# A complete but succinct description of work using relevant important keywords while being snappy when possible

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**Abstract**

Four Sentences: State the problem. Say why it is an interesting problem. Say what your solution achieves, not what it is. Say what follows from your solutions.

## I. Introduction

### *A. Problem*

*1) Statement:*

What is the specific problem did you (attempt to) solve?[1] Why exactly does this problem exist? Who specifically has this problem? Scientists? Military? Industry?

*2) Importance:*

How important is finding a solution (be realistic)? What would be possible that previously was not? Who specifically would benefit and how? Scientists? Military? Industry?

*3) Difficulty:*

How difficult is the problem to solve (be realistic)? What specifically must be overcome? Are specific technologies required? Is there knowledge required? Does it require organizational or institutional support/cooperation?

### *B. Solution*

*1) Proposed Solution:*

[1]Getting to the point as soon as possible is very important. I do not recommend putting any background before stating what the point of your paper is. Sentence 1 is more important than the abstract.

Photo (or concept drawing) of your design preferably being deployed in the field. This figure should appear on page one. Many readers will not look at anything else. Caption is a short description and summary of system functionality.

Fig. 1. Photo (or concept drawing) of your design preferably being deployed in the field. This figure should appear on page one. Many readers will not look at anything else. Caption is a short description and summary of system functionality.

Briefly what is your solution? Reference fig. 1.[2]

What is different about your solution? How does it overcome the problem difficulty?

*2) Design Considerations:*

What specific challenges does your solution face (briefly)? How are those challenges different from those of other solutions?

*3) Success Criteria:*

How would you evaluate a design of your concept (be specific)? Why is that criteria valid/important?

Did you create a working prototype? Did it meet your sucess criteria? Are further improvements likely?

## II. Background

I try to avoid including this section. It lengthens and defocusses the paper. I try to push this information into references or appendix. I assume my readers are either experts or know how to look things up. If you need this, keep it as short as possible or attempt to fold it into the Introduction and/or Related Work.

Are there any conccepts required to understand the rest of your paper that you would not already expect your readers to understand?[3]

## III. Related Work

Keep this section as short as possible and try to combine with Introduction and/or Background.

### *A. Standard Practice*

How is this (or similar) problem commonly or historically solved?[4] Why is this not good enough? How is this different than your solution?

### *B. State-of-the-Art*

How is this (or similar) problem solved by entities with greater access resources and the newest technology?[5] Why is this not good enough? Why is this not more common? How is this different than your solution?

[2]Getting an impressive figure on page one is very important. Most people skim figures before they do anything else. Fig. 1 is more important than sentence 1.

[3]Look to reference texts books or comprehensive review papers.

[4]Look to reference texts books or comprehensive review papers.

[5]Look to reference texts books or comprehensive review papers.

### C. Key Projects

Are there any specific related projects you need to address? Why are they not good enough? Why is this not more common? How is this different than your solution?

## IV. System Overview

### A. Design Overview

What does the system look like? What are the functional subsystems? How do the subsytems interact?

For each subsystem: What is it? How does it work? How does it interact?

### B. System Model

I prefer to start with a broad picture and then drill down into details rather than start with building blocks and build up into full structure. This is an uncommon choice, but one that I believe strongly in.

What is the overall state model? What are the state variables? How are they related?

What category of system or equation is this? (ie. harmonic oscillator) What kinds of results does it predict?

### C. System Elements

For each term:

What does this represent physically? How do you predict the term?

What assumptions are you making? Are they realisitic, conservative, conditional, or stupid?

Can it be measured? Does measurement match prediction? Under what conditions? What does this mean? Are only emperical measured values valid?

### D. System Dynamics

Given characterisitics of each element, how is model expected to behave?

### E. Control

Is the system controllable?

What are the control inputs?

What are the control outputs?

Is the system stable?

## V. Modeling Results

Why using models instead of models matched to lab results?[6]

Are these model results reasonable?

What assumptions are being made? Why is this valid?

## VI. Lab Results

What needs testing?

For each test: How did you set up the tests? How did you isolate variables? How did you control inputs? How did you measure outputs? Did results match expectations? What do results mean?

Do lab results generally match expectations? Can a system be deployed based on results?

## VII. Field Results

Who? What? When? Where? How?

Location, Depth, Duration, Distance?

What are qualitative observations? Expectations vs Reality?

What did you demonstrate?[7]

What were the major successes?

What do the results mean?

## VIII. Conclusion

### *A. Success*

Did you reach your success criteria? (be realistic)

What does that mean?

### *B. Conclusions*

For each conclusion or major point: Restate the conclusion plainly.

[6]Model results can fold nicely into lab tests, but some projects rely heavily on modeling. This is fine, but it should be justified.

[7]This is a big deal and very impressive. While it only amounts to a paragraph or two of writing, it is the thing that makes a paper. Real artists ship, and real engineers deploy.

### C. Future Work

What Technology Readiness Level (TRL)[8] is the system in? What is next for this project? What needs to be investigated further? What needs to be tested?

## IX. Acknowledgments

For each: This project was made possible by a grant from the Foundation (123456)

For each: We wish to acknowledge (person/organization) for (contribution to project)

For each: We wish to acknowledge the captains and crews of the R/V Neverdock for their expertise and professionalism at sea.

## References

Use multiple bib files (related.bib/background.bib/...). Organize within the files as well. Write your own abstracts into the entries.

10-30 refs is reasonable. 15-25 makes more sense.

## Appendix

### A. Appendix

- Background information required to understand new concepts.
- Avoid using appendixes.

[8] I use the precise wording from TRL without actually refering to it. For example, TRL4 -> "validated in lab", TRL6 -> "demonstrated in the deep sea environment"