

Writing a Research Proposal

A guide for Science and Engineering students

A Research Proposal has several inter-related purposes: Writing an effective research proposal also trains you in a valuable skill required to operate effectively in both

1. Your proposed topic should address a significant problem and, therefore, advance the state of knowledge in that field.
2. You have identified an appropriate methodology and underlying theory to address the problem, including data collection methods and equipment, if required.
3. Your methods of data analysis are outlined and appropriate to your data set so that you can draw useful conclusions from your work.
4. You have an organised plan for your work, including a timeframe.

academia and industry after you graduate. You are presenting a reasonable thesis idea or hypothesis, the significance of which you have demonstrated by relating it to relevant literature in the field of enquiry. You are also proposing a methodology to investigate the problem with clear steps leading to a reasonable conclusion.

The main criterion for the award of a PhD is that your thesis constitutes an original contribution to knowledge in a particular field. Remember that you may eventually refine or even abandon your initial topic as your research progresses, but the proposal demonstrates that you are aware of the process of enquiry and experimentation that leads to a thesis outcome.

Finally, the research questions, significance and methodology that you write in your Research Proposal will help you refine your Themis ethics research application.

The structure of a thesis proposal

The structure and size of your Research Proposal will vary depending the requirements of your Faculty or School so the initial step is to find out departmental guidelines and requirements. Nevertheless, there are certain elements that any Research Proposal requires and these should be presented in the following order.

Title or Cover Page: identifies the research project title, the student researcher, the institution, department, and the project mentors or supervisors.

The title should be brief and descriptive and may use a colon (:) to separate the topic from the focus (e.g. *Stormwater Harvesting: managing the hazards of surface water pollution by run-off*).

Table of Contents: lists the sections of the Research Proposal (headings and indented sub-headings) and the corresponding page numbers.

Abstract: outlines the essence of the research project in around 150–200 words. It describes the purpose and motivation for the study, and a statement of the problem,

the data collection methodology and analysis, and the significant results and implications of the research.

Introduction: provides background information for the research (i.e. the problem being addressed) and is typically structured from general information to narrow or focused ideas; whereupon your research question/s or hypotheses are presented.

The Introduction should be about 10% of your proposal. Imagine you are writing for a general science reader rather than an expert audience.

The Introduction includes a *brief* review of relevant literature or knowledge in the field, so that you are able to present the gap in the existing knowledge and, therefore, the significance and originality – the purpose and aims – of your research.

Finally, articulate the scope of your research; or what you will *not* be doing, so as to limit your task.

Research Question/s: what is the primary question you are trying to solve? It may be a hypothesis/hypotheses or research question/s and is usually a few sentences (in statement and/or question form) that articulate the essence of your project and its scope. E.g. *Land use and terrestrial carbon storage in western Victoria from 1890-2020: A historical reconstruction and simulation study.*

Research Design or Methodology: includes a description and rationale for the methods of data collection and analysis, and the materials used when solving the problem. When and how will you know, for example, that sufficient experimentation has been done, and sufficient and valid data analysed, to support or invalidate the original hypothesis?

This section includes the dataset/s, calculations, equipment, calibration graphs, and procedures to be used, lists project limitations and outlines how ethical considerations of the research have been considered.

Typically, it uses subheadings (i.e. Subjects, Instrumentation, Data Collection, Methods of Analysis etc.) and is written with a future aspect, e.g. *The research will initially examine water treatment processes in...*

Preliminary Results: details any results that you may already have as a result of previous Honours or Masters research work, perhaps also from a pilot study. It is important to relate these results to the critical framework of your intended PhD research.

Timetable / Plan: lists the stages of the research project in timeline, spreadsheet or tabular format, and the deadlines for completion of these stages or tasks. You should include any challenges to completion that you anticipate facing.

Thesis Outline or Structure: outlines the proposed chapters of the thesis and the content of each chapter in several lines or a paragraph, including a Table of Contents.

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Significance and Implications of the Study: relates the intended or expected outcomes of your research to the original aims expressed in the Introduction so that the significance of the study and the contribution to knowledge is apparent.

List of References: lists **all** the resources cited in your resource proposal using a referencing format appropriate to your faculty or discipline. Do **not** list resources that are not referred to in your proposal. This is a good time to begin using a bibliographic tool such as EndNote to track all the references for your study.

