is discussed, along with more general standards for evaluating reviews.

Fitt, M. Harrison, Andrew Walker, and Heather Leary. April 1, 2009. Assessing the Quality of Doctoral Dissertation Literature Reviews in Instructional Technology. Paper presented at the Annual Meeting of the American Educational Research Association, San Diego, CA. http://digitalcommons.usu.edu/cgi/viewcontent.cgi?article=1007&context=itls_facpub.

From the abstract: Assessment of the doctoral dissertation literature review provides insight into a student's preparation for future work as a researcher. In 2004, efforts to assess the quality of literature reviews in doctoral dissertations were pioneered by Boote and Beile. Their work

represents an important response to the call for improved research skills among emerging scholars. The purpose of this study is to replicate their work in a focused area of educational research, specifically Instructional Technology, and to examine the inter-rater reliability of the rubric. The findings suggest that dissertation literature reviews in Instructional Technology show the same need for improvement as dissertation literature reviews from education as a whole. Potential avenues of research are identified as well as improvements for rubric.

Gall, M. D., W. R. Borg, and J. P. Gall. 1996. *Educational Research: An Introduction*. 6th edition. White Plains, NY: Longman.

From the abstract: A comprehensive introduction to the major research methods and types of data analysis used [in educational research], this text provides detailed coverage of all facets of research.

Guidelines for Abstracts. ANSI/NISO Z39.14-1997. NISO Press. Bethesda, MD. http://www.niso.org/apps/group_public/download.php/6609/Guidelines%20for%20Abstracts.pdf.

From the abstract: Guidance is presented for authors and editors preparing abstracts that represent the content of texts reporting on the results of experimental work or descriptive or discursive studies. Suggestions for the placement of abstracts within publications or other media are given, along with recommendations for abstracting specific documents. Types of abstracts and their content are described. Also included are suggestions on the style of abstracts and a list of selected readings on the subject of abstracting. Examples of abstracts are appended.

Hart, Chris. 1998. *Doing a Literature Review: Releasing the Social Science Research Imagination*. London: Sage.

This book about writing a literature review is for students in social sciences and humanities. The contents include guidance on searching for literature on a topic, analyzing arguments, organizing ideas and perspectives, producing a literature review, and justifying the need for an investigation.

Levy, Yair, and Timothy Ellis. 2006. Towards a Framework of Literature Review Process in Support of Information Systems Research. *Proceedings of the 2006 Informing Science and IT Education Joint Conference*. http://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0CDMQFjAA&url=http%3A%2F%2Fciteseerx.ist.psu.edu%2Fviewdoc%2Fdownload%3Fdoi%3D10.1.1.102.1506%26rep%3Drep1%26type%3Dpdf&ei=d_OvUeu_JsaKrAGNtoDADg&usg=AFQjCNELzDU01TVR6xxrJS8rnrpEvlvbgw&sig2=B-fClB-aXSMRVynQwbOLfw&bvm=bv.47534661,d.aWM.

From the abstract: This paper introduces an initial effort towards developing a framework for writing an effective literature review. The target audience for the framework are novice IS researchers or other researchers who are constantly struggling with the development of an effective literature-based foundation for the proposed research. The proposed framework follows the systematic data processing approach comprised of three major stages: (1) inputs (literature gathering and screening); (2) processing (Blooms Taxonomy); and (3) outputs (writing the review). This paper provides the rationale for developing a solid literature review and addresses the central stage: processing the literature. The paper concludes by providing arguments for the value of an effective literature review as well as implications for future work in this proposed framework.

Mattson, Jeremy, and David Ripplinger. December 1, 2008. How to Conduct a Literature Review. *Transportation and Logistics Seminar*, Small Urban & Rural Transit Center, Upper Great Plains Transportation Institute. http://www.ugpti.org/events/seminar/downloads/2008-12-01DaveRipplinger.pdf.

This presentation includes why a literature review is necessary, tips on searching, evaluating sources, reading literature, note-taking, writing and traps to avoid.

Mullins, Gerry, and Margaret Kiley. 2002. "It's a PhD, Not a Nobel Prize": How Experienced Examiners Assess Research Theses. *Studies in Higher Education* 27(4): 369-386. http://www.studentservices.uwa.edu.au/__data/page/65297/Its_a_PhD_not_a_Nobel_Prize.pdf.

From the abstract: Research to date on the examination process for postgraduate research theses has focused largely on the deconstruction of examiners' reports. This article reports on a study of the processes that experienced examiners go through, and the judgements they make before writing their reports. A sample of 30 experienced examiners (defined as having examined the equivalent of at least five research theses over the past 5 years), from a range of disciplines in five universities was interviewed. Clear trends emerged with regard to: the criteria used by examiners and the levels of student performance expected by them; critical judgment points in the examination process; the examiners' perceptions of their own role in the process; the influence on examiners of previously published work, the views of the other examiner(s) and their knowledge of the student's supervisor or department; and the level of perceived responsibility between student and supervisor.

Randolph, Justus. June 2009. A Guide to Writing the Dissertation Literature Review. *Practical Assessment, Research & Evaluation* 14(13). http://pareonline.net/getvn.asp?v=14&n=13.

From the abstract: Writing a faulty literature review is one of many ways to derail a dissertation. This article summarizes some pivotal information on how to write a high-quality dissertation literature review. It begins with a discussion of the purposes of a review, presents taxonomy of literature reviews, and then discusses the steps in conducting a quantitative or qualitative literature review. The article concludes with a discussion of common mistakes and a framework for the self-evaluation of a literature review.

Washington, Simon, John Leonard, David Manning, Craig Roberts, Billy Williams, Ataur Bacchus, Adarsh Devanhalli, Jennifer Ogle, and Daniel Melcher. 2001. Scientific Approaches to Transportation Research. *NCHRP Report 20-45*, Vols. 1 and 2. http://onlinepubs.trb.org/onlinepubs/nchrp/cd-22/start.htm.

This document is an extensive manual on transportation research. Of particular note are Volume 1, Chapter 5, which addresses the purpose and organization of literature reviews; Volume 1, Appendix A, which covers the evaluation of sources; and Volume 1, Appendix C, which covers formatting.

Webster, Jane, and Richard Watson. June 2002. Analyzing the Past to Prepare for the Future: Writing a Literature Review. *MIS Quarterly* 26(2): xiii-xxiii. http://www.sis.uta.fi/~pt/TIEA5_Thesis_Course/Session_08_2013_02_11/webster02-AnalyzingPastToPrepareForFuture-WritingLiteratureReview_0.pdf.

This editorial addresses the quality of literature reviews that accompanied works submitted to *MIS Quarterly*, with notes about the journal's expectations, organization of reviews, and use of the review to extend theories and identify directions for new research.

APPENDIX D

Draft Specification Language

The suggested language below is meant to provide a framework for dialogue between the transportation agency and the principal investigator regarding what is expected in the literature review for a particular research project. The final language may be inserted into the research contract or used as a memorandum of understanding or other less formal agreement. A shared understanding of the features of the literature review outlined below is an important starting point. Defining specific deliverables will increase the likelihood that the investigator will understand the agency's objectives for the literature review and make a good faith effort to meet them.

