

## **AC 2009-140: USING ENGINEERING THESES AND DISSERTATIONS TO INFORM COLLECTION-DEVELOPMENT DECISIONS, ESPECIALLY IN CIVIL ENGINEERING**

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## **USING ENGINEERING THESES AND DISSERTATIONS TO INFORM COLLECTION DEVELOPMENT DECISIONS ESPECIALLY IN CIVIL ENGINEERING**

**Abstract:** To develop an excellent collection for graduate student use, a librarian must take the time to know what students are using for their research and study. Citation analysis can be used to enhance a librarian's knowledge of tools and resources used by the graduate population and therefore allow better purchase and service decisions. For graduate students, especially in fields where journal publication is not necessarily the venue of choice, theses and dissertations are a font of information. Citation patterns provide information about the governmental and web resources that should be included in a collection. Tracking down the cited materials provides the librarian with information about the discovery tools that should be taught to newer students. Civil engineers, especially in the transportation and construction fields, use specialized resources and unique databases.

### **Introduction:**

Citation studies, especially when using materials that require manually processing bibliographies, can be time consuming and cumbersome, but they help guide collection development efforts with empirical information. Broadus<sup>[1]</sup> discussed this idea extensively as a method to aid the non-subject specialist in building a collection. Dr. Smith<sup>[2]</sup> specifically notes that citation analysis of theses and dissertations can help in both collection development and user services development. Kriz's<sup>[3]</sup> citation analysis of West Virginia University College of Engineering doctoral dissertations was used to dramatically hone the journal collection to best suit the needs of that institution. Citation studies, along with collection use information (especially electronic journal use), comparative shelf counts and interlibrary loan information are the traditional methods used by librarians to justify their collection development decisions.

The citation study of engineering theses and dissertations at the University of Arkansas, Fayetteville was started in early 2005 to assess the Libraries' collection. With the advent of substantial new funds for the Libraries in the previous 5 years, journal subscriptions as well as electronic resources were aggressively purchased. This study was undertaken to determine if sufficient funding was being allocated towards monographs. While completing this study it became evident that a more in-depth view of the civil engineering citation patterns was needed to appropriate gauge the types of resources needed by this client group.

### **Literature:**

A review of the library, engineering, and educationally related literature was conducted. Little is written on the literature of civil engineering. In order to take the broadest look at related literature, the search was conducted not only in general civil engineering, but also the areas of environmental engineering, structural engineering, transportation engineering, and construction engineering that have active research groups at the University of Arkansas, Fayetteville. Most of

the articles discussed specific databases and instruction but did not discuss specific resources used by civil engineers.

The first article that discusses civil engineering literature is written by a civil engineer. In 1930, Flinn<sup>[4]</sup> condensed a lecture delivered to group of engineering educators at Yale University that discussed research in civil engineering. He said, “So comprehensive is the practice of civil engineering that engineers of single great enterprises have to apply directly or indirectly a large portion of human knowledge, including not a few subtexts which at first mention would seem to the uninformed far afield.” As he goes on to expound on the importance of research in this diverse field he states, “Finally, it must be remembered that all research projects should begin in the library.” Unfortunately he does not address the types of printed resources used by the engineer; rather, he simply states that recording research and procedures as well as depositing them in the library for others would be a useful idea. This may be the beginning of the need for technical reports and other “unpublished” resources used by civil engineering.

In the 1980s and 1990s several articles address the use of journals, books, and conferences in engineering. These articles do not go into any depth about the specific materials used by civil engineers. Though the grey literature is mentioned, few details are provided until Thompson<sup>[5]</sup> wrote an article in 2001 that defined the types of unique resources used by engineers. These include standards, specifications, technical reports (both governmental and non-governmental), government documents (local, state, and federal), patents, and manufacturers’ resources (now largely available on the Web). His article does not address the specific organizations and resources used by civil engineers. While discussing building a new collection, Brin<sup>[6]</sup> mentions a few specific resources of use to civil engineers. Another civil engineer, Chanson,<sup>[7]</sup> writes about issues relating to publish or perish for the civil engineering researcher. He makes the point that “[t]he cost of traditional libraries and international databases are often prohibitive. Many consulting engineers can only access a commercial search engine like Google Scholar™ and digital OAR [open access repositories].” He goes on to declare that though he was positively surprised by open access resources, “the quality and impact of the works remain linked through expert-review process and publication in international scientific journals and books.” He does discuss, at length, the improvement of international governmental publications in the last few years.