See <http://www.lib.unimelb.edu.au/endnote/> for further information about EndNote.

Writing the Research Proposal

How to write: Remember that you do not need to write your Research Proposal in the order in which it will be read. In fact, you might begin the writing process with a concept map drawn up on large-size paper in landscape orientation.

Give your concept map a title at the top of the paper and then write appropriate headings for the different sections of the Research Proposal (e.g. Introduction, Methodology, Conclusion) and draw boxes around these headings so they look like pages of a book.

Now, add anything you think you will need in these boxes (e.g. figures, graphs, references, topic sentences) and use colours to highlight different kinds of content. Because this is a creative brainstorming session don't restrict your ideas and don't be concerned with neatness. The idea is to gain an impression of the whole proposal and to draft your chapter outline.

The next step is writing the rough draft. Start with the Methodology section and remember to provide enough information for the experiments and data collection to be replicated by someone else, but nothing more. Then, ask yourself, what is *different* about your proposed method? What kind of research are you proposing? This will give you your sub-headings.

- **Experimental** – equipment, materials, method
- **Modeling** – assumptions, mathematical tools, method
- **Computational** – inputs, computational tools, method.

Next, write up the implications and significance of your research in bullet-point form. Then, write your Introduction, remembering that the conclusions you draw from your research (i.e. the significance and implications) are related to the aims and objectives of the research which you state in the introduction.

Finally, distil everything you have written down to its essence and write the Abstract for your proposal.

Tips and common problems

- Use well-labelled figures and self-made drawings (i.e. sketches) to illustrate key aspects of your proposal, to reduce overall text length, and to clarify your own thinking. Each figure or drawing should have a title and informative caption. Most engineers and scientists are visual learners, so your pictures *are* indeed worth 1000 words.
- Edit and revise your writing thoroughly; poor grammar and inappropriate style detract from your message and compromise your credibility as a researcher. Use spell check and grammar check applications.
- Make an appointment with **Academic Skills**; and read your proposal out aloud; errors often get picked up this way.

- Use transition language (e.g. '*In other words*', '*In contrast*') to signal to the reader what is happening in your text.
- Avoid language that is overly hesitant or tentative (e.g. '*It seems that...*', '*It is hoped that ...*').
- Break up large blocks of text into smaller sections using sub-headings and bullet-points.
- Anticipate possible problems with, or limitations of, the research. Address such issues directly for your own benefit as much as for the benefit of the proposal.
- Don't confuse the rationale for the research with the research question/s: don't confuse the big questions that rationalise the research with the smaller and more precise research questions.
- Ensure that the proposal is easy for readers to skim read. Never assume the reader has read the previous section. Use headings and restate key ideas throughout.
- Obtain copies of other research proposals in your field and study the ways they, a) devise titles; b) structure their proposal; and c) use technical language. You might ask your supervisor for previous examples, or simply Google for examples.
- Check that your objectives are expressed in terms of measurable, quantifiable outcomes and not just methods or activities.
- Check that your referencing style is appropriate to your faculty or discipline and consistently used. The University of Melbourne library website <http://www.lib.unimelb.edu.au/cite/> is an excellent authority for referencing styles as well as past RHD theses.
- The university library **LibGuides** site is also a fantastic resource for discipline-specific materials. Go to <http://unimelb.libguides.com/index.php>
- Finally, draw up a check-list from the relevant application form and make sure that your research proposal fulfils all criteria.

Further Resources

The following resources contain advice on writing and evaluating Research Proposals in various areas of Science and Engineering.

These North American university sites provide advice on the stages and strategies of academic and industrial research proposal writing:

<http://facstaff.gpc.edu/~ebrown/infobr3.htm>

<http://www.ecf.utoronto.ca/~writing/handbook-proposals.html>

The following document from the University of Cambridge Engineering department outlines strategies for writing effectively in the sciences:

<http://www-mech.eng.cam.ac.uk/mmd/ashby-paper-V6.pdf>

This site provides an example of a research proposal for research into the role of research proposals in undergraduate biochemical and biological engineering courses:

<http://aiche.confex.com/aiche/2005/techprogram/P27927.HTM>

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