- **Scope.** The literature review for this project shall include [*all literature/a representative sample of literature/all major works*] related to [*project topic*], published within the last [*xx*] years as well as older research pivotal to the subject. The literature review shall identify where there are gaps in knowledge in the published literature.
- **Purpose.** The literature review shall support the research project by analyzing and synthesizing previous literature. The following specific aspects of the research topic shall be addressed as well as others the investigator deems appropriate. [*List specific topics and desired methods of analysis.*]
- **Perspective.** Where there is controversy or disagreement in the published literature, diverse views shall be presented. The literature review shall evaluate arguments with the intent of illuminating the strengths and weaknesses of each rather than advocating for a specific position and shaping the evaluation of literature to support that position.
- **Organization.** The literature review shall be organized in such a way that conclusions the researcher has drawn, and the evidence to support those conclusions, are clearly presented. Works that are topically related shall be presented together.
- **Pertinence.** Literature cited in the review shall primarily be of research quality: peer-reviewed journals, conference proceedings and scholarly books. Other sources may be included as the investigator deems appropriate, with an explanation of the rationale for inclusion.
- **Audience.** The audience for this literature review and the research report is primarily agency practitioners and policymakers. The language and writing style should be appropriate for this audience.

APPENDIX E

Literature Resources
Where to Search

RITA EVANS
University of California, Berkeley

JANE MINOTTI
New York State Department of Transportation

BARBARA POST
Transportation Research Board (ret.)

BOB SWEET
University of Michigan Transportation Research Institute

Searching for transportation information poses a dilemma. A researcher with a broad inquiry can easily be overwhelmed by the range of possible resources from government, academic, and commercial providers and not know the best place to begin searching. Or, someone looking for specific information can be stymied by not knowing a good place to even start. Some resources cover all modes and functions, others specialize in formats such as statistics, while still others focus on subject areas such as safety or data. The interdisciplinary nature of many queries may require searching outside of transportation-focused resources.

This list was developed by information professionals with decades of experience in finding and using transportation information and providing researchers and practitioners guidance in locating the information they need. It is intended to guide users by identifying high-quality, reliable sources of information that cover a wide range of topics and information formats within transportation. It describes many commonly used resources, indicating the modes and subject areas they cover. It groups resources by broad categories to help users determine starting points based on the nature of the queries.

This carefully selected and vetted list is based on our collective best understanding and experience working with transportation information resources and those seeking such information. It will serve a broad constituency but it is not an exhaustive or comprehensive, meet-all-needs list of every source of transportation information. Quality, relevance, and usefulness, not quantity, guided the selection of resources. Information on *how to search* and on writing a *literature review* based on search results is contained in Part I and Part II, respectively, of this e-circular.

All resources are listed as free, fee-based, or both. A *fee-based* note in an entry indicates that a subscription or license is required to access full-text resources from the publisher or professional society that provides the database or service. Searching and abstracts may be free. Researchers should consult their libraries for possible access to fee-based sources and to full-text articles, reports, and papers that are not freely available.

The subjects assigned to each resource are taken from the Transportation Research Board's Transportation Research Thesaurus (TRT), available at trt.trb.org. All URLs given for the resources that are listed were current and functional as of March 2014.

RESOURCES

Bibliographic Databases

ABI/Inform. ProQuest. http://www.proquest.com/products-services/abi_inform_complete.html. Business research. Full-text journals, business press and trade publications. Subjects: businesses, commodities, freight service, industries, markets. Fee-based.

Academic Search Complete. EBSCO. http://www.ebscohost.com/academic/academic-search-complete. Multidisciplinary. Indexes 11,000 peer-reviewed journals and trade publications. Subjects: aviation, planning, transportation. Fee-based.

Aerospace Research Center. American Institute of Aeronautics and Astronautics. http://arc.aiaa.org/search. Aerospace technology, engineering and science. Indexes all AIAA meeting papers published since 1963 and journal articles since 1996. Subjects: aerospace engineering, aviation, materials. Fee-based.

ASCE Library. American Society of Civil Engineers. http://ascelibrary.org/. Civil engineering. Indexes and provides full-text access to all 33 ASCE journals (1983 to present), conference proceedings (2000 to present), standards, and e-books. Includes topical special collections. Subjects: bridges, construction, environment, harbors, highway engineering, materials, pavements, pipelines, transportation, tunnels. Fee-based.

Civil Engineering Database. American Society of Civil Engineers. http://cedb.asce.org/. Provides access to indexes of ASCE journals, conference proceedings, standards, and e-books. Subjects: bridges, construction, environment, harbors, highway engineering, materials, pavements, pipelines, transportation, tunnels. Free.

Engineering Village. Elsevier. http://www.engineeringvillage.com/. All engineering disciplines. Indexes more than 5,000 journals as well as conference papers and technical reports; includes millions of bibliographic citations and abstracts. Subjects: bridges, construction, environment, highway engineering, traffic engineering, transportation. Fee-based.

Environmental Sciences and Pollution Management. ProQuest. http://search.proquest.com/espm. Indexes more than 10,000 journals, conference proceedings, technical reports and books on air quality, energy resources and other topics. Includes environmental impact statements. Subjects: energy, environment, pollution, safety. Fee-based.

ERIC Database. U.S. Department of Education, ProQuest. http://www.eric.ed.gov. Primarily education. Indexes books, journals, reports, proceedings, statistical data, tests, and dissertations. Subjects: school buses; school children; pedestrians; bicycling; cyclists, school safety. Free.

FRA E-Library. Federal Railroad Administration. http://www.fra.dot.gov/eLib/Find. Provides access to accident, safety, litigation and compliance reports; technical and environmental reports; conference papers; press releases; and policy and guidance documents. Subjects: rail transportation. railroads. freight and passenger service. railroad safety, regulation. Free.

Google Scholar. http://www.google.com/schhp?hl=en. Multidisciplinary. Retrieves articles, theses, books, and abstracts from academic publishers, professional societies, online repositories, universities, and other websites. Some records include links to related articles and to other sources that cite the item. Subjects: energy, environment, planning, safety, transportation. Free.

IEEE Xplore. Institute of Electrical and Electronics Engineers. http://www.ieee.org/ieeexplore/. Electrical engineering, computer science, and electronics. Indexes 160 journals, 1,200 conference proceedings, and more than 3,800 technical standards published by IEEE. Subjects: control (electronic), information systems, information technology, intelligent transportation systems, vehicle electronics. Fee-based.

IHS Jane's Transportation News and Reference. Jane's Information Group. http://www .ihs.com/products/janes/transport/index.aspx. Market, news, and equipment information for air traffic control, airports, urban transportation systems, and railways. Provides country and city surveys of systems, fleets, technologies, and markets. Subjects: air traffic control, airports, public transit, railroads. Fee-based.

INSPEC. Thomson Reuters. http://thomsonreuters.com/inspec/. Electrical engineering, electronics, computer science. Indexes 5,000 journals and other serial titles; 2,500 conference proceedings added annually. Subjects: control, information systems, information technology, intelligent transportation systems, traffic engineering, vehicle electronics. Fee-based.

