



Research Methods in Science in Engineering

## Business Proposals

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## Outline

- The Heilmeier Catechism
- Winning Strategies

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# The Heilmeier Catechism

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## The Heilmeier Catechism



**George Harry Heilmeier, Ph.D.**  
 May 22, 1936 – April 21, 2014  
[https://en.wikipedia.org/wiki/George\\_H.\\_Heilmeier](https://en.wikipedia.org/wiki/George_H._Heilmeier)

George H. Heilmeier, a former DARPA director (1975-1977), crafted a set of questions known as the "Heilmeier Catechism" to help Agency officials think through and evaluate proposed research programs.

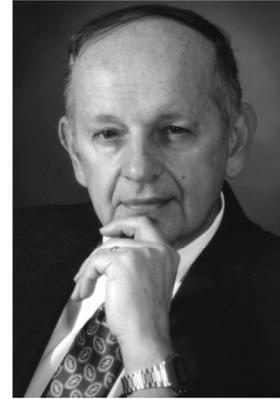
- What are you trying to do? Articulate your objectives using absolutely no jargon.
- How is it done today, and what are the limits of current practice?
- What is new in your approach and why do you think it will be successful?
- Who cares? If you are successful, what difference will it make?
- What are the risks?
- How much will it cost?
- How long will it take?
- What are the mid-term and final "exams" to check for success?

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## The Heilmeier Catechism



1. What are you trying to do? Why is it hard?  
*Articulate your objectives using absolutely no jargon.*
2. How is it done today? What are the limits of current practice?
3. What is the new technical idea or approach?
4. Why do you think you will be successful?
5. Who cares? What is the impact if successful?
6. What are the risks and mitigations?
7. What will it cost? How long will it take?
8. What is your plan? How will the project be organized?
9. How will you measure your progress? How will intermediate results be generated?
10. What is your plan to commercialize the technology?



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# Winning Strategies

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# Best Proposal Advice Ever!

## Win the proposal before ever writing it.

Network with program managers and potential funders.

Build genuine relationships with them and develop a strong reputation.

When money becomes available, they will think of you first and notify you.

Cold proposals rarely win.



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# Plan Entire Project Before Writing Proposal

Key things to consider:

- Vision and goals of the project
- Significance
- Risks and mitigations
- Performance goals and metrics
- Deliverables
- Team and collaborators
- Major purchases
- Objectives and tasks

Having your project skeleton completed prior to writing will make your proposal stronger through consistency and answers to key questions that are clear, blunt and succinct.

**Project Skeleton**

<b>Final Project Plan</b> Provide a table that is concise, memorable, and easily understood	
<b>Overarching Research Goal beyond the project:</b> What is the long-term vision and the goal of your research that you hope to fund this project?	<b>Specific Goal of the Project:</b> • List the goal of this specific project • Put it in context of the larger field system
<b>Background (Setting and context of problem):</b> • Do you identify the point of a crisis? • build up to the need for the project	<b>Problem Statement (what specifically are you solving):</b> • State the specific problem to be solved • It is important to limit the scope of your research • You cannot solve all problems in one project
<b>Significance of the Project (why is this research important):</b> • What things will your research explore? • What new scientific areas does it enable? • Put this in context of serving the scientific community • Make your research useful to others	<b>Risks and Mitigation:</b> • List all serious challenges • Include how they will be mitigated • Include Plan B, alternatives, etc.
<b>Performance Goals &amp; Metrics for Success:</b> • How will you measure your progress? • How will you know if your research is successful? • List specific and measurable success and goals	<b>Project Deliverables:</b> • What will you deliver to the customer? • Reports? A demonstration? Hardware? Software? • Knowledge? Publications?
<b>Team and Collaborators (PI):</b> • Principal Investigator (PI) • Students and other key personnel • Subcontractors and consultants	<b>Major Purchases:</b> • List any major equipment purchases • Or perhaps other major cost items
<b>Objective 1:</b> Objectives are high level items that do not depend on other objectives	Task 1.1: Funds should directly address the objectives Task 1.2: Be specific with task titles Task 1.3: Use accurate words like develop, characterize, build, etc. Task 1.4:
<b>Objective 2:</b> Use specific language for objectives	Task 2.1: Task 2.2: Task 2.3: Task 2.4:
<b>Objective 3:</b> Small research will not have many objectives. If it does, you may be confusing tasks with objectives	Task 3.1: Task 3.2: Task 3.3: Task 3.4:
<b>Objective 4:</b>	Task 4.1: Task 4.2: Task 4.3: Task 4.4:

\*Keep the entire table to a single page.