Recently an article by Williams and Fletcher<sup>[8]</sup> reported on the use of resources by engineering graduate students at Mississippi State University using a citation analysis of dissertations and theses. They stated that journals were still the most cited but “percentage[s] ranged from a low of 26% in civil engineering to a high of 58% in agricultural and biological engineering.” Close to 25% of the resources used by graduate students were not traditionally available in university and college libraries general collections. These resources include standards, technical reports, government documents and web resources defined as grey literature by Thompson. Civil engineers are especially strong in the use of this grey literature with over 41% of their citations referring to resources outside the more traditional university library resources. The Mississippi

findings as well as the lack of literature detailing the resources used by civil engineers reinforce the need for further study of their information seeking patterns.

### **Methods:**

For the initial project – evaluating how well the library was providing monographic resources to graduate students in engineering – a subset of theses and dissertations from 2003 and 2004 were used. The intent was to harvest citations for all theses and dissertations of College of Engineering students published during this two year window. Sub-disciplines of engineering at the University of Arkansas include biological, medical, industrial, mechanical, chemical, electrical and computer engineering as well as computer science. Each manuscript was either retrieved from the library or *ProQuest Theses and Dissertations*. It should be noted, that at the University of Arkansas, there is a non-thesis option for master's students in most engineering fields. No attempt was made to include these projects in our study.

Over 100 manuscripts were identified at the initial stages of this project. Additional manuscripts were identified as the graduate school processed student submissions for degrees that had been granted during the study period. The initial study was concluded after 74 manuscripts were analyzed as a clear pattern of accessibility to book and journal resources was established.

An engineering graduate assistant was responsible for the initial assessment of cited resource type based on the preset parameters. Conference proceedings were included in one of the two categories being studied, monographs or serials, depending on their method of purchase or how they were cataloged. Resources that did not fit these parameters were not included in the initial study. A database was used to track the types of resource cited. Each cited resource was assigned an initial material category and was searched in our catalog to determine availability through the Libraries. If a resource was not available in our collection, then *WorldCat* and *Google* were used to determine resource type. The author reviewed all resources the graduate assistant had indicated as not held by the Libraries and reviewed all bibliographies reassigning resource type as needed and provided additional searching for resources not easily defined.

A second study on the types of resources used by civil engineering students was completed after the initial citation analysis was concluded. The civil engineering citation study was expanded to include all dissertations and theses from the Department of Civil Engineering during 2003 and 2004. The goal of the second study was to learn more about the resources the graduate students in civil engineering used and what, if any changes were needed in collection development and services to make it easier for the incoming students to find resources through the library. There were 22 theses and 3 dissertations published by civil engineering students in this study period at the University of Arkansas. All were included in the secondary study regardless of the subcategory of civil engineering. For the second study the categories of resources cited were further refined; all types of resources were included, but no additional information on ownership or accessibility was gathered.

## Results and Discussion – Building a better collection

The initial study showed the library needed to improve the funding for monographic materials in order to have a robust collection. Books and other monographic materials comprised one-third of the resources cited by engineering graduate students. The study clearly showed that less than 50% of the monograph materials (including conferences published with ISBNs) were available in the library collection. However, more than 85% of the serial publications (including conferences published with ISSN) cited by the graduate students were available locally. A case was made to the head of collection development that a larger portion of funds was needed to support graduate learning and research in engineering through the purchase of monographic materials.

	<b>Monographs</b>	<b>Serials</b>
<b>Number cited</b>	580	1513
<b>Number held</b>	278	1298
<b>% held</b>	47.9%	85.7%

As the author reviewed the graduate assistants' work, it quickly became apparent that the resources cited by civil engineering students had many unique characteristics. Over one half of the civil engineering citations needed librarian input to determine resource category and locate holdings information. Almost one third of the civil engineering citations were incomplete or incorrect especially those for unpublished conference proceedings and the governmental information. So though the initial citation study clearly showed the need for more funds in the monographic budget it was important to further research the civil engineering graduate students citation habits to determine if the library was providing the appropriate resources for this group of engineers. Further study was needed to determine what types of resources are used the civil engineering graduate students. Then the author could determine if changes in collection development activities were needed, a secondary goal of the initial study.