LexisNexis. LexisNexis. http://www.lexisnexis.com. News and business, legal, and reference information. Full-text access to hundreds of U.S. and foreign newspapers, legal and business publications, wire services, transcripts, and trade publications. Subjects: businesses, commodities, freight service, industries, legislation and regulation, logistics, markets, news, policy, trade. Fee-based.

National Technical Information Service (NTIS)–National Technical Reports Library (NTRL). U.S/ Department of Commerce. http://www.ntis.gov/search/index.aspx; http://www .ntis.gov/products/ntrl.aspx. Multidisciplinary. NTIS contains records for more than 3 million technical reports (800,000 with full-text links) from government agencies including the U.S. DOT and the U.S. Department of Energy. Full-text reports can be downloaded free of charge and hardcopies of all reports can be purchased. NTRL offers subscription-based access to NTIS indexes, abstracts, and technical reports. Subjects: aviation, energy, engineering, environment, pavements, transportation. NTIS free, NTRL fee-based.

National Transportation Library Digital Repository. U.S. Department of Transportation, Bureau of Transportation Statistics. http://ntl.bts.gov. Database of electronic resources including full-text research and technical reports from the U.S. DOT, state DOTs, and university transportation centers. Provides access to research and policy sites. Subjects: air transportation, construction, highways, maintenance, policy, public transit, transportation, railroad transportation; water transportation, safety. Free.

Practice Ready Papers. TRB. http://prp.trb.org. Database of TRB peer-reviewed papers where the information presented is ready for immediate implementation by transportation practitioners.

Subjects: air transportation construction, highways, maintenance, policy, public transit, transportation, railroad transportation, safety, water transportation. Free.

ProQuest Dissertations and Theses. ProQuest. http://www.proquest.com/products-services/pqdt.html. Citations to more than 3 million dissertations and theses and 1 million full-text. Subjects: communications and control, construction, energy, engineering, environment, planning and design, safety and security, transportation operations. Fee-based.

ProQuest Newsstand. ProQuest. http://www.proquest.com/products-services/newsstand.html. More than 1,300 newspapers and online news sources from 1977 to present. Includes full-text major U.S. and international newspapers. Subjects: businesses, markets, news. Fee-based.

PsycINFO. American Psychological Association. http://www.apa.org/pubs/databases/psycinfo/index.aspx. Provides information about psychological aspects of disciplines such as medicine, education, business and law. Subjects: alcohol use, behavior, distraction, drivers, drug use, human factors, perception. Fee-based.

PubMed/MEDLINE. U.S. National Institutes of Health, National Library of Medicine. http://www.ncbi.nlm.nih.gov/pubmed/. Biomedicine. Indexes 5600 journals and includes more than 19 million citations. Subjects: alcohol use, anatomy, biophysics, distraction, drivers, drug use, injuries, human behavior, human factors, perception. Free.

SAE Digital Library. Society of Automotive Engineers. http://digitallibrary.sae.org/quicksearch/. Automotive–vehicle and aerospace engineering. Indexes technical papers, standards, e-books, and other material from SAE International and other providers. Subjects: aerospace engineering, automotive engineering, vehicle electronics. Fee-based.

SafetyLit. World Health Organization and San Diego State University. http://safetylit.org. Indexes reports from 30 professional disciplines relevant to preventing unintentional injuries including economics, engineering, ergonomics and human factors, health and medicine, law and law enforcement, and psychology. Subjects: crashes, ergonomics, human factors, safety, injuries, law enforcement. Free.

ScienceDirect. Elsevier. http://www.sciencedirect.com/. Multidisciplinary. Indexes more than 2,200 peer-reviewed journals published by Elsevier in the sciences and engineering. Subjects: energy, environment, highways, railroads, safety, transportation. Fee-based.

Scopus. Elsevier. http://www.scopus.com/. Multidisciplinary. Covers journals, patents, and websites from more than 5,000 publishers. Indexes more than 21,000 science, medical, technical, and social science peer-reviewed titles. Provides citation and cited-reference searching. Subjects: aviation, energy, engineering, environment, highway engineering, human factors, planning, safety, traffic engineering, transportation. Fee-based.

TranWeb. Northwestern University Transportation Library. http://tran.library.northwestern.edu/. Indexes journal articles, trade publications, and conference proceedings on all modes and aspects of transportation. Free.

TRB Publications Index. TRB. http://pubsindex.trb.org. Indexes of papers, articles, and reports published by the Transportation Research Board, the Highway Research Board, the Strategic Highway Research Program, and related programs. Subjects: transportation; highways; air transportation; railroad transportation; water transportation; public transit; construction; maintenance; safety; policy. Free.

TRID, TRB, and ITRD. http://trid.trb.org. World's largest and most comprehensive bibliographic database for transportation. Contains more than 1 million records of published research and ongoing research projects. Covers peer-reviewed journals, research and technical reports, papers from conference proceedings, trade publications, environmental impact statements, and books. Provides links to more than 120,000 full-text reports, papers, and articles. Includes all modes and aspects of transportation. International in scope with 400,000 records from European sources. Subjects: transportation; highways; air transportation; railroad transportation; water transportation; public transit; construction; maintenance; safety; policy. Free.

Web of Science. Thomson Reuters. http://thomsonreuters.com/thomson-reuters-web-of-science. Multidisciplinary. Indexes more than 8,000 peer-reviewed journals in the sciences, social sciences, and humanities. Includes Science Citation Index, providing searching of footnoted citations. Subjects: aviation, bridges, construction, energy, environment, highway engineering, human factors, planning, safety, traffic engineering, transportation. Fee-based.

Data and Statistics

Annual Energy Review. U.S. Department of Energy, Energy Information Administration. http://www.eia.gov/totalenergy/data/annual/index.cfm. Reports annual energy statistics, beginning with 1949. Includes data on total energy production, consumption, and trade; overviews of petroleum, natural gas, coal, electricity, nuclear energy, renewable energy, international energy, as well as financial and environmental indicators. Subjects: energy, environment, fuel consumption. Free.

Boating Safety Resource Center. U.S. Coast Guard. http://www.uscgboating.org/statistics/default.aspx. Provides statistics on all reported recreational boating safety accidents and incidents throughout the United States and its territories. Subjects: safety, ships, water transportation. Free.

Bureau of Transportation Statistics. U.S. Department of Transportation, Research and Innovative Technology Administration. https://www.rita.dot.gov/bts/. Comprehensive coverage of all modes of transportation data; provides statistical analysis and abstracts. Subjects: aviation, crashes, drivers, freight transportation, highway travel, rail, transportation modes, transportation operations. Free.

CAFÉ–Fuel Economy. U.S. DOT, NHTSA. http://www.nhtsa.gov/fuel-economy. Includes links to reports on fuel economy performance of vehicle fleet. Subjects: environment, fuel consumption, vehicles. Free.

Census Transportation Planning Products (CTPP). FHWA. http://www.fhwa.dot.gov/planning/census_issues/ctpp/. A set of special tabulations from decennial census demographic surveys, designed for transportation planners. Utilizing large sample size, it provides reliable and accurate data. Subjects: census, persons and personal characteristics, transportation operations. Free.

