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Engineers and Scholarly Journals

Reading Patterns in the Electronic Era

CAROL TENOPIR AND DONALD W. KING

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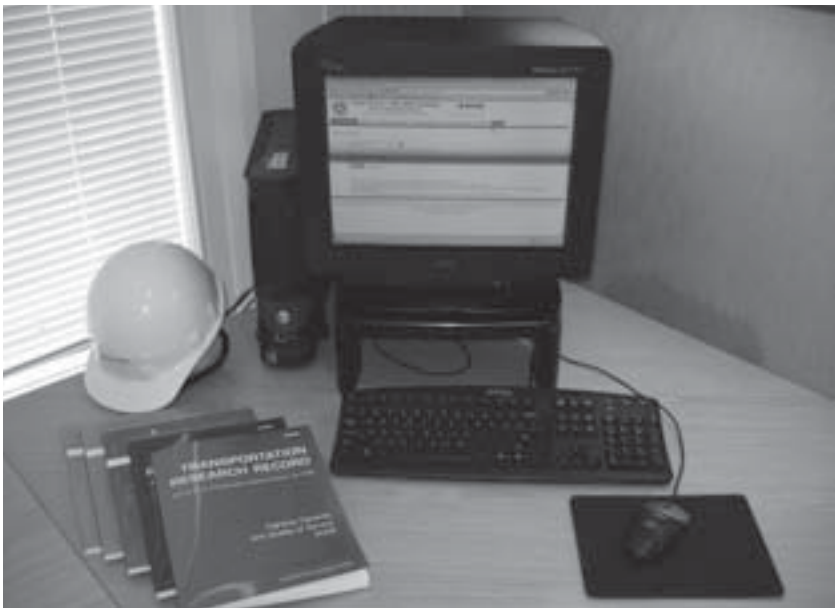
Scholarly journals are an important source of trusted information, although the engineering professional reads fewer journal articles on average than do members of the scientific and engineering academic communities. Studies have shown that engineers spend a smaller proportion of work time reading from scholarly journals and that they read fewer articles than scientists and physicians. Nonetheless journals are useful and valuable to engineers, who also read many types of information resources, including standards, technical reports, books, and articles.

When engineers read articles, they rate the importance to their job as very high. Other information sources—particularly oral reports and oral communications—are more important for engineers than for scientists or medical professionals. Recent studies confirm these trends, which have been observed for decades, although a growing percentage of reading is now from electronic sources.



Comparing Patterns

The reading patterns of engineers have been studied extensively for nearly 50 years. Studies in the 1960s, for example, found that engineers use technical reports frequently (*1–3*). Several studies have compared the use and importance of scholarly journals for several fields, including medicine, sciences, social sciences, and engineering (*4–5*).

Most of the data presented here were collected in readership surveys from 2000 to 2005 at five universities and the Oak Ridge National Laboratory (ORNL), a Department of Energy science and energy research facility in Tennessee. Responses by engineers were compared with those by scientists and members of other professions.

The surveys focused on the most recent reading—a variation of the critical incident technique. After the respondent estimated an amount of reading, the questions turned to the last article read. Questions covered details about the last reading, including the time spent, how the article was identified, where it was obtained, the purpose and value of the reading, and the form and format of the reading. In addition, a limited number of questions required recall—such as the amount of reading in the past month—and demographic questions aimed at such information as the respondent's subject discipline, age, gender, and degree.

Reading Journals

A 1977 national survey sponsored by the National Science Foundation showed that engineers read an average of 80 scholarly articles per year and spent about 60 hours reading these articles, or an average of 45 minutes per reading (*6*). Approximately 30 percent of all readings were by engineers in universities and the remainder by engineers in other locations. The university engineers averaged 150 readings and other engineers about 60 readings per year.

A series of 32 surveys in the 1980s and 1990s

revealed that engineers in industry, government, and federal laboratory settings averaged about 83 annual readings and spent 72 hours per year reading these articles (7). Engineers averaged an additional 210 hours reading materials such as trade journals or bulletins (47 readings per year); books of all kinds (40 readings); technical reports, mostly internal (81 readings); and other work-related documents. In 2001 a survey at ORNL showed that engineers averaged 98 annual readings of scholarly articles and 88 hours reading these articles, an indication that nonuniversity engineers had increased their reading of articles and their time spent reading.

A similar pattern was observed for university engineers. The amount of reading and time spent reading by university engineers increased from 150 readings in 1977 to 250 by 2005 and from 110 to 170 hours spent reading per year.

Some increased reading of scholarly articles is attributable to broadened access to articles through bibliographic and full-text article databases and e-journal systems. More time spent reading articles, however, may detract from reading other materials. Regardless, engineers' willingness to devote time to reading articles indicates the value they place on the information.