An unexpected benefit of this project is the training it provided the engineering library graduate assistants. The University of Arkansas Libraries has one engineering graduate student on staff in a formal Graduate Assistant position. The incumbents receive the same salary and benefits as all other engineering related graduate assistants. They provide 20 hours of work per week including reference assistance, peer-to-peer training and collection development assistance. This program is well documented in two articles by Jones, Parsch, and Varghese.<sup>[9, 10]</sup> Three different graduate assistants participated in the collection of data for the initial study. After training, the graduate assistants were able to classify resources and determine what was owned by the University Libraries and what freely available electronic resources were cataloged or added to the library

web pages for ease of access. The experience gained by the GA while doing this project was integrated into their skill set used at the reference desk.

## Results and Discussion – Civil Engineering Resources

Over 800 items were cited in the 25 civil engineering manuscripts used for the second study. Table 2 shows the types of resources are cited by civil engineering graduate students. 40% of resources can be classified as grey literature.

Articles	Books	Dissertations and Thesis	Conference Paper	Government Documents	Technical Reports	Standards	Others	Total
320	122	44	129	76	85	20	42	838
38.2%	14.6%	5.3%	15.4%	9.1%	10.1%	2.4%	5.0%	100%

Further division of the citation patterns by the level of degree was completed. Though the sample size is small, it shows that the Ph.D. candidates are using somewhat different resources than Master's candidates. Tables 3 and 4 clearly show this difference. The writer's of dissertations used other dissertations and theses much more often than thesis writers, 13% to 1% respectively. Masters' candidates used book materials more and made heavier use of the grey literature – almost twice as much as the doctoral students.

Articles	Books	Dissertations and Thesis	Conference Paper	Government Documents	Technical Reports	Standards	Others	Total
138	31	37	41	15	15	2	6	285
48.4%	10.9%	13.0%	14.4%	5.3%	5.3%	0.7%	2.1%	100%

Articles	Books	Dissertations and Thesis	Conference Paper	Government Documents	Technical Reports	Standards	Others	Total
182	91	7	88	61	70	18	36	553
32.9%	16.5%	1.3%	15.9%	11.0%	12.7%	3.3%	6.5%	100%

## Conclusion

While these citation studies were being completed, the collection was enhanced by appropriate acquisitions, cataloging and web portal changes. The need for more equitable distribution between monographic and serials purchases was noted and is being addressed as funds become available. As the bibliographies were reviewed it became important to decipher the commonly used acronyms in a, for the author, unfamiliar area of engineering, civil engineering. It became clear that governmental and quasi-governmental resources should be added to the collection and

made more visible on the web portals developed by the Libraries for civil engineers. A large number of governmental and quasi-governmental organizations web sites and indexes were cataloged. An important governmental database, TRIS (Transportation Research Information Service), which has dramatically expanded its coverage of appropriate literature in the last 2 years, became a featured resource in the civil engineering database lists and is now demonstrated routinely. The information resources in civil engineering continue to grow and need more organization as was noted by the development of the Transportation Knowledge Networks <sup>[11]</sup> The hours of graduate assistant and librarian time used in these studies have hopefully lead to better services for engineering graduate students at the University of Arkansas, Fayetteville and will inform many collection development decisions in the coming years.

It is possible, given the practical nature of the master's degree in many civil engineering fields, that the governmental resources are especially important to them. Perhaps the type of research projects undertaken by the master's student more readily reflect the work of the civil engineering in designing systems and processes that meet everyday needs. The work of doctoral students may be more focused to more esoteric research as they prepare for teaching and research obligations that are a part of faculty positions. Further research is needed to clarify these issues, as well as help today's librarian make decisions about what resources they university or college library should collect.

### **Civil Engineering Resources**

Below is a listing of the organizations, government entities, and other resources of which a librarian dealing with transportation and construction engineering must be aware. It is not comprehensive and is focused towards the needs of the civil engineers at the University of Arkansas, Fayetteville.