Commodity Flow Survey. U.S. DOT, Bureau of Transportation Statistics. http://www.rita.dot.gov/bts/sites/rita.dot.gov.bts/files/publications/commodity_flow_survey/index.html. Primary source of national- and state-level data on domestic freight shipments by American establishments in mining, manufacturing, wholesale, auxiliaries, and selected retail industries. Data are provided on the types, origins and destinations, values, weights, modes of transport, distance shipped, and ton-miles of commodities shipped. Subjects: commodities, freight transportation, hazardous materials, trade. Free.

Congestion Data for Your City. Texas Transportation Institute. http://mobility.tamu.edu/ums/congestion-data/. Provides basic statistics and ranking for urban areas in categories of: travel delay, excess fuel consumed, truck congestion cost, and total congestion cost with comparisons back to 1982. Detailed information is provided on spreadsheets for 101 cities. Subjects: commuting, drivers, freight transportation, fuel consumption, traffic congestion. Free.

Data.gov. U.S. General Services Corporation. http://www.data.gov/. Site of U.S. government's Open Data portal. Comprehensive coverage of over 20 topics including Climate, Geospatial, Public Safety, and over 90,600 datasets. Federal, state and local data, resources, and tools. Subjects: crashes, drivers, environment, highway safety, injuries, safety. Free.

Data Sources Related to Freight Transportation. U.S. DOT, FHWA. http://ops.fhwa.dot.gov/freight/freight_analysis/data_sources/index.htm. Includes links to information on highway, maritime, rail, and pipeline modes, product information, and road classification. Subjects: freight transportation, highway travel, trade, transportation modes. Free.

Estimating Information: Average Low Bid Unit Price. Texas Department of Transportation. http://www.txdot.gov/business/letting-bids/average-low-bid-unit-prices.html. Includes average low unit bid prices for highway construction and maintenance projects statewide and by district. Subjects: construction, economic and social factors, road construction. Free.

Fatality Analysis Reporting System. NHTSA. http://www.nhtsa.gov/FARS. Provides annual data regarding fatal injuries in motor vehicle traffic accidents; allows user to run customized queries. Subjects: alcohol use, bicyclists, crashes, distraction; drivers, fatalities, highway safety, injuries, safety. Free.

Federal Aviation Administration Data and Research. FAA. http://www.faa.gov/data_research/. Provides data on accidents and incidents, safety, passengers, cargo, commercial space, funding, and aviation forecasts. Subjects: aircraft crashes, aviation, safety.

Federal Motor Carrier Safety Administration: Data, Analysis and Statistics. U.S. DOT,

Federal Motor Carrier Safety Administration. http://www.fmcsa.dot.gov/facts-research/facts-figures/analysis-statistics/dashome.htm. Provides access to safety ratings and crash statistics for commercial trucks and buses in tables, reports. Subjects: buses, crashes, freight transportation, hazardous materials, motor carriers, safety. Free.

Federal Railroad Administration: Office of Safety Analysis. Federal Railroad Administration. http://safetydata.fra.dot.gov/OfficeofSafety/default.aspx. Provides data files on railroad safety information including accidents and incidents, inspection and highway–rail crossing data. Subjects: freight transportation, rail, safety. Free.

Freight Analysis Framework. U.S. DOT, FHWA. http://ops.fhwa.dot.gov/freight/freight_analysis/faf/. Integrates data from a variety of sources to create a comprehensive picture of freight movement among states and major metropolitan areas. Provides estimates for tonnage and value, by commodity type, mode, origin, and destination. Subjects: commodities, freight transportation, trade, transportation operations. Free.

Highway Safety Information System. U.S. DOT, FHWA, Turner Fairbank Highway Research Center. http://www.hsisinfo.org/. A multistate database that contains crash, roadway inventory, and traffic volume data for a select group of states. Participating states were selected based on the quality and quantity of data available, and ability to merge data from various files. Subjects: crashes, drivers, highway safety, road construction. Free.

Highway Statistics. U.S. DOT, FHWA. http://www.fhwa.dot.gov/policyinformation/statistics.cfm. Provides analyzed statistical data on motor fuel; motor vehicles; driver licensing; highway-user taxation; state and local government highway finance; highway mileage, and federal aid for highways. Presented in tabular format and charts. Site includes a historical archive back to 1945. Subjects: drivers, fatalities, finance, highway travel, taxation. Free.

IHS Fairplay Bespoke Maritime Data Services. HIS. http://www.ihs.com/products/maritime-information/data/index.aspx. Databases cover ship movements, ship characteristics, ownership, maritime companies, ports and terminals. Includes news archive and image bank. Subjects: harbors, shipping, ships, transit, water transportation. Fee-based.

Journey to Work and Place of Work. U.S. Census Bureau. http://www.census.gov/hhes/commuting/. Includes data on Means of Transportation to Work, Travel Time to Work, Time Leaving Home to Go to Work, Private Vehicle Occupancy, and Travel to Work Characteristics. Subjects: behavior, commuting, highway travel, transportation operations. Free.

Life Cycle Benefit-Cost Analysis Model. California Department of Transportation. http://www.dot.ca.gov/hq/tpp/offices/eab/LCBC_Analysis_Model.html. Life-cycle benefit–cost analysis for proposed projects performed using Cal-B/C, a PC-based spreadsheet model. Can analyze many types of state highway and public transit construction and operational improvement projects. Subjects: construction, economics, finance, road construction. Free.

Measurement of Government Transportation Financial Statistics. U.S. DOT, Bureau of

Transportation Statistics. http://www.rita.dot.gov/bts/sites/rita.dot.gov.bts/files/publications/government_transportation_financial_statistics/measurement_of_GFTS_2012/index.html. Consists of transportation revenues and expenditures for federal, state and local governments. Contains data by revenue source, expenditure type, and mode. Subjects: economics, finance. Free.

Monthly Energy Review. U.S. Department of Energy, Energy Information Administration. http://www.eia.gov/totalenergy/data/monthly/. Includes total energy production, consumption, and trade; energy prices; overviews of petroleum, natural gas, coal, electricity, nuclear energy, renewable energy, and international petroleum; carbon dioxide emissions; and data unit conversions values. Subjects: energy, greenhouse gases, trade. Free.

Motor Carrier Management Information System. U.S. DOT, Federal Motor Carrier Safety Administration. http://mcmiscatalog.fmcsa.dot.gov/. Provides information on the safety fitness of commercial motor carriers and hazardous material shippers subject to the Federal Motor Carrier Safety Regulations and the Hazardous Materials Regulations. Subjects: hazardous materials, motor carriers, safety, shipping. Free.

Motor Vehicle Accidents and Fatalities. U.S. Census Bureau. http://www.census.gov/compendia/statab/cats/transportation/motor_vehicle_accidents_and_fatalities.html. Data from US Census Bureau on Transportation motor vehicle accidents and fatalities from Statistical Abstract. Subjects: crashes, distraction, drivers, fatalities, injuries, safety. Free.

