



Research Methods in Science in Engineering

Proposing Your Research

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Outline

- Introduction
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- Proposal Presentation

Slide 2

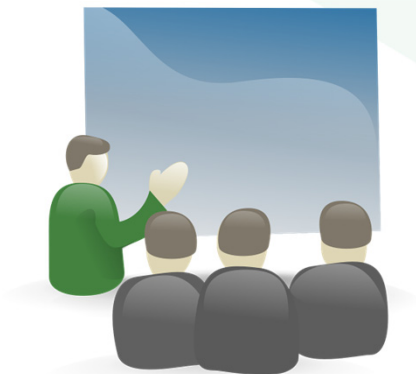
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Introduction

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Purpose of the Proposal

The research proposal is for the committee to determine if your research will be sufficient to earn a PhD.



Things the committee must ensure:

- Is the research new enough?
- Is the research significant enough?
- Is the research difficult enough?
- Is the topic well defined?
- Is the plan achievable?
- How will success be measured?
- Will the research be sufficiently disseminated?

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Think Like a Lawyer

Think like a lawyer when creating your proposal.

The research proposal is contract between yourself and the committee.

If all the proposed research is successfully accomplished, the committee agrees to sign for the degree.

It is just as important to state what the research will NOT entail as it is to state what the research WILL entail.

Don't leave the committee any reason to fail you or require more work of you after you are successful at all stated goals and metrics.



Proposal Document

Proposal Document Outline

- Proposal Summary (one page max)
 - Problem statement or hypothesis (~ 0.25 pages)
 - Novelty and significance (~ 0.25 pages)
 - Scope, objectives, and research plan (~ 0.5 pages)
- Background (~ 4 pages)
 - History and state-of-the-art (~ 2 pages)
 - Prior research (~ 2 pages)
- Proposed Research (2-4 pages)
 - Research topic (1-2 pages)
 - Technical approach (1-2 pages)
 - Significance and novelty of the proposed research (0.5 to 1.0 pages)
- Research Plan (~ 10 pages)
 - Scope & objectives (0.5 to 1.0 pages)
 - Schedule of tasks and milestones (~ 0.5 pages)
 - Research deliverables (~ 0.5 pages)
 - Detail description of tasks (0.5 to 1 pages per task)
 - Performance goals and quantitative metrics to measure success. (0.5-1 page)
 - Dissemination plan (0.5-1 page)
- References (> 100 references is typical)



Hypothesis Vs. Problem Statement

Proposals that are more *scientific* than they are *engineering* will have a hypothesis statement.

Hypothesis: A proposed statement about what may be true.

Engineering proposals will often have a problem statement instead of a hypothesis.

Problem Statement: One or two sentences that explain the key problem(s) that your project will address.

Hypothesis or Problem Statement Section (~ 0.5 pages)

- What is the topic and why is it important?
- What is the state-of-the-art in this field?
- What have others done?
- What is the research hypothesis or problem statement?
- What new and novel things will the research contribute?
- Why is the research hard and PhD worthy
- What is the scientific and societal impact if the research is successful?

Proposal Summary (1 page max)

The Proposal Summary section is a summary of your entire proposal. When writing this section, pretend this is the only section the committee will read.

- Problem statement or hypothesis (~ 0.25 pages)
- Novelty and significance (~ 0.25 pages)
 - Why is the research important?
 - What is the potential impact if successful?
- Scope, objectives, and research plan (~ 0.5 pages)
 - What are the specific goals of the research?
 - What technical approach will accomplish the research?
 - What is the work plan (i.e. tasks)?
 - How will progress be measured quantitatively?
 - How will others know if the research is successful?

Background Section (~ 4 pages)

- History & State-of-the-Art (~ 2 pages)
 - Discuss the history of the topic from the big bang to the present.
 - What has been done in this field to date and by whom?
 - How is the problem addressed today?
 - What is the state-of-the-art?
 - What problems or limitations does the state-of-the-art have?
 - Briefly state how your research contributes new knowledge.
- Prior Research (~ 2 pages)
 - Discuss any related research you have performed.
 - List your publications/presentations with a short one or two sentence description of your work in each.

This section should establish you as a subject-matter expert and prepared to take on your research.

Proposed Research Section (2-3 pages)

The Proposed Research section builds on the background to describe how your research will build on the state-of-the-art.