#### **Building codes**

*International building code* / International Code Council --  
<http://www.iccsafe.org/> -- a three year publication cycle

*Supplement to the international codes* / International Code Council

*Building codes illustrated: a guide to understanding the 2000 international building code* / Francis D.K. Ching, Steven R. Winkel, Hoboken, NJ : John Wiley, c2003

*2004 Arkansas energy code for new building construction: supplements and amendments to the 2003 International energy conservation code* – local and state codes are also appropriate

National Conference of States on Building Codes and Standards --  
<http://www.ncsbc.org/>

*National Building Code of Canada from the National Research Council Canada*  
*Uniform Plumbing Code and Uniform Mechanical Code / the International Association of Plumbing and Mechanical Officials*

**ASTM International (originally known as the American Society for Testing and Materials) compilations**

*International building code. ASTM referenced standards* is a useful tool that brings together all the standards cited in the code.

*ASTM Standards in BUILDING CODES* is now on its 45<sup>th</sup> edition with over 1300 building code related standards.

**Soil Surveys** – recently become almost easy

*Soil Data Mart* <http://soildatamart.nrcs.usda.gov/> NCRS – Natural Resources Conservation Service, US Department of Agriculture

**National Infrastructure (governmental groups)** – most are a part of DOT FHWA – Department of Transportation Federal Highway Administration – many documents are available through GPO. Selective catalog the sites and documents based on local needs.

Highway Bridge Replacement & Rehabilitation (HBRRP)  
National Bridge Inspection Program  
National Bridge Inspection Standards (NBIS)  
National Bridge Inventory (NBI)  
National Historic Covered Bridge Preservation (NHCBP)  
Innovative Bridge Research and Construction (IBRC)

Research and Innovative Technology Administration (RITA)

[http://www.rita.dot.gov/about\\_rita/](http://www.rita.dot.gov/about_rita/)

Bureau of Transportation Statistics (BTS) <http://www.bts.gov/about/>

National Transportation Library's (NTL) [http://ntl.bts.gov/about\\_ntl.html](http://ntl.bts.gov/about_ntl.html)

US Department of Transportation University Transportation Center (UTC)

<http://utc.dot.gov/>

**“Quasi-governmental organizations”** - include university research and transportation industry participation with a strong governmental involvement. These organizations are very interrelated and often work jointly. Many, but not all, of these resources are published by the Transportation Research Board (TRB). More of the publications are becoming available electronically. Often there will be a representative from state universities to the TRB that may receive many of their publications as part of their work.

### **Organizations:**

AASHTO -- American Association of State Highway and Transportation Officials -- <http://www.transportation.org/?siteid=37&pageid=310>  
TRB -- Transportation Research Board, Part of the National Academies -- [http://www.trb.org/news/blurb\\_detail.asp?id=8037](http://www.trb.org/news/blurb_detail.asp?id=8037)

### **Programs:**

NCHRP -- National Cooperative Highway Research Program  
SHRP-- Strategic Highway Research Program -- <http://www.trb.org/SHRP2/SHRPPubs.asp>  
Superpave -- SUperior PERforming Asphalt PAVEments -- see: <http://obr.gcnpublishing.com/articles/jul03b.htm> for a good article  
SHRP 2 -- <http://www.trb.org/SHRP2/>  
TCRP -- Transit Cooperative Research Program  
TFHRC -- Turner-Fairbank Highway Research Center -- <http://www.tfhrc.gov/about.htm>

### **Publications** (very selective on topics of interest today, titles only)

- *A guide for achieving flexibility in highway design*
- *A policy on geometric design of highways and streets*
- *AASHTO Strategic Highway Safety Plan*
- *Bridge life-cycle cost*
- *Guide for the planning, design, and operation of pedestrian facilities*
- *Guidebook for assessing the social and economic effects of transportation projects*
- *Standard specifications for transportation materials and methods of sampling and testing*
- *Transportation: invest in our future: a new vision for the 21st century*
- *User benefit analysis for highways manual*