National Automotive Sampling System. U.S. DOT, NHTSA. http://www.nhtsa.gov/NASS. Composed of two systems, the Crashworthiness Data System (CDS) and the General Estimates System (GES), and based on cases selected from a sample of police crash reports. Provides data on passenger vehicle crashes to identify potential improvements in vehicle design. GES data focus on the overall crash picture and trends. Subjects: crashes, highway safety, injuries, safety. Free.

National Bridge Inventory Database. U.S. DOT, FHWA. http://www.fhwa.dot.gov/bridge/britab.cfm. Provides data tables from National Bridge Inventory identifying bridges by new construction and rehabilitation, state and county, condition, deficiencies, deck type, year of construction and other factors. Subjects: bridges, structural health monitoring. Free.

National Emissions Inventory (NEI) Air Pollutant Emission Trends Data. U.S. Environmental Protection Agency. http://www.epa.gov/ttnchie1/trends/. Presents the estimate of national emissions of the criteria air pollutants. Emissions of pollutants are estimated for many different source categories, collectively accounting for all anthropogenic emissions. Subjects: environment, greenhouse gases, pollutants. Free.

National Household Travel Survey. U.S. DOT, FHWA. http://nhts.ornl.gov/. National data on the travel behavior of the American public. Allows for analysis of daily travel by all modes, characteristics of the people traveling, their household, and their vehicles. The 2009 NHTS updates information gathered in the 2001 NHTS and in prior Nationwide Personal Transportation Surveys. Subjects: behavior, commuting, persons and personal characteristics, transportation modes. Free.

National Transit Database. U.S. DOT, FTA. http://www.ntdprogram.gov/ntdprogram/. Information and statistics on more than 660 transit systems in the United States. The types of data reported include operational characteristics, services characteristics, capital revenues and assets, and financial operating statistics. Subjects: buses, rail, transit, transportation modes. Free.

National Transportation Atlas Database. U.S. DOT, Bureau of Transportation Statistics. http://www.rita.dot.gov/bts/sites/rita.dot.gov.bts/files/publications/national_transportation_atlas_database/index.html. Set of nationwide geographic databases of transportation facilities, networks, and associated infrastructure. These datasets include spatial information for modal networks and intermodal terminals. Metadata documentation, as prescribed by the Federal Geographic Data Committee, is provided for each database. Subjects: transportation modes, transportation operations. Free.

National Transportation Safety Board (NTSB). http://www.ntsb.gov/. The NTSB is an independent federal agency charged by Congress with investigating every civil aviation accident in the United States and significant accidents in other modes of transportation–railroad, highway, marine and pipeline. Subjects: aircraft crashes, aviation, highway safety, pipelines, rail, safety, water transportation. Free.

National Transportation Statistics. U.S. DOT, Bureau of Transportation Statistics. http://www.rita.dot.gov/bts/sites/rita.dot.gov.bts/files/publications/national_transportation_statistics/index.html. Statistics on the U.S. transportation system, including its physical components, safety record, economic performance, the human and natural environment, and national security. More than 260 data tables plus data source and accuracy statements. Internet edition is updated quarterly. Subjects: economic and social factors, environment, safety, transportation operations. Free.

State Data System (SDS). U.S. DOT, NHTSA. http://www.nhtsa.gov/Data/State+ Data +Program+&+CODES. While the Fatality Analysis Reporting System (FARS) has fatal crash data, SDS includes valuable data on injury and property-damage-only crashes. Consists of census data taken from police accident reports. Subjects: crashes, drivers, highway safety. Free.

State Traffic Safety Information. U.S. DOT, NHTSA. http://www-nrd.nhtsa.dot.gov /departments/nrd-30/ncsa/STSI/USA%20WEB%20REPORT.HTM?Year=2003&State =AZ&Accessible=0. Data by state on traffic fatality totals, rates, alcohol involvement, restraint usage, types of vehicles and persons, crash type. Subjects: crashes, drivers, highway safety, safety. Free.

State Transportation Statistics. U.S. DOT, BTS. http://www.rita.dot.gov/bts/sites/rita.dot .gov.bts/files/publications/state_transportation_statistics/index.html. Statistical profile of state transportation infrastructure. Freight movement, passenger travel, system safety, vehicles, and transportation-related economy and finance, energy usage, environment. Subjects: environment, economic and social factors, transit, transportation modes, transportation operations. Free.

Statistical Abstract of the United States. U.S. Census Bureau. http://www.census.gov

/compendia/statab/. Description: Comprehensive summary of statistics on the social, political, and economic organization of the United States and a guide to sources of other data from the Census Bureau, other federal agencies, and private organizations. Subjects: census, economic and social factors, persons and personal characteristics. Free.

Transportation Energy Data Book. U.S. Department of Energy, Energy Efficiency and Renewable Energy. http://cta.ornl.gov/data/index.shtml. Statistics and information that characterize transportation activity with data on factors that influence transportation energy use. Chapters focus on petroleum, energy, highway vehicles, light vehicles, heavy vehicles, alternative fuel vehicles, fleet vehicles, household vehicles, nonhighway modes, transportation and the economy, greenhouse gas emissions, and criteria pollutant emissions. Subjects: environment, fuel consumption, greenhouse gases, pollutants. Free.

Transportation Statistics Annual Report. U.S. DOT, BTS. http://www.rita.dot.gov/bts/sites/rita.dot.gov.bts/files/publications/transportation_statistics_annual_report/index.html. Presents data and information about the performance and impacts of the U.S. transportation system. Topics include traffic flows for all modes; travel times and measures of congestion; transportation costs; availability and use of mass transit; consequences of transportation for the environment; and the extent, connectivity, and condition of the transportation system. Subjects: economic and social factors, environment, finance, safety, transportation, transportation modes. Free.

TranStats. U.S. DOT, BTS. http://www.transtats.bts.gov/. Provides comprehensive datasets by agency, mode, and subject. Subjects: economic and social factors, environment, safety, transportation, transportation modes, transportation operations. Free.

Urban Mobility Information. Texas A&M Transportation Institute. http://mobility.tamu.edu/ums/. Provides mobility and congestion data on freeways and major streets for 100 urban areas. Includes annual *Urban Mobility Report* and *Congested Corridors Report* along with summary data tables and description of methodologies. Subjects: commuting, highway travel, traffic congestion. Free.

Waterborne Commerce Statistics Center. U.S. Army Corps of Engineers, Navigation Data Center. http://www.iwr.usace.army.mil/Locations/IWRCenters/WaterborneCommerceStatisticsCenter(WCSC).aspx. Includes internal U.S. waterway monthly tonnage, container traffic for U.S. ports and all 50 states and U.S. territories; waterborne commerce of the U.S. waterways and harbors. Subjects: commodities, harbors, shipping, water transportation. Free.

Directories

Transportation Research Board Directory. TRB. http://www.trb.org/CommitteeandPanels/OnlineDirectory.aspx#. The TRB Online Directory provides access to points of contact and information on TRB's standing committees, project-based committees and panels, and governing committees, as well as to lists of TRB sponsors, affiliates, and representatives. In addition, the directory provides password-controlled access to contact information on TRB's more than 7,000 volunteers. Subjects: directories, professional personnel, specialists. Free.