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# How to Divide Your Time Writing a Proposal

## First Page

**Stunning Figure 1**

**Answer Heilmeier's Questions**

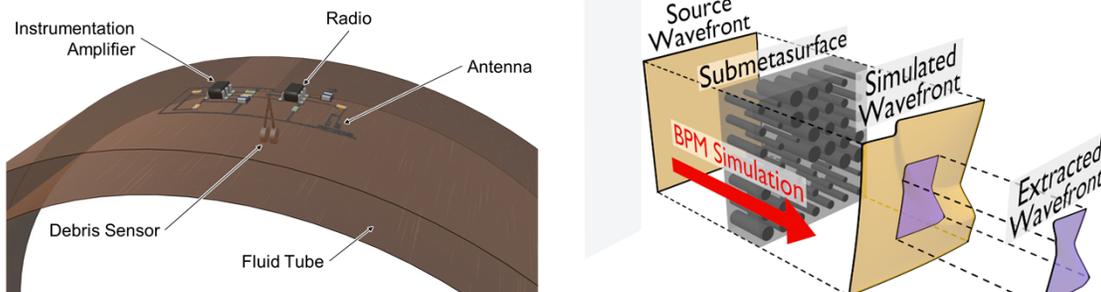
*Also address why you are the right person/team and what capabilities you offer to the project.*

## Everything Else

Background	Technical Approach	Scope	Objectives
Work Plan	Tasks	Schedule	Milestones
Metrics	Related Work	Facilities	Cost

# Figure 1

Create a stunning figure that completely summarizes your proposed research. The snazzier and more realistic the better. Keep it simple and understandable. This should be placed as close to the front of your proposal as the rules allow. This is the time to show off!



# Plan the Project Before Anything Else

**Project Skeleton**

<b>Final Project Title</b> Provide a title that is precise, memorable, and easily understood.	
<b>Background</b> What is the long term vision and the goal of your research that you hope to see in the project?	<b>Specific Goal of your Project</b> • List the goal of the specific project • Be as specific as the budget goal system
<b>Background (History and context of problem)</b> • How does this problem arise? • How did you find it? • What are the current research efforts?	<b>Public Statement (what you will be doing)</b> • How the specific problem you are solving • It is important to state the scope of your research • It is important to state the problem in a public statement
<b>Scientific Basis</b> • What things will your research address? • What are scientific areas that it connects? • Put this in context of solving the scientific community	<b>Scientific Significance</b> • List all system challenges • Include how they will be integrated • Include Plan B alternatives, etc.
<b>Why is your research needed by others?</b>	<b>Project Deliverables</b> • What will you deliver to the customer? • Report? A demonstration? Hardware? Software? • Publications? Publications?
<b>Performance Goals</b> • How will you measure your progress? • How will you know if your research is successful? • List specific and measurable metrics and goals	<b>Major Partners</b> • List any major equipment purchases • Or perhaps other major cost items
<b>Team and Collaborations</b> • Principal Investigator info • Students and other key personnel • Subcontractors and consultants	
<b>Objectives 1</b> • Objectives are high level aims • How do you depend on other objectives	<b>Task 1.1</b> (Link should directly address the objective) <b>Task 1.2</b> (Be specific with task title) <b>Task 1.3</b> (Use appropriate acronyms like develop, characterize, build, etc.) <b>Task 1.4</b>
<b>Objectives 2</b>	<b>Task 2.1</b> <b>Task 2.2</b> <b>Task 2.3</b> <b>Task 2.4</b>
<b>Objectives 3</b> • Use specific language for objectives	<b>Task 3.1</b> <b>Task 3.2</b> <b>Task 3.3</b> <b>Task 3.4</b>
<b>Objectives 4</b> • Good research will not have many objectives. If it does, you may be confusing folks	<b>Task 4.1</b> <b>Task 4.2</b> <b>Task 4.3</b> <b>Task 4.4</b>

\*Keep the entire table in a single page

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