Researching a topic

There are some things which cannot be learned quickly, and time, which is all we have, must be paid for their acquiring.

Ernest Hemingway

Death in the Afternoon, 1932

The best way to learn about a topic is to read other researchers' publications. Reading other researchers' work is also an essential part of research. But before you can start reading other researchers' work, you will first need to find relevant publications. This process is called information searching and it is an essential research skill.

KEYWORDS

To search for relevant information in any sources, you will first need to identify the **keywords** that define your project. According to the Merriam-Webster dictionary, a keyword is '**a significant word from a title or document used especially as an index to content**'. Keywords are used in all web searches and play an important role in the archiving of books and articles. Most journal articles list their keywords as these increase the chance of the articles being retrieved, read and cited by researchers. Three journal articles and their keywords are listed below:

- Guo, H., Low, K. S., & Nguyen, H. A. (2011). Optimizing the localization of a wireless sensor network in real time based on a low-cost microcontroller. IEEE Transactions on Industrial Electronics 58(3): 741–749.
  Keywords: Microcontrollers; particle swarm optimization; wireless sensor network.
- Khong, P. W. (1999). Optimal design of laminates for maximum buckling resistance and minimum weight. Journal of Composites Technology & Research 21(1): 25–32.
  Keywords: Laminates; fuzzy multi-optimization; finite strip analysis.
- Leong, E. C., & Rahardjo, H. (2012). Two and three-dimensional slope stability re-analyses of Bukit Batok slope. Computers and Geo-technics 42: 81–88.
  Keywords: Two-dimensional; three-dimensional; limit equilibrium; slope stability; residual soil; unsaturated; matric suction; groundwater table; rainfall; factor of safety.

If you read the title of an article and its list of keywords, you will see that some of the keywords appear in the article's title. Other keywords highlight the core content of the article. Once you have a list of the keywords that define the research topic, you can use these keywords to search for relevant publications.

Keywords and phrases can be combined using Boolean operators (AND, NOT, OR and NEAR) to limit, widen or define your search. Most online databases and Internet search engines support Boolean searches. Table 4.1 illustrates the use of Boolean operators to search for information.

Table 4.1 Use of Boolean operators to search for information.

Boolean operator	*Example*	*Explanation*
AND (alternate +)	Microcontrollers AND network, or Microcontrollers + network, or Microcontrollers network	AND combines two or more words in the search. By default, a search involving two words implies the AND Boolean operator is used. If a phrase rather than two separate words are to be searched, put the words in quotation marks, for example 'Microcontrollers network'. The more words or phrases join with AND, the fewer documents you will find.
NOT (alternate −)	Microcontrollers network—chips	Remove documents containing 'chips' from the list of documents containing 'Microcontrollers network'.
OR	Microcontrollers OR network	OR requires either of the words or phrases combined by OR to appear in the document. The more words or phrases you combined with OR, the more documents you will find.
NEAR	'Microcontrollers network' NEAR chips	Requires the word 'chips' to be found within the proximity of the phrase 'Microcontrollers network'. The number of words between the two search terms varies with the database and search engine.

SOURCES OF INFORMATION

The Internet is the most popular source of information.

- **Start by writing down the keywords in the same order that they are typed including the Boolean operators to generate a list of search results.** Next, write the **URL of the web page** and the date that you accessed the web page as the information that you captured may be changed at a later date.

URL stands for ***Uniform Resource Locator***. A URL is nothing more than the address of a given unique resource on the Web. In theory, each valid URL points to a unique resource. Such resources can be an HTML page, a CSS document, an image, etc.

Here are some examples of URLs:

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https://developer.mozilla.org
https://developer.mozilla.org/en-US/docs/Learn/
https://developer.mozilla.org/en-US/search?q=URL
```

- You can then either copy and paste the information relevant to your topic onto a Word or similar type of word processing document, or use software specially created for note-taking (e.g. Diigo, Evernote, Microsoft Onenote, Springnote, Ubernotes, WebNotes).

Using the Internet to seek information, however, presents **certain problems**. **First, you will have to sift through a vast amount of information to find the information that is relevant to your research** and, **second, you will have to determine the reliability of the information**. **The first problem** may be solved to a certain extent **by using a list of more specific keywords or phrases combined with the Boolean operator. But the second problem— determining the reliability of information—can only be resolved when you have become more knowledgeable about the research topic.** For example, your search may produce a number of open access journal publications. Some of these open access journal publications, however, may be of **dubious quality**. At the earlier stages of your project, you may find it difficult to judge the quality of a journal article. Examples of dubious journals to avoid can be found at a website, **http://scholarlyoa.com/, created by Jeffery Beal**, an academic librarian who maintains a database of such journals. A more reliable way of seeking information on your topic is to use your **institution's library resources**. Books and published theses are excellent publications to start your research on a topic. Besides hardcopy publications, check whether your institution's library subscribes to electronic databases. You can search electronic databases for articles published in conferences and journals, as well as for patents. **Engineering databases such as Engineering Village (Engineering Index) by Elsevier and Web of Science by Thomson Reuters provide a consolidated electronic resource for you to search for published information.** There are also specialized databases for specific fields though Engineering Village and Web of Science should be your primary databases for your search. You can search the databases by using the same keywords you used for Internet searches. The information provided by the databases includes the title, abstract, source of the article, and citation data.

TYPES OF INFORMATION

Once you have obtained potentially relevant information on your research topic, you will need to evaluate it critically. The following questions will guide you in your evaluation:

1. How relevant is the information to your research topic? You may find that only part of the information found is relevant.
2. If the information is relevant, what is its significance? You may want to categorize this information under research method, materials and methods or results and discussion.
3. If the information is related to research method, is the research method clearly explained? Is it the only research method? Why did the author choose this research method? Is the research method grounded on theory?
4. If the information is related to materials and methods, what were the materials and methods used? How were the experiments designed? How were the measurements made? How reliable and accurate are the measurements?
5. If the information is related to results and discussions, how did the author analyze and interpret the data? Is there an alternative method of analysis? Is the interpretation sound? Dose the conclusions reflect the data and analysis?
6. How does the information contribute to your understanding of the research topic? What are the strengths and limitations of the information?
7. **Is there any information gap in the research that you can fill**? As you research a topic, you will come across some papers that have high citations, that is, the papers have been referenced (cited) by many researchers. **Such papers are key papers that you should make a note of, particularly if they are directly related to your research topic.**

INTERESTING FACTS

Engineering Village originated from *Engineering Index* (Ei). Ei was created by Dr. John Butler Johnson, a professor of civil engineering at Washington University in St. Louis, Missouri in 1884 out of a need to gain knowledge of engineering literature. Ei consists of an index and the abstracts. In 1918, Ei was acquired by the American Society of Mechanical Engineers. In 1967, the first Ei electronic bulletin, 'Current Information Tape for Engineers' (CITE), was produced. In 1969, CITE evolved into COMPENDEX (COMPuterized ENgineering inDEX). In 1995, EngineeringVillage.com was launched. In 1998, Elsevier purchased Ei. Currently *Engineering Village* covers 12 databases containing patents, monographs, books and dissertations.