Federal Highway Administration Research Expertise Directory. FHWA, Turner–Fairbank Highway Research Center. https://www.fhwa.dot.gov/research/tfhrc/expertise/. The expertise of TFHRC scientists, engineers, and support staff at 20 laboratories and data centers encompasses more than 100 transportation-related disciplines and expertise areas. Subjects: directories, professional personnel, specialists. Free.

AASHTO Committees. American Association of State Highway and Transportation Officials. http://www.transportation.org/Pages/Committees.aspx. Much of AASHTO's work is done by committees comprising volunteer state DOT personnel. AASHTO provides a forum for consideration of transportation issues and conducts surveys, provides data, and testifies before Congress on transportation legislation. Subjects: directories, professional personnel, specialists. Free.

Websites

Association of American Railways (AAR). http://www.aar.org/. Statistics on U.S. and Canadian freight railroads including Class I performance measures, cost indices, and time indicators. Some data are free; cost indices, analyses and freight commodity statistics are fee based. Subjects: freight traffic, railroad transportation, railroads. Free and fee-based.

Context Sensitive Solutions. FHWA. http://contextsensitivesolutions.org. A portal funded by FHWA linking to information on context-sensitive solutions and design. Subjects: highway design; context sensitive design; planning. Free.

Deer-Vehicle Crash Information Clearinghouse. Iowa State University Institute for Transportation. http://www.deercrash.org/index.htm. A pooled fund project to expand the data collection, research evaluation, and information exchange on deer–vehicle crashes. Subjects: deer, roadside fauna. Free.

Council of State Governments Knowledge Center. Council of State Governments. http://knowledgecenter.csg.org/kc/. Variety of types of information focus on issues related to state governments. Subjects: state government; legislation, public policy. Free.

International Air Transport Association (IATA). http://www.iata.org/publications/Pages /index.aspx. Aviation economics and operations. Data and analysis of economics and policy affecting the globalperformance of the airline industry. Subjects: airlines, airports, economics, international airports, international transportation. Free.

ITE Technical Information. Institute of Transportation Engineers. http://www.ite.org /technical/default.asp. Provides links to websites related to specific topics such as traffic calming, context-sensitive design, pedestrians, connected vehicles. Subjects: context-sensitive design, highway design, traffic engineering, transportation engineering. Free.

Local Technical Assistance Program (LTAP) Clearinghouse. FHWA. http://www.ltap.org /index.php. A resource database to provide practical, technical, and training-related information for the transportation workforce. TRT terms: education and training; maintenance; construction;

highways; construction safety; construction and maintenance personnel. Free.

National RTAP Rural Transit Assistance Program. FTA. http://webbuilder.nationalrtap.org/. Provides support and resources in rural transit-related materials, including training modules, reports, and technical briefs. TRT terms: education and training, transit, tribal government. Free.

Pedestrian and Bicycle Information Center. University of North Carolina Highway Safety Research Center. http://www.pedbikeinfo.org. Provides information and training to diverse audiences about health and safety, engineering, advocacy, education, enforcement, access, and mobility as it relates to pedestrians and bicyclists. This site is funded by the FHWA. Subjects: walking; pedestrians; bicycles, cycling; bicycles; bicyclists; nonmotorized transportation; walkways. Free.

Science.gov. CENDI (Commerce, Energy, NASA, Defense Information Managers Group). http://science.gov. Provides access to over 55 databases and over 2,100 selected websites from 15 federal agencies, offering 200 million pages of authoritative U.S. government science information including research and development results. Subjects: science; technology; engineering; energy; environment; policy. Free.

Transportation and Climate Change Clearinghouse. U.S. DOT, Center for Climate Change and Environmental Forecasting. http://climate.dot.gov/. Designed as a one-stop source of information on transportation and climate change issues. It includes information on GHG inventories, analytic methods and tools, GHG reduction strategies, potential impacts of climate change on transportation infrastructure, and approaches for integrating climate change considerations into transportation decision making. Subjects: climate change; environmental policy; environmental protection; environmental impacts; environmental quality. Free.

Transportation Meta Search. Google. https://www.google.com/cse/home?cx=006511338351663161139:hovexomtgsw. Google custom search engines created by transportation information professionals for quality transportation-related websites. Search the websites of the 50 state and District of Columbia DOTs, public transit agencies, university transportation centers, LTAP and TTAP centers, and MPOs. Subjects: highways, multimodal transportation, state departments of transportation, websites. Free.

U.S. Department of Transportation Maritime Administration. http://www.marad.dot.gov/. Fleet and trade statistics for water transportation in the United States. Subjects: shipping, ships, water transportation. Free.

U.S. Department of Transportation Pipeline and Hazardous Materials Safety Administration. U.S. DOT Pipeline and Hazardous Materials Safety Administration. http://phmsa.dot.gov/. Data, statistics, and reports on pipelines and the movement of hazardous materials in the United States. Also links to reports, statutes, and other documents. Includes the National Pipeline Mapping System. Subjects: hazardous materials, mapping, pipeline safety, pipelines. Free.

The National Work Zone Safety Information Clearinghouse. Texas A&M Transportation

Institute. http://www.workzonesafety.org. A comprehensive information resource on roadway construction zone safety funded by FHWA. Subjects: work zone safety; work zone traffic control; construction safety. Free.

Research Databases

Federal Aviation Administration Data and Research. FAA. http://www.faa.gov/data_research/. This site provides accident and incident reports; aviation data and statistics; data on safety, passengers, and cargo; commercial space data; funding and grants; and aviation forecasts. Subjects: air traffic, air traffic control, air transportation, airlines, airport operations, air transportation policy, passenger service. Free.

Research in Progress. TRB. http://rip.trb.org. A database of current and recently completed research projects from the U.S. DOT, state DOTs, universities, TRB, and international organizations. Subjects: transportation; highways; air transportation; railroad transportation; research projects, water transportation; public transit; construction; maintenance; safety; policy. Free.

Research Need Statements. TRB. http://rns.trb.org. A database of research needs developed by TRB Technical Committees. Subjects: transportation; highways; air transportation; railroad transportation; water transportation; public transit; research projects, research management, construction; maintenance; safety; policy. Free.

Transport Research Portal. European Union (EU) Seventh Framework Programme for Research. http://www.intransport.eu/search/about. The aim of this project is to foster a closer and more effective communication between researchers working in the field of transport technologies, both in the EU and internationally. It seeks to do this providing access to information from databases of past and ongoing research projects worldwide. Subjects: transportation; highways; air transportation; railroad transportation; research projects, water transportation; public transit; construction; maintenance; safety; policy. Free.

U.S. DOT Research Hub. U.S. DOT Research and Innovative Technology Administration. http://ntlsearch.bts.gov/researchhub/index.do. This database is a central location for projects funded by 10 U.S. DOT agencies. Database provides links to research reports and other products generated by completed projects. Subjects: federal government, research projects, research management. Free.

