

# Literature Review and Formulating a Problem

## CONTENTS

4.1	What Is a Literature Review? .....	72
4.2	Types of Literature Reviews. ....	73
4.2.1	Stand-Alone Literature Review Articles. ....	73
4.2.2	Research Proposal .....	73
4.2.3	Research Report in the Workplace .....	73
4.3	Common Structure of Literature Reviews .....	74
4.4	What is the Literature? .....	75
4.5	The “Information Cycle” .....	75
4.5.1	Primary Sources .....	76
4.5.2	Secondary Sources .....	77
4.5.3	Tertiary .....	77
4.6	Working Backwards .....	77
4.7	The Published Literature .....	78
4.7.1	Peer Review .....	78
4.8	How to Find the Literature .....	79
4.8.1	Computer Science Research Databases .....	79
4.8.2	Footnote Chasing .....	80
4.9	Writing the Literature Review. ....	80
4.10	Key Points When Writing a Literature Review .....	82
4.11	Adaptive Resource Allocation in Cloud Systems .....	83
4.11.1	Types of Cloud Computing .....	84
4.11.1.1	IaaS (Infrastructure as a Service) .....	85
4.11.1.2	PaaS (Platform as a Service) .....	86
4.11.1.3	SaaS (Software as a Service) .....	87
4.11.1.4	Cloud Computing vs. Traditional Web Hosting .....	88
4.11.2	Task Scheduling in Cloud Computing Systems ....	88
4.11.2.1	Model of Task Scheduling .....	88
4.12	Keyword Explanation .....	90

4.13 Summary .....	93
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This chapter describes the suggestion on how to do a comprehensive literature review and to summarize the research challenge from the previous publications. In the science and engineering area, understanding the previous publications' research background, research motivation, contribution, and future work will be vital for building basic knowledge on the current research. By reviewing the previous works and the novel problem can be summarized. Then, the next step is to formulate this problem with a clear description. A few examples will be given in this chapter for showing how to do a thorough literature review and problem formulation.

#### 4.1 WHAT IS A LITERATURE REVIEW?

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A literature review is much more than a list of separate reviews of articles and books. They are common and very important in the sciences. A literature review is a critical, analytical summary and synthesis of the current knowledge of a topic. It should compare and relate different theories, findings, and so on, rather than just summarize them individually. It should also have a particular focus or theme to organize the review. It does not have to be an exhaustive account of everything published on the topic. But it should discuss all the more significant academic literature important for that focus.

The organization of a review depends on the type and purpose of the review, as well as on the specific field or topic being reviewed. But in general, it is a relatively brief but thorough exploration of past and current work on a topic. Literature reviews are usually organized thematically, such as different theoretical approaches, methodologies, or specific issues or concepts involved in the topic— rather than a chronological listing of previous work.

A thematic organization makes it easier to examine contrasting perspectives, approaches, methodologies, findings, etc., and to analyze the strengths and weaknesses of, and point out any gaps in previous research. This is the heart of what a literature review is all about. A literature review may offer new interpretations, theoretical approaches, or other ideas. If it's intended to be part of a research proposal or report, it should demonstrate the relationship of the research to others'

work. But whatever else it does, it must provide a critical overview of the current state of research efforts.

## 4.2 TYPES OF LITERATURE REVIEWS.

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There are different types of literature reviews and different purposes. The most common are:

### 4.2.1 Stand-Alone Literature Review Articles.

These provide an overview and analysis of the current state of research on a topic. The goal is to evaluate and compare previous research on a topic to provide an analysis of what is currently known and to reveal controversies, weaknesses, and gaps in current work—pointing to directions for future research.

Writing a stand-alone review can be an effective way to get a good handle on a topic and to develop ideas for your own research. E.g., the basis of your research project can be contrasting theoretical approaches or conflicting interpretations of findings.

Can you find evidence supporting one interpretation vs. another, or can you propose an alternative interpretation that overcomes their limitations?

