

PROJECT LEAD THE WAY

**PLTW**

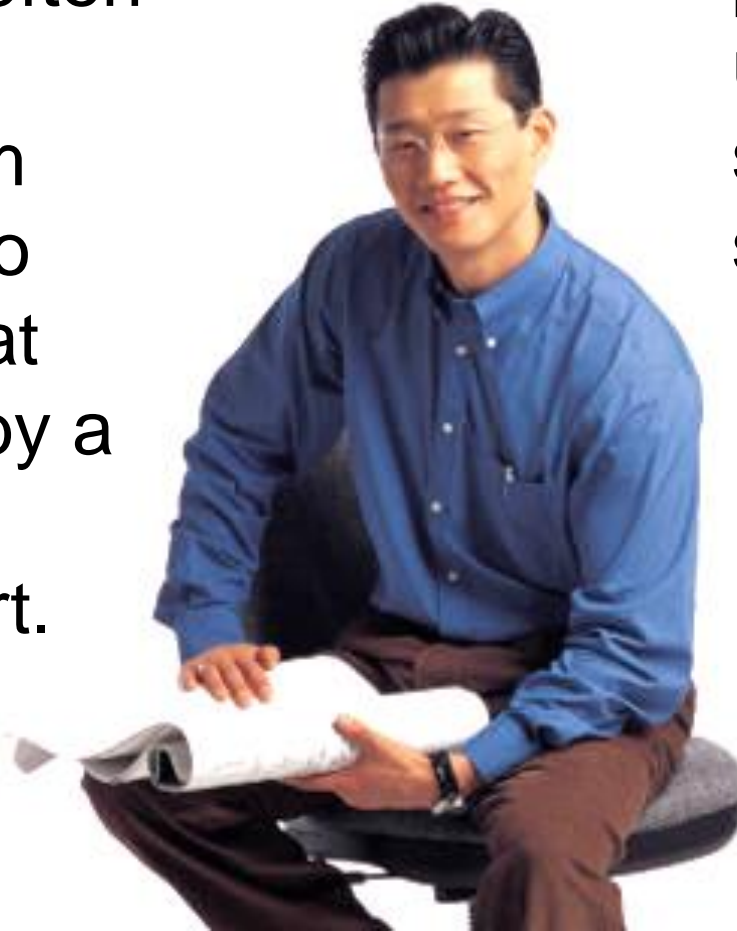
## **A Design Process**

# The Design Process

- What Is Design?
- What Is a Design Process?
- Design Process Examples
- Design Process Used in IED

# What Is Design?

The word “*design*” is often used as a generic term that refers to anything that was made by a conscious human effort.



*Design* is also a process that is used to systematically solve problems.

# What Is a Design Process?



A *design process* is a systematic problem-solving strategy, with criteria and constraints, used to develop many possible solutions to solve or satisfy human needs or wants and to narrow down the possible solutions to one final choice.

– ITEA *Standards for Technological Literacy*

water unit.  
cooking  
food storage,  
microwave, etc etc

even if station is not  
altitude = stabilized.