SUBJECT INDEX

There are several resources wherein a researcher would be able to find information on any of the subjects listed in this index. Those resources are listed on the following page under the initial heading *All Subjects.*

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Academic Search Complete
Bureau of Transportation Statistics
Data.gov
Google Scholar
Google Transportation Meta Search
LexisNexis
Measurement of Government Financial Statistics
NTIS–NTRL
National Transportation Library Digital Repository
National Transportation Statistics
Practice-Ready Papers
ProQuest Dissertations and Theses
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Research Needs Statements
Science.gov
ScienceDirect
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State Transportation Statistics
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Transportation Research Board Directory
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TRID
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PubMed–MEDLINE
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Automotive Engineering

SAE Digital Library

Aviation

Academic Search Complete
AIAA Electronic Library
Bureau of Transportation Statistics
FAA Data and Research

IHS Jane's Transportation News and Reference
IATA
National Transportation Library Digital Repository
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Industries

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Information Technology

IEEE Xplore
INSPEC

Injuries

FARS
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Persons and Personal Characteristics

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Work Zone Safety

The Work Zone Safety Clearinghouse
RiP
TRB Publications Index
TRID

MODE INDEX

There are several resources wherein a researcher would be able to find information on any of the modes listed in this index. Those resources are listed below under the initial heading *All Modes*.

All Modes

Academic Search Complete
BTS
Data.gov
Google Scholar
Google Transportation Meta Search
LexisNexis
Measurement of Government Financial Statistics
NTIS–NTRL
National Transportation Library Digital Repository
National Transportation Statistics
Practice-Ready Papers
ProQuest Dissertations and Theses
ProQuest Newsstand
RiP
Research Needs Statements
Science.gov
ScienceDirect
Scopus

State Transportation Statistics
Statistical Abstract of the United States
Transport Research Portal
TRB Directory
Transportation Statistics Annual Report
TranWeb
TRB Publications Index
TRID
U.S. DOT Research Hub
Web of Science

Aviation

AASHTO Committees
Aerospace Research Center
ASCE Library
FAA Data and Research
IEEE Xplore
IHS Jane's Transportation News and Reference
IATA
National Transportation Atlas Database
NTSB
SAE Digital Library
Transportation Energy Data Book
TranStats

Freight Transportation

AASHTO Committees
Annual Energy Review
CAFE–Fuel Economy
Commodity Flow Survey
FMCSA–Data, Analysis, and Statistics
Freight Analysis Framework
Freight Analysis Framework State Profiles
Motor Carrier Management Information System
National Emissions Inventory (NEI) Air Pollutant Emission Trends Data
National Transportation Atlas Database
Transportation Energy Data Book
TranStats

Highways

AASHTO Committees
Annual Energy Review
ASCE Library

CAFE–Fuel Economy
Census Transportation Planning Products (CTPP)
CFS
Compendex
Congestion Data for Your City
Context-Sensitive Solutions
Data Sources Related to Freight Transportation
Deer–Vehicle Crash Information Clearinghouse
ERIC Database
Estimating Information: Average Low Bid Unit Price
FARS
FHWA Research Expertise Directory
Highway Safety Information System
Highway Statistics
IEEE Xplore
INSPEC
ITE Technical Information
Journey to Work and Place of Work
Life-Cycle Benefit–Cost Analysis Model
LTAP Clearinghouse
Motor Vehicle Accidents and Fatalities
National Automotive Sampling System
National Bridge Inventory Database
NEI Air Pollutant Emission Trends Data
NHTSA
National Household Travel Survey
National Transportation Atlas Database
NTSB
SAE Digital Library
SafetyLit
State Data System
State Traffic Safety Information
The Work Zone Safety Clearinghouse
Transportation and Climate Change Clearinghouse
Transportation Energy Data Book
TranStats
Urban Mobility Information
U.S. DOT Pipeline and Hazardous Materials Safety Administration

Marine Transportation

AASHTO Committees
ASCE Library
Boating Safety Resource Center
IHS Fairplay Bespoke Maritime Data Services
National Transportation Atlas Database

NTSB
Transportation Energy Data Book
TranStats
U.S. DOT Maritime Administration
Waterborne Commerce Statistics Center

Motor Carriers

Commodity Flow Survey
FMCSA–Data, Analysis, and Statistics
NEI Air Pollutant Emission Trends Data
NTSB
Transportation Meta Search
TranStats
Urban Mobility Information

Passenger Transportation

AASHTO Committees
Annual Energy Review
CAFE–Fuel Economy
CTPP
Congestion Data for Your City
Environmental Science and Pollution Management
FARS
FHWA Research Expertise Directory
INSPEC
ITE Technical Information
Journey to Work and Place of Work
Motor Vehicle Accidents and Fatalities
National Automotive Sampling System
NEI Air Pollutant Emission Trends Data
NHTSA
National Household Travel Survey
National Rural Transit Assistance Program
NTSB
PsycINFO
PubMed/MEDLINE
SAE Digital Library
SafetyLit
State Data System
State Traffic Safety Information
Transportation and Climate Change Clearinghouse
Transportation Energy Data Book
TranStats
Urban Mobility Information

Pedestrians and Bicycles

AASHTO Committees
ITE Technical Information
NEI Air Pollutant Emission Trends Data
NTSB
Pedestrian and Bicycle Information Center
PubMed/MEDLINE
TranStats
U.S. DOT Research Hub

Pipelines

Environmental Science and Pollution Management
National Transportation Atlas Database
NTSB
Transportation Meta Search
TranStats
U.S. DOT Pipeline and Hazardous Materials Safety Administration

Public Transportation

AASHTO Committees
Annual Energy Review
Boating Safety Statistics
CTPP
FRA E-Library
IHS Jane's Transportation News and Reference
IEEE Xplore
Journey to Work and Place of Work
Life-Cycle Benefit–Cost Analysis Model
NEI Air Pollutant Emission Trends Data
National Household Travel Survey
National Rural Transit Assistance Program
National Transit Database
National Transportation Atlas Database
NTSB
RiP
Transportation Energy Data Book
TranStats

Railroads

AASHTO Committees
AAR
FRA Office of Safety Analysis

FRA E-Library
IHS Jane's Transportation News and Reference
National Transportation Atlas Database
NTSB
Transportation Energy Data Book
TranStats

APPENDIX F

Definitions

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The following definitions were developed specifically for the transportation research community by members of the TRB CoR and LIST Committees. It will be recommended the definitions and singular forms for these terms are added to the TRT.

LITERATURE SEARCH: NO TRT TERMS

A literature search is a well-planned and organized investigation for, and collection of, sources on a specific topic. Based on:

- Nursing Times.net: "A literature search is a well thought out and organised search for all of the literature published on a topic."
- Merriam-Webster: "The methodical investigation of all published sources for information bearing on a usu. scientific or technological subject."

LITERATURE SEARCH SUMMARY: NO TRT TERMS

A Literature Search Summary is a brief description of ongoing research and published works on a specific topic. The purpose of which is to document previous and current work such that new work can build upon it rather than duplicating it. Based on:

- The TRB NCHRP problem statement form (attached below).
- TRB staff definition (Crawford Jencks, personal communication, 4/17/13).