You can find examples published in countless academic journals. There is a well known journal series called Annual Reviews: <http://www.annualreviews.org/> specifically devoted to literature review articles. The best known literature review journal for computer science is called Computing Reviews: <http://reviews.com/>

### 4.2.2 Research Proposal

This could be a proposal for a PhD dissertation, a senior thesis, or a class project. It could also be a submission for a grant.

The literature review, by pointing out the current issues and questions about a topic, is a crucial part of demonstrating how your proposed research will contribute to the field, and hopefully convince your thesis committee to allow you to pursue the topic of your interest or a grant funding agency to pay for your research efforts.

#### 4.2.3 Research Report in the Workplace

When you finish your research and write your thesis or paper to present your findings, it should include a literature review to provide the context in which your work is a contribution. Your report should show how your work relates to others' work, in addition to detailing the methods, results, etc. of your research.

This kind of literature review is often a revision of the review for a research proposal, which may be a revision of a stand-alone review. Each revision should be a fairly extensive revision. With the increased knowledge and experience in the topic as you proceed, your understanding of the topic will increase. So you will be in a better position to analyze and critique the literature. Also, your focus will change as you proceed in your research. Some areas of the literature you initially reviewed will be marginal or irrelevant for your eventual research and you will need to explore other areas more thoroughly.

### 4.3 COMMON STRUCTURE OF LITERATURE REVIEWS

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Dr. Mankoff provided you with some examples of how your literature reviews should look. They may vary in how they are organized. But a common general structure is to have sections such as:

**Abstract** - Brief summary of the contents of the article

**Introduction** - An explanation of the purpose of the study; a statement of the research question(s) you intend to address

**Literature review** - A critical assessment of the work done so far on this topic—to show how the current study relates to what has already been done

**Methods** - How the study was carried out (e.g. instruments or equipment, procedures, methods to gather and analyze data)

**Results** - What was found in the course of the study

**Discussion** - What do the results mean

**Conclusion** - State the conclusions and implications of the results; discuss how it relates to the work reviewed in the literature review; also point to directions for further work in the area

#### 4.4 WHAT IS THE LITERATURE?

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The ‘literature’ that is reviewed should be written by scientists and researchers for scientists and researchers. They may include any of the following:

1. Academic, scholarly journal articles (i.e., peer-reviewed)
2. Books
3. Conference Proceedings
4. Dissertations
5. Patents
6. Standards
7. Technical Reports
8. Websites and other Internet Resources

#### 4.5 THE “INFORMATION CYCLE”

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The diagram below is a brief picture of how scholarly literature is produced and used. Research does not have a beginning or an end. Researchers build upon work that has already been done in order to add to it, providing more resources for other researchers to build on.

They read the literature of their field to see what issues, questions, and problems are current, then formulate a plan to address one or more of those issues. Then they make a more focused review of the literature, which they use to refine their research plan. After performing their research, they present their results (such as presentations at conferences and/or published articles) to other scientists in the field. So they add to the general subject reading (‘the literature’).

Research may not have a beginning or an end. But researchers have to begin somewhere. There are three categories of types of literature: primary, secondary, and tertiary. Let me explain these in more detail.

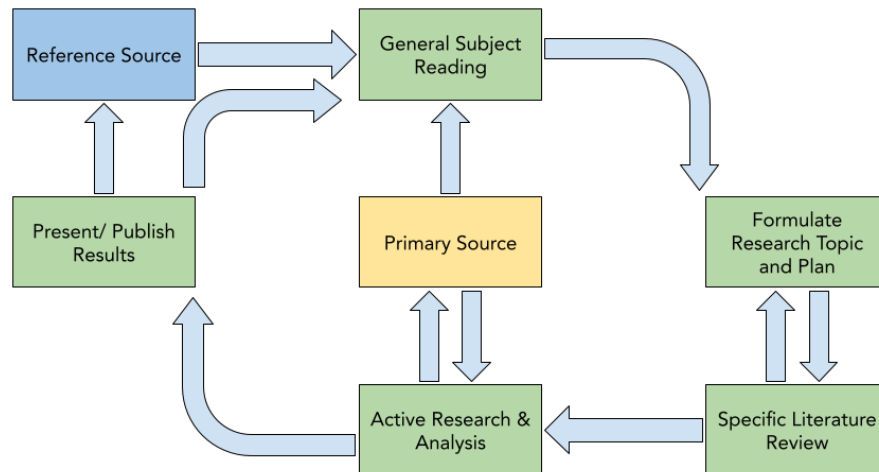


Figure 4.1: Illustration of Information cycle

#### 4.5.1 Primary Sources

Direct, uninterpreted records of the subject of a research project. Primary sources are what you perform your research work on. So a primary source can be almost anything, depending on the subject and purpose of your research.