### **Societies, Trade Groups and other non-governmental organizations and research groups**

American Concrete Institute (ACI) - [http://www.concrete.org/MEMBERS/MEM\\_INFO.HTM](http://www.concrete.org/MEMBERS/MEM_INFO.HTM)  
Association of Asphalt Paving Technologists (AAPT) - <http://www.asphalttechnology.org/>  
Institute of Transportation Engineers ITE - <http://www.ite.org/aboutite/index.asp>  
Institution of Highways & Transportation (IHT) - <http://www.iht.org/en/index.cfm>  
National Asphalt Pavement Association (NAPA) - <http://www.hotmix.org/>  
National Center for Asphalt Technology (NCAT) - <http://www.eng.auburn.edu/center/ncat/>  
Precast/Prestressed Concrete Institute (PCI) - <http://www.pci.org/about/index.cfm>

**Databases (non-commercial)**

TRIS (Transportation Research Information Service) -

This database provides access to almost 450,000 records of published transportation research and over 470 serial publications on air, highway, rail, and maritime transport; mass transit; and other transportation modes. Other areas include regulations, legislation, energy, environmental and maintenance technology, operations, traffic control, and communications. Include citations to and abstracts and links of journal articles as well as all forms of grey literature. Recent additions, such as OCLC links and extensive international documents make this a major source of transportation information

TRB Publications Index

“The TRB Publications Index contains over 21,000 annotated citations for all TRB and Strategic Highway Research Program (SHRP) publications from the mid 1970s until present.” All NCHRP and TCRP publications are included.

## References:

- [1] Broadus, Robert N., **The Applications of Citation Analyses to Library Collection Building**. In *Advances in Librarianship*, ed, N. J. Voigt and M. H. Harris, New York, Academic Press, 1997.
- [2] Smith, Linda C., **Citation Analysis**, *Library Trends*, 1981, **30** (1), 83-105.
- [3] Kriz, Harry M, **Library Management Implications of Journal Citation Patterns in Engineering Doctoral Dissertations**, ED 243481, 1984.  
[http://www.eric.ed.gov/ERICDocs/data/ericdocs2sql/content\\_storage\\_01/0000019b/80/34/78/b2.pdf](http://www.eric.ed.gov/ERICDocs/data/ericdocs2sql/content_storage_01/0000019b/80/34/78/b2.pdf) (accessed 2008 December 11).
- [4] Finn, A. D., **Research advances in civil engineering**, *Civil Engineering*, **1** (1930), 14-16.
- [5] Thompson, Larry A., **Grey literature in engineering**, *Science & Technology Libraries*, 2001, **19** (3), 57-73, [http://dx.doi.org/10.1300/J122v19n03\\_05](http://dx.doi.org/10.1300/J122v19n03_05) (accessed 2009 January 12).
- [6] Brin, Beth L., **Building a library collection to support new engineering programs**, *Science and Technology Libraries*, 2001, **19** 19-37.
- [7] Chanson Hubert, **Research quality, publications, and impact in civil engineering into the 21<sup>st</sup> century. Publish or peris, commercial versus open access, Internet versus libraries?** *Canadian Journal of Civil Engineering*, 2007 **34**, 946-951.
- [8] Williams, Virginia K., Christine Lea Fletcher, **Materials Used by Master's Students in Engineering and Implications for Collection Development: A Citation Analysis**, *Issues in Science and Technology Librarianship*, Winter 2006, <http://www.istl.org/06-winter/refereed1.html> (accessed 2008 December 23).
- [9] Jones, Philip; Janet H Parsch, and Vijith Varghese, **Graduate Assistants at the University of Arkansas Libraries: Past, Future, and Significance, Part I.**, *Arkansas Libraries*; Winter2004, Vol. 61 Issue 4, p4-10.
- [10] Jones, Philip; Janet H Parsch, and Vijith Varghese **Graduate Assistants at the University of Arkansas Libraries: Past, Future, and Significance, Part II.**, *Arkansas Libraries*; Summer2005, Vol. 62 Issue 2, p6-11.
- [11] Transportation Research Board, "TRB SPECIAL REPORT 284: **Transportation Knowledge Networks A Management Strategy for the 21st Century**", TRB Report Summary 25, January 2006, <http://onlinepubs.trb.org/Onlinepubs/sr/sr284ReportSummary.pdf> (accessed 2009 February 12)