

# A Primer On Writing a Research Proposal

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My Fellow STEM Scholars,

By now, each of you should know the importance of getting involved in research projects as soon as possible. Research projects can significantly help you figure out what you are truly passionate about. They also help your resume stand out! If you can get paid, that is simply “icing on the cake.” Try to learn as much as possible.

ALL OF YOU will have to write some type of proposal during your long professional careers!!!!

The following is intended to serve as an outline for a proposal.

## **OUTLINE FOR RESEARCH PROPOSAL**

The following outline follows WAESO proposal guidelines but it can be used for virtually any proposal; e.g. Fulton Research Initiative (FURI).

NOTE 1:

Before writing anything, make sure you get the proposal guidelines and submission instructions from the organization that you will be submitting the proposal to.

WAESO, for example, requires the submission of three (3) documents:

- (i) PROPOSAL (OVERVIEW)**
- (ii) PROPOSED ACTIVITIES**
- (iii) MATERIALS-SUPPLIES**

Details for component each component are given below. Other than this three (3) document decomposition, the following is a detailed outline for (virtually) any proposal that you might ever have to write.

NOTE 2:

In general, your proposals will be reviewed by one or more reviewers.

### **A FEW VERY IMPORTANT SUGGESTIONS:**

- a) Put together a good team! Everyone should contribute significantly to the effort.
- b) Try to find a sponsoring faculty member that is VERY interested in your problem or problem area.
- c) Closely follow the outline given below.
- d) Get the main ideas down first – then worry about language, spelling, grammar, and other details.
- e) Use the section heading given below.
- f) Try to include the questions listed below within each section.
- g) Use small sentences within your proposal.
- h) Use bulleted lists whenever possible. They are typically easy for a reviewer to read.
- i) Have someone that you trust proof read your proposal before sending it to your faculty supervisor.

### **1. Research Problem To Be Addressed**

What technical (engineering or scientific) problem will you be addressing?

Reviewers of your proposal should clearly understand what problem you plan to address.

Try to pick a problem that you and your team members are passionate about.

I typically suggest a problem within an area that one can spend a life time working within...something that can lead to a senior design project, and MS, or even a PhD.

You may want to speak to you sponsoring faculty member in order to determine a suitable research problem.

You want to try to give an overall summary of your proposal here.

This is not easy to do, but it is what you want to do.

Think of it as your "30 second presidential campaign commercial."

Here are a few topics that have been funded by WAESO over the years:

*Hypersonic Vehicle Scramjet Fuel-Injection Combustion Modeling Via CFD*

*Micro Air Vehicle Drag Reduction Via Transient Couette Flow Analysis*

*Climate Change Modeling and Policy Approaches*

*Climate Change Modeling Via CFD*

*Building an Autonomous Underwater Vehicle*

*Development of a Remote Control App for an i-Phone*

*Modeling and Control of Hypersonic Vehicles*

*Development of Efficient Multimedia Search Engines*

*Modeling and Control of Robotic Systems*

*Modeling and Control of Semiconductor Ovens*

*Modeling and Control of Thermal Systems*

*Modeling and Control of Electromechanical Systems*

*Modeling and Control of Jet Engines*

*Modeling and Control of Re-entrant Semiconductor Fabrication Lines*

*Modeling, Simulation, Animation, and Real-Time Control of Dynamical Systems*

See <http://aar.faculty.asu.edu/lapdp.html> for cutting-edge research topics.

## **2. Significance of Problem**

Why is this problem important? Why is it considered important by the engineering/scientific community?

Reviewers of your proposal should clearly understand why your problem is important (and hence worth pursuing).

Do NOT assume that the reviewers are familiar with your problem. Use Sections 1 and 2 to “educate” the reviewers.

## **3. Critical Questions To Be Addressed**

What critical questions and sub-questions do you plan to address?

This, in principle, serves as an overview of the work to be performed.

As such, it can be VERY useful to a reviewer - particularly one that is unfamiliar with your topic.

#### **4. Literature Survey: Prior Approaches**

Here is where you attempt to concisely summarize the status of the field for individuals reviewing your proposal.

What have others done on the problem being addressed?

What approach have they taken?

What successes have they achieved?

What is left to be done? (This, in principle, should motivate your work.)

The above is crucial!

It shows reviewers whether or not you have done your homework.

Here, you will want to cite specific sources; e.g. technical papers, theses, etc...

Cite web sites as a last resort.

Try to use respected scientific sources whenever possible.

You also want to explain what you done on the problem.

This particularly important if you have received prior WAESO funding.

Some of you may not have anything to say here.

If you have written a paper on the subject, you ought to summarize the work completed.

#### **5. Proposed Technical Approach**

What will your approach be?

Give specific details.

This is what one might refer to as the “meat” of the proposal.

In principle, this is where you spell out your "new/novel" ideas.

Here, “new” and “novel” are used loosely.

NOTE 3:

We are not expecting you to win a Nobel-prize work!!!!!! ( Not yet. :o )

It is understood that you are just getting started and hence that you are just learning about research.

NOTE 4:

You might have several approaches which you will be comparing!!!! In such a case, clearly describe each approach to be pursued. The pursuit of several approaches is generally a good strategy to take because you can typically learn something useful by systematically comparing distinct approaches.

## **6. Contributions of Proposed Work**

Here, you should describe why your proposed work is worthwhile?

That is, why is your approach(es)/investigation is worth pursuing?

What is most important here is that you clearly explain why your approach is worth considering given the state of the field (as explained above within your Literature Survey in Section 4.)

*One might argue that this is the most important part of your proposal because you are (in principle) describing the merit of your approach in comparison to all other approaches taken to date by researchers in the area around the world.*

Generally speaking, this is the hardest part of the proposal to write.

I usually try to write this first and then come back to it after I am done writing the rest of the proposal.

NOTE 5:

As stated above, we are NOT expecting Nobel prize work here.

Our goal, and that of organizations like WAESO, is to teach you to pursue problems in a systematic and comprehensive manner.

NOTE 6:

This funding opportunity exists because it is understood on Capitol Hill that the Nation needs many more highly trained engineers, scientists, and mathematicians in order for us to continue to remain competitive.

## **7. Materials and Supplies**

In this section, you should say:

Materials and supplies are described within a separate MATERIALS-SUPPLIES document that has been provided.

**NOTE 7:**

**Please place Section 7 within a separate MATERIALS-SUPPLIES document.  
(Required by WAESO)**

Within this separate MATERIALS-SUPPLIES document you should clearly describe what materials and supplies you will need to successfully complete the project; e.g. books, software, etc...

**NOTE 8:**

Here, you must provide a detailed itemized budget within a table.  
Below the table, you should provide reasonable justification for each item in your budget.

Different organizations permit different amounts for materials and supplies.

WAESO has traditionally permitted up to \$600 towards materials and supplies!!!

## **8. Description of Proposed Activities and Anticipated Results**

In this section, you should say:

Proposed activities and anticipated results are described within a separate PROPOSED ACTIVITIES document that has been provided.

Here, you should give extra details as to how you will answer each of the critical questions discussed above. As such, it is just a more detailed breakdown of the work to be pursued. You might break down each critical question or problem into clear sub-questions or sub-problems.

## **9. Tasks, Time Line, and Work Allocation**

In this section, you should say:

Tasks, Time Line, and Work Allocation are described within a separate PROPOSED ACTIVITIES document.

Here, you should provide a detailed time line describing when each task will be accomplished. You should also describe which team member will do what!

Some type of Gantt chart should be used here.

[http://en.wikipedia.org/wiki/Gantt\\_chart](http://en.wikipedia.org/wiki/Gantt_chart)

**NOTE 9:**

**Please place Sections 8 and 9 within a separate PROPOSED ACTIVITIES document.**  
(Required by WAESO)

## **10. Team Background and Qualifications**

Here, you should provide some relevant background for each of your team members.  
e.g. name, major, courses taken, courses to be taken

Including a 1 page resume here is not a bad idea.

## **11. Project Supervisor and Team Meetings Schedule**

Why is your supervisor qualified to supervise this work?  
Visit the advisor's web site for some background information.

When and where will you be meeting with your project supervisor?  
Your team should meet with your project supervisor at least once per week.  
One or two additional conference calls are also highly recommended.  
When will your team members meet separately? 1-2 times per week is recommended.  
Weekends might be best.

## **12. Other Reasons for Pursuing the Proposed Research**

What are other reasons you wish to pursue the proposed research?  
e.g. learn about the topic,  
need money,

build for a senior design topic,  
build for an MS thesis,  
prepare for more advanced work in the area,  
build for a PhD thesis....

Would you like this to lead to a senior design topic  
and/or and MS thesis and/or PhD thesis?

### **13. TEAM INFORMATION**

Provide the following for each of your team mates:

Name  
SS number  
Phone number  
email address

### **14. REFERENCES**

You should provide a good comprehensive list of numbered references here which are suitably cited throughout your proposal.

Having a good set of references is very important.

It shows a knowledgeable reviewer whether or not you have truly done your homework.

Please do your homework!