- Research topic (1-2 pages)
- Technical approach (1-2 pages)
- Significance and novelty of the proposed research (0.5 to 1.0 pages)

Research Plan Section (~ 10 pages)

- Scope & Objectives (0.5-1 pages)
 - What is the overarching vision?
 - What is the specific goal of your research?
 - How does your research fit into the overarching vision?
 - What fundamental questions will you answer?
 - What are you going to do? What are you going NOT going to do?
 - What are your objectives in order to meet your final goal?
 - What are your metrics for success?
- Schedule of Tasks and Milestones (~ 0.5 pages)
 - Provide a high-level description of your work plan?
 - What specific tasks will you perform to accomplish your research objectives?
 - Provide a Gantt chart showing schedule of tasks and milestones.
- Research Deliverables (~ 0.5 pages)
 - What will your research produce? List journal articles, conference presentations, device demonstrations, final written dissertation/thesis, other?
- Detailed Description of Tasks. For each task (~ 1 page) :
 - Describe the purpose and outcome of the task in one sentence, the first sentence.
 - Describe all of the work to be performed in this task.
 - List any metrics for success.
 - Identify and discuss any related milestones.
 - Discuss any risks and mitigations.
- Dissemination Plan (0.5-1 page) :
 - What specific papers will be published? Provide tentative authors, title, and journal.
 - Will any posters or other such materials be produced?
 - Will there be any efforts to incorporate the research into the classroom?
 - Will there be any outreach activities?

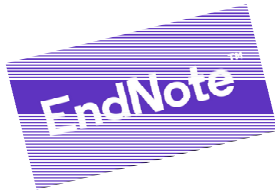
The Research Plan is the main part of the proposal that outlines the actual work that will be done.



References Section (> 100 references)

It is common for PhD proposals to have in excess of 100 citations. Most of these will be cited in your background section to establish yourself as a subject matter expert.

Consider using a reference manager!



Proposal Document Template

A template for the proposal document is available on the EMPossible website:

<https://empossible.net/wp-content/uploads/2021/09/EMP-Research-Proposal-Document.docx>

The collage displays five pages of a proposal document template. The pages are as follows:

- Page 1 (Leftmost):** Title page with the EMPossible logo, the text "MEANINGFUL PROPOSAL TITLE", and fields for "Your Name" and "B.S.E.E. University Name, 2020". It also lists "Ph.D. Research Proposal for the degree of Doctor of Philosophy in the Department of Electrical & Computer Engineering" and "Committee Members".
- Page 2:** Section 1.0 Proposal Summary, 1.1 Problem Statement (or Hypothesis), 1.2 Research Plan, and 1.3 Scope and Objectives.
- Page 3:** Section 1.0 Proposed Research, 1.1 Research Topic, 1.2 Significance of the Proposed Research, and 1.3 Scope and Objectives.
- Page 4:** Section 1.4 Detailed Description of Tasks, including a Gantt chart showing a schedule of tasks and sub-tasks from Fall to Spring.
- Page 5 (Rightmost):** Section 1.5 References and a footer with "Page 5".



Slide 15

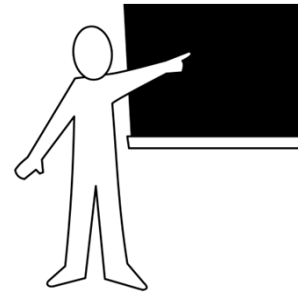
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Proposal Presentation

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Proposal Presentation Outline

- Introduction
 - Problem statement or hypothesis (1 slide)
 - Proposed Research (1 slide)
 - Significance of the Research (1 slide)
- Background
 - Provide 1-2 slide summaries of any background topics a person will need to understand the research.
 - State-of-the-Art. Summarize a comprehensive literature search.
 - Prior research.
- Proposed Research
 - Scope & Objectives (1 slide)
 - Technical approach (1-3 slides)
 - Metrics for success (1 slide)
 - Schedule of tasks and milestones (1 slide)
 - Describe each task (1-2 slides per task)
 - Research deliverables & dissemination plan
- Conclusion
 - Summary: topic, significance, metrics, timeline and deliverables (1 slide)
 - Publications & presentations (include pending and in progress)
 - References (if not provided on each slide)
 - Acknowledgements: funding source, committee members, etc.
- Appendix (Optional)
 - Include anything that may help answer questions by the audience and committee.



Proposal Presentation Template

A template for the proposal presentation is available on the EMPossible website:

<https://empossible.net/wp-content/uploads/2021/09/EMP-Research-Proposal-Presentation.pptx>