BIBLIOGRAPHY OR ADDITIONAL REFERENCES

"Bibliographies" (Xbbq) is a related term to "Guides to the Literature" (Xbbm). A bibliography is a list of citations or works, usually on a single topic. Based on:

- Merriam-Webster: A bibliography is "the works or a list of the works referred to in a text or consulted by the author in its production."
- Dictionary.com:
  - A bibliography is "a complete or selective list of works compiled upon some principle, as authorship, subject, place of publication, or printer."
  - A bibliography is "a list of source materials that are used or consulted in the preparation of a work or that are referred to in the text."
- Cornell University: A bibliography "is a list of citations to books, articles, and documents."
- Purdue University: "A bibliography is a list of sources (books, journals, websites, periodicals, etc.) one has used for researching topic."

Types of bibliographies or additional references include the following:

- Consulted, but not referenced, in the preparation of the product of a research or academic effort, such as a technical report or a scientific paper.
- Due to topical relatedness, viewed as potentially of interest to a consumer of the product of a research or academic effort.

ANNOTATED BIBLIOGRAPHY: NO TRT TERMS

An annotated bibliography is a list of citations or works, usually on a single topic with a brief summary or analysis for each entry. Based on:

- Dictionary.com: An annotated bibliography is "a bibliography that includes brief explanations or notes for each reference."
- Cornell University: "An annotated bibliography is a list of citations to books, articles, and documents. Each citation is followed by a brief (usually about 150 words) descriptive and evaluative paragraph, the annotation."
- Purdue University: An annotated bibliography "is a list or sources (books, journals, web sites, periodicals, etc.) one has used for researching a topic" with "a summary and/or evaluation of each of the sources."

Types of annotated bibliographies (from Capella University) include the following:

- Summative: "Summative annotations provide the reader with a solid sense of the content of the article or book being annotated."
- Evaluative: "Evaluative annotations include both a description and a critical assessment of the article or book being annotated."

LITERATURE CITED, WORKS CITED, AND REFERENCES OR REFERENCE LIST: NO TRT TERMS

Literature or works cited, sometimes referred to as references or reference list, is a list of resources used to prepare the product of a research or academic effort. Based on

- University of Wisconsin: Literature cited is an acknowledgement of "any works or ideas of others that have influenced your experiment, conclusions, or interpretation of the data."
- George Mason University: Literature cited is a list of "all authors cited in the text" and only those authors cited in the text.

TRB information for authors and publication standards uses the term "references" to indicate cited materials. However, other sources use "references" as a more general term to indicate bibliographies, annotated bibliographies, literature cited, and works cited.

Examples of standards for bibliographies or additional references, annotated bibliographies, and literature cited or works cited include the following:

- *Associated Press Style Book*;
- *Chicago Manual of Style* (suggested by TRB, ASCE, and IEEE); and
- Modern Language Association (MLA)

LITERATURE REVIEW

"Literature reviews" is a TRT term (Xxqm). A literature review is the process of reading, analyzing, evaluating, and summarizing materials collected as the result of a literature search about a specific topic.

Based on http://grammar.about.com/od/il/g/literaturereviewterm.htm, a literature review is "the process of reading, analyzing, evaluating, and summarizing scholarly materials about a specific topic".

LITERATURE SUMMARY

Use literature review.

LITERATURE SURVEY

TRT entry: Literature surveys USE Literature reviews.

SYNTHESIS

"Syntheses" (Xbby) is a related term to "Guides to the Literature" (Xbbm). In transportation research, a synthesis is usually a literature review and a state of the practice survey.

Based on TRB, a synthesis is a report "…on current knowledge and practice, in a compact format, without the detailed directions usually found in handbooks or design manuals. Each report in the series provides a compendium of the best knowledge available on those measures found to be the most successful in resolving specific problems."

TRT TERMS

Literature Reviews (Xxqm)

- Use for literature surveys.
- Broader term: Reviews (Xxq).
- Related terms (Hierarchical): Annual reviews (Xxqa).
- Top terms > Information organization (X) > Documents (Xx) > Reviews (Xxq) > Literature reviews (Xxqm).

Guides to the Literature (Xbbm)

- Broader term: Guides to information (Xbb)
- Related terms (Hierarchical):
  - Classification (Xbbc),
  - Indexes (Information management) (Xbbf),
  - Catalogs (Xbbk),
  - Bibliographies (Xbbq),
  - Biographies (Xbbw),
  - Abstracts (Xbbx), and
  - Syntheses (Xbby).
- Top terms > Information organization (X) > Information management (Xb) > Guides to information (Xbb) > Guides to the literature (Xbbm).

THE NATIONAL ACADEMIES

Advisers to the Nation on Science, Engineering, and Medicine

The **National Academy of Sciences** is a private, nonprofit, self-perpetuating society of distinguished scholars engaged in scientific and engineering research, dedicated to the furtherance of science and technology and to their use for the general welfare. On the authority of the charter granted to it by the Congress in 1863, the Academy has a mandate that requires it to advise the federal government on scientific and technical matters. Dr. Ralph J. Cicerone is president of the National Academy of Sciences.

The **National Academy of Engineering** was established in 1964, under the charter of the National Academy of Sciences, as a parallel organization of outstanding engineers. It is autonomous in its administration and in the selection of its members, sharing with the National Academy of Sciences the responsibility for advising the federal government. The National Academy of Engineering also sponsors engineering programs aimed at meeting national needs, encourages education and research, and recognizes the superior achievements of engineers. C. D. (Dan) Mote, Jr., is president of the National Academy of Engineering.

The **Institute of Medicine** was established in 1970 by the National Academy of Sciences to secure the services of eminent members of appropriate professions in the examination of policy matters pertaining to the health of the public. The Institute acts under the responsibility given to the National Academy of Sciences by its congressional charter to be an adviser to the federal government and, on its own initiative, to identify issues of medical care, research, and education. Dr. Victor J. Dzau is president of the Institute of Medicine.

The **National Research Council** was organized by the National Academy of Sciences in 1916 to associate the broad community of science and technology with the Academy's purposes of furthering knowledge and advising the federal government. Functioning in accordance with general policies determined by the Academy, the Council has become the principal operating agency of both the National Academy of Sciences and the National Academy of Engineering in providing services to the government, the public, and the scientific and engineering communities. The Council is administered jointly by both Academies and the Institute of Medicine. Dr. Ralph J. Cicerone and C. D. (Dan) Mote, Jr., are chair and vice chair, respectively, of the National Research Council.

The **Transportation Research Board** is one of six major divisions of the National Research Council. The mission of the Transportation Research Board is to provide leadership in transportation innovation and progress through research and information exchange, conducted within a setting that is objective, interdisciplinary, and multimodal. The Board's varied activities annually engage about 7,000 engineers, scientists, and other transportation researchers and practitioners from the public and private sectors and academia, all of whom contribute their expertise in the public interest. The program is supported by state transportation departments, federal agencies including the component administrations of the U.S. Department of Transportation, and other organizations and individuals interested in the development of transportation. **www.TRB.org**

www.national-academies.org

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