Amount of Reading

In surveys by Tenopir and King, respondents were asked, "In the past month (30 days), approximately how many scholarly articles have you read?" A scholarly article was defined as one "found in journal issues, author websites, or separate copies such as preprints, reprints, and other electronic or paper copies." A reading was defined as "going beyond the table of contents, title, and abstract to the body of the article."

The survey focused on readings, not on the specific articles read. Almost 16 percent of readings by university engineering faculty in 2005 and 30 percent of readings by nonuniversity engineers in 2001 were rereadings. The distribution of readings tends to be highly skewed, with only a few engineers reading many articles in the preceding month.

Figure 1 shows the average amount of reading per month by university faculty and staff by subject disciplines. The amount of reading by engineering faculty is less than that by science and medical faculty.

Time Spent Reading

The average time spent reading an article has decreased from an average of 48 minutes per article across all subject disciplines in 1977 to an average of 34 minutes per article in 2005. Because the average number of article readings has increased dramatically at the same time, the total time spent reading articles has increased, but by less than would have been projected. On average, the decrease in the amount of time engineers spent per article was less than that for scientists or medical faculty.

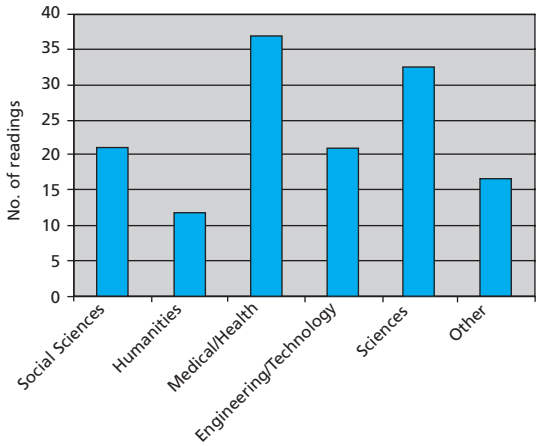


FIGURE 1 Average Readings per Month by Subject Discipline: Faculty in U.S. Research Universities, 2005 (n = 941)

Engineering faculty read fewer articles on average than colleagues did in several other disciplines but spent more time per article (Figure 2). In 2005 university engineers reported spending an average of 41 minutes per article or 172 hours per year—this included only reading, not searching, retrieving, and citing the articles. ORNL engineers reported spending an average of 54 minutes per article in 2001 or about 88 hours reading journal articles annually.

Sources and Format

As journal prices have increased, engineers have subscribed to fewer journals and have sought articles from other sources, such as libraries and separate copies. The availability of electronic journals also has changed information-seeking and reading patterns. The average number of subscriptions per university engineer was 2.56 during 2000 to 2003; 16 percent of university engineers, however, reported

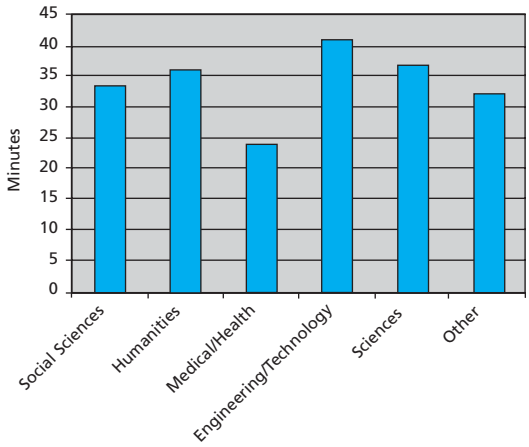


FIGURE 2 Average Time Spent per Article by Subject Discipline: Faculty in U.S. Research Universities, 2005 (n = 937)

receiving no personal subscriptions. The average number of personal subscriptions per ORNL engineer was 1.16. These numbers are down from an average of 2.93 subscriptions per engineer in 1977.

The main sources for access to print or electronic journal articles were personal subscriptions, library collections, and separate copies. University readers obtained 57 percent and ORNL engineers 50 percent of readings from library collections. Nearly two-thirds of university engineers' readings from library collections were in electronic journals, up from one-third during 2000 to 2003. Most of the electronic article readings were printed out—few were read online.

In addition, researchers often obtained articles as separate copies from interlibrary loan requests, author websites, colleagues, subject repositories such as arXiv.org, and other sources. University and ORNL engineers reported using similar numbers of article copies—22 percent and 18 percent, respectively. The most frequent source of separate copies was another person, such as a colleague or an author.