A few examples of what can count as primary sources would be:

1. **Lab Reports** - Records of the results of experiments
2. **Field Notes, Measurements, etc.** - Records of observations of the natural world (electrons, elephants, earthquakes, etc).
3. **Conference Proceedings** - Scientists and researchers getting together and presenting their latest ideas and findings
4. **Articles of Original Research** – Published in peer-reviewed journals
5. **Dissertations**
6. **Patents**
7. **Internet** - Websites that publish the author's findings or research; e.g. your professor's home page listing research results. But remember, use extreme caution when using the Internet as a primary source ... anyone with a computer can put up a website.

#### 4.5.2 Secondary Sources

Books, articles, and other writings by scientists and researchers reporting their work to others. They may be reporting the results of their own primary research or critiquing the work of others.

So these sources are usually the focus of a literature review: this is where you go to find out in detail what has been and is being done in a field, and therefore to see how your work can contribute to the field.

#### 4.5.3 Tertiary

These include encyclopedias, indexes, textbooks, and other reference sources. In general, there are two types of tertiary (reference) sources:

**Summaries/Introductions** - Encyclopedias, dictionaries, textbooks, yearbooks, and other sources that provide an introduction or summary “state of the art” of the research in the subject areas covered. They are an efficient means to quickly build a general framework for understanding a field.

**Databases/Indexes** - Provide lists of primary and secondary sources of more extensive information. They are an excellent way of finding books, articles, conference proceedings and other publications in which scientists report the results of their research.

### 4.6 WORKING BACKWARDS

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Usually, here's how your research process for a literature review will work:

**Tertiary** - Start by finding background information on your topic by consulting reference sources for introductions and summaries. Find bibliographies or citations of secondary and primary sources.

**Secondary** - Find books, articles, and other sources providing more extensive and thorough analyses of your topic. Check to see what other scientists have to say about your topic. Find out what has been done and where there is a need for further research. Discover appropriate methodologies for carrying out that research.

**Primary** - Now that you have a solid background knowledge of your topic and a plan for your own research, you're in a better position to understand, interpret, and analyze the primary source information. Find primary source evidence to support or refute what other scientists

have said about your topic. Or posit an interpretation of your own and look for more primary sources. Or create more original data to confirm or refute your thesis. When you present your conclusions, you will have produced another secondary source to aid others in their research.

## 4.7 THE PUBLISHED LITERATURE

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Let's get a better understanding of how scientists publish and report the results of their research.

### 4.7.1 Peer Review

An important part of academic publishing is the peer review, or refereeing, process. When a scientist submits an article to an academic journal or a book manuscript to a publisher, the editors or publishers send copies to other scientists and experts in that field who review it.

The reviewers check to make sure the author has used methodologies appropriate to the topic, that they've used those methodologies properly, taken other relevant work into account, and adequately supported the conclusions, as well as considered the relevance and importance to the field. A submission may be rejected or sent back for revisions before being accepted for publication.

Peer review does not guarantee that an article or book is 100% correct. Instead, it provides a "stamp of approval" saying that experts in the field have judged this to be a worthy contribution to the discussion of an academic field.

Peer reviewed journals typically note that they are peer-reviewed, usually somewhere in the first few pages of each issue. Books published by university and most association presses typically go through a similar review process (e.g., IEEE Press). Other book publishers may also have a peer review process. But the quality of the reviewing can vary among different book or journal publishers. Use academic book reviews or check how often and in what sources articles in a journal are cited. Ask a professor or two in the field, to get an idea of the reliability and importance of different authors, journals, and publishers.