Most of engineers' article readings came from recent journals; however, an appreciable amount of reading consisted of articles published more than 10 years ago. The university engineers read older articles more frequently than the ORNL engineers did. The library collection was the principal source, especially as the age of the articles increased. The age distribution of articles read from electronic journals is almost the same as for those read from print journals. Some articles were identified by one means and then obtained from the library's electronic collection. Newer articles were mostly found through browsing, and older articles through searches.

Gauging Value

The value of an article is defined by the consequences of reading and by what engineers are willing to pay for the information or by how much time they are willing to spend to obtain and read the articles.

One way to measure the consequences of reading journals is to determine the purpose for which the article is read. Engineers were asked to indicate the principal purpose for which they have used or plan to use the information obtained from the most recently read article. For university and ORNL engineers, the most frequent principal purpose was research. Among ORNL engineers, one-quarter of the readings was for current awareness or keeping up with the literature; only 6.5 percent of university engineering faculty gave this reason.

In the university surveys, the engineers were asked, "In what ways did the reading of the article affect the principal purpose?" When primary research was the principal purpose, the most frequent response was that the reading "improved the result," followed by "it inspired new thinking or ideas," and "it narrowed, broadened, or changed the focus of the research." Reasons mentioned less frequently were "Resolved technological problems," "Saved time or other resources," "Resulted in collaboration or joint research," and "Resulted in faster completion."

TRB's Journal Reaching Engineers on the Web

The *Transportation Research Record: Journal of the Transportation Research Board* (TRR), one of the leading sources for scholarly research and practical papers on all aspects of transportation, is now available online. The full texts of more than 8,000 peer-reviewed papers published in the journal series since 1996 are accessible to TRR Online subscribers and to employees of TRB sponsors; other users may search and view abstracts and purchase complete individual papers.

TRR Online subscribers receive permanent access to the full text of all papers published during the subscription year purchase, as well as access to some content from previous years while their subscription is current. Subscribers also may purchase access to archival content. The website offers personalized alerts for journal features and specified search terms.

For more information about the services, subscriptions, and pricing, visit www.TRB.org/TRROnline or call the TRB Bookstore at 202-334-3213; e-mail TRBSales@nas.edu.

Other Influences

Engineers whose research or other professional contributions have been acknowledged through awards or special recognitions tended to read more and to spend more time reading than those whose work had not been acknowledged. In the survey, engineers who had received recognitions averaged nearly twice as many readings as those who had not.

Scientific and technical information is communicated via many other channels, such as informal reporting, technical reports, and conference presentations and proceedings. Engineers therefore have many opportunities to be exposed beforehand to the information found in articles that they may read. The surveys asked: "Prior to your first reading of this article, did you know about the information reported or discussed?" About one-half stated that they were aware of the information, although they read the article anyway, sometimes at great length.

Online Versus Print

Ease of use is important for journal-related services and advanced features. The time required to identify, locate, and obtain articles affects use. For example, electronic journals in library collections are more extensively used than the available print collections.

Approximately 80 percent of engineers who have personal subscriptions continue to read the articles in print, although electronic versions are available. Earlier surveys indicated that browsing print journals took less time than browsing electronic versions, but more recent and refined data suggest that this may no longer be true. Readers still consider personal print subscriptions to a few core journals to be more convenient for current awareness reading.

Another consideration is whether electronic articles are read online or printed out. Less than one-quarter of the readings of electronic articles were online. Online readings tended to be shorter in duration than readings of printed versions. How the electronic articles were read—online or printed out—was consistent with survey results from other disciplines, suggesting that ease of use influences the choice. The decision to print an article out may be dictated by the need to keep a copy available.

Journal Quality and Services

Certain attributes affect in varying degrees the use of journals and related services—such as the quality of the content, the number of articles and pages, the number of issues, the format, the archive availability, and the price (*8*). Important attributes for article sources, such as library collections, include the comprehensiveness and the age of the journal collections, the location, the hours of availability, the accessibility, the format of the collection, and the collection-related services, such as reference support. Search service attributes include price, recall and precision of results, and display features.

Convenience and Value

Scholarly journals are an important source of high-quality and convenient information for engineers in their work. Engineers read fewer journal articles on average and spend more time per article than do scientists and social scientists, but scholarly articles from a variety of sources serve an important role in research, current awareness, and teaching for engineers. Engineers read a combination of print and electronic articles and the average number of articles read is increasing.

The continuing value of article readings is demonstrated by the time that engineers spend on reading and their observations that the articles contribute to their work. Engineers use many sources of readings, with library electronic collections gaining in use. Readings from library journal collections are considered of higher value, are more likely to be electronic, are often older articles, and are more likely to be for research.

Engineers will continue to read from article sources that are convenient and that bring value to their work. Along with technical reports, standards, specifications, and books, journal articles have a role to play in engineers' need for information.

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