**Informal Sharing** - Scientists discuss their ongoing projects to let others know what they are up to or to give or receive assistance with their work. Conferences and online discussion forums (blogs, wikis, etc.) are common ways for these discussions. Increasingly, scientists are using personal websites to present their work.



**Conference Presentations** - Many organizations sponsor conferences at which scientists read papers, or display at poster sessions to present the results of their work. To give a presentation, scientists submit a proposal which is reviewed by those sponsoring the conference. Some databases list conference proceedings along with the author and contact information.

**Journals** - Articles in journals contain specific analyses of particular aspects of a topic. Since these can be written and published more quickly than books, academic libraries subscribe to many journals and the contents are indexed in databases and elsewhere so you can easily find them.

**Books** - Books take a longer time to get from research to publication. But they can cover a broader range of topics, or cover a topic more thoroughly than articles or conference presentations. Always remember to search your library catalog for titles. Librarians can show you how to search for books elsewhere beyond simply Google Books and you can request to borrow them through the Interlibrary Loan process usually at no cost.

**Dissertations/Theses** - Graduate students earning advanced degrees typically write a substantial piece of original work and then present the results in the form of a thesis or dissertation. Usually, only the library and/or department at the school where the work was done has copies of the dissertation. But once again, the library can usually get you a copy of most dissertations at no cost.

**Websites** - In the process of tracking down journal articles and conference proceedings, you'll learn who the better known scientists are in your particular field of research. Look for their personal websites to see if you can find additional sources that you haven't found elsewhere.

**Reference Sources** - Encyclopedias, dictionaries, and other reference sources provide introductions or summaries of the current work in a field or on a topic. These are usually written by a scientist and/or publisher serving as an editor who invites submissions for articles from experts on the topics covered.

## 4.8 HOW TO FIND THE LITERATURE

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OK, so how to find the literature?

#### 4.8.1 Computer Science Research Databases

1. **ACM Digital Library:** Full text of journal articles, conference proceedings, and reviews published by the Association for Computing Machinery (ACM).
2. **CiteSeerX:** Free computer science citation database with some full text available. Lists the most frequently cited authors and documents in computer science, as well as impact ratings. Also provides algorithms, metadata, services, techniques, and software.
3. **IEEE Xplore:** Full text of all IEEE journals and conference proceedings published since 1988. Also includes all current IEEE standards. Some titles available pre-1988.
4. **Lecture Notes in Computer Science:** Full text of conference proceedings in computer science from Springer. About 100 conferences published per year.
5. **ScienceDirect:** A full text scientific database offering science, medical and technical (STM) journal articles and book chapters from more than 2,500 peer-reviewed journals and over 11,000 books.
6. **Scopus:** Supports research needs in the scientific, technical, medical and social sciences fields and, more recently, also in the arts and humanities. Contains both peer-reviewed research literature and quality web sources. Includes citation linking and citation tracking for patents.

#### 4.8.2 Footnote Chasing

The key articles in encyclopedias, books, or journals are always helping. The bibliography at the end of each paper or article is another way to help you chase the most interesting topics. In such a way, you can access more articles that interest you by tracking down existing ones.

### 4.9 WRITING THE LITERATURE REVIEW.

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Keep these points in mind as you are writing your literature review:

1. What is the purpose for the literature review and make sure your review specifically addresses your purpose(s).
2. Write as you read, and revise as you read more. Rather than wait until you have read everything you are planning to review, start writing as soon as you start reading.
3. You will need to reorganize and revise it all later. But writing a summary of an article when you read it helps you to think more carefully about the article.
4. Having drafts and annotations to work with will also make writing the full review easier since you won't have to rely completely on your memory or have to keep thumbing back through all the articles.
5. The first draft is for you, so you can tell yourself what you are thinking. Later you can rewrite it for others to tell them what you think.

Here are some general steps that one can follow when you writing a literature review:

**Stage One: Annotated Bibliography.** As you read articles, books, etc., on your topic, write a brief critical synopsis of each. After going through your reading list, you will have an abstract or annotation of each source you read. Later annotations are likely to include more references to other works since you will have your previous readings to compare. But at this point the goal is to get accurate critical summaries of each individual work.

**Stage Two: Thematic Organization.** Find common themes in the works you read and organize them into categories. Usually, each work in your review can fit into one category or sub-theme of your main theme. But sometimes a work can fit in more than one. Write some brief paragraphs outlining your categories, how in general the works in each category relate to each other, and how the categories relate to each other and to your overall theme.

**Stage Three: More Reading.** Based on the knowledge you have gained in your reading, you should have a better understanding of the topic and of the literature. You have discovered specific researchers who are important to the field or methodologies you were not aware of. Look for more literature by those authors, on those methodologies, etc. You

may be able to set aside some less relevant areas or articles which you pursued initially. Integrate the new readings into your literature review draft. Reorganize themes and read more as appropriate.

**Stage Four: Write Individual Sections.** For each section, use your annotations to write a section which discusses the articles relevant to that theme. Focus your writing on the theme of that section, showing how the articles relate to each other and to the theme, rather than focusing your writing on each individual article. Use the articles as evidence to support your critique of the theme rather than using the theme as an angle to discuss each article individually.

**Stage Five: Integrate Sections.** Now that you have the thematic sections, tie them together with an introduction, conclusion, and some additions/ revisions in the sections to show how they relate to each other and to your overall theme.

#### 4.10 KEY POINTS WHEN WRITING A LITERATURE REVIEW

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More specifically, here are some points to address when writing about works you are reviewing. In dealing with a paper or an argument or theory, you need to assess it (clearly understand and state the claim) and analyze it (evaluate its reliability, usefulness, validity). Look for the following points as you assess and analyze papers, arguments, etc. You do not need to state them all explicitly, but keep them in mind as you write your review:

**Be specific and be succinct.** Briefly state specific findings listed in an article, specific methodologies used in a study, or other important points. Literature reviews are not the place for long quotes or in-depth analysis of each point.

**Be selective.** You are trying to boil down a lot of information into a small space. Mention just the most important points in each work you review.

**Is it a current article?** How old is it? Have its claims, evidence, or arguments been superseded by more recent work? If it is not current, is it important for historical background?

**What specific claims are made?** Are they stated clearly?

**What support is given for those claims?** E.g., what evidence, and what type (experimental, statistical, anecdotal, etc)

is offered? Is the evidence relevant? Sufficient? What arguments are given? What assumptions are made and are they warranted?

**What is the source of the evidence or other information?** The author's own experiments, surveys, etc? Government documents? How reliable are the sources?

**Does the author take into account contrary or conflicting evidence and arguments?** I.e., how does the author address disagreements with other researchers?

**What specific conclusions are drawn** Are they warranted by the evidence?

**How does this article, argument, theory, etc, relate to other work?**

However, these are just the points that should be addressed when writing about a specific work. It is not an outline of how to organize your writing. Your overall theme and categories within that theme should organize your writing and the above points should be integrated into that organization.

#### 4.11 ADAPTIVE RESOURCE ALLOCATION IN CLOUD SYSTEMS

From an overview, cloud computing is an exciting trend in the IT community. In cloud computing, people move computing and data from local to large data centers [227]; then, the service is conducted through the Internet and provided by the data centers [298].

Cloud computing in 2021 has become the go-to model for information technology as companies prioritize as-a-service providers over traditional vendors, accelerate digital transformation projects, and enable the new normal of work following the COVID-19 pandemic [74].

And while enterprises are deploying more multicloud arrangements the IT budgets are increasingly going to cloud giants. According to a recent survey from Flexera on IT budgets for 2021, money is flowing toward Microsoft Azure and its software-as-a-service offerings as well as Amazon Web Services [304]. Google Cloud Platform is also garnering interest for big data and analytics workloads. But hybrid cloud and traditional data center vendors such as IBM, Dell Technologies, Hewlett-Packard Enterprise, and VMware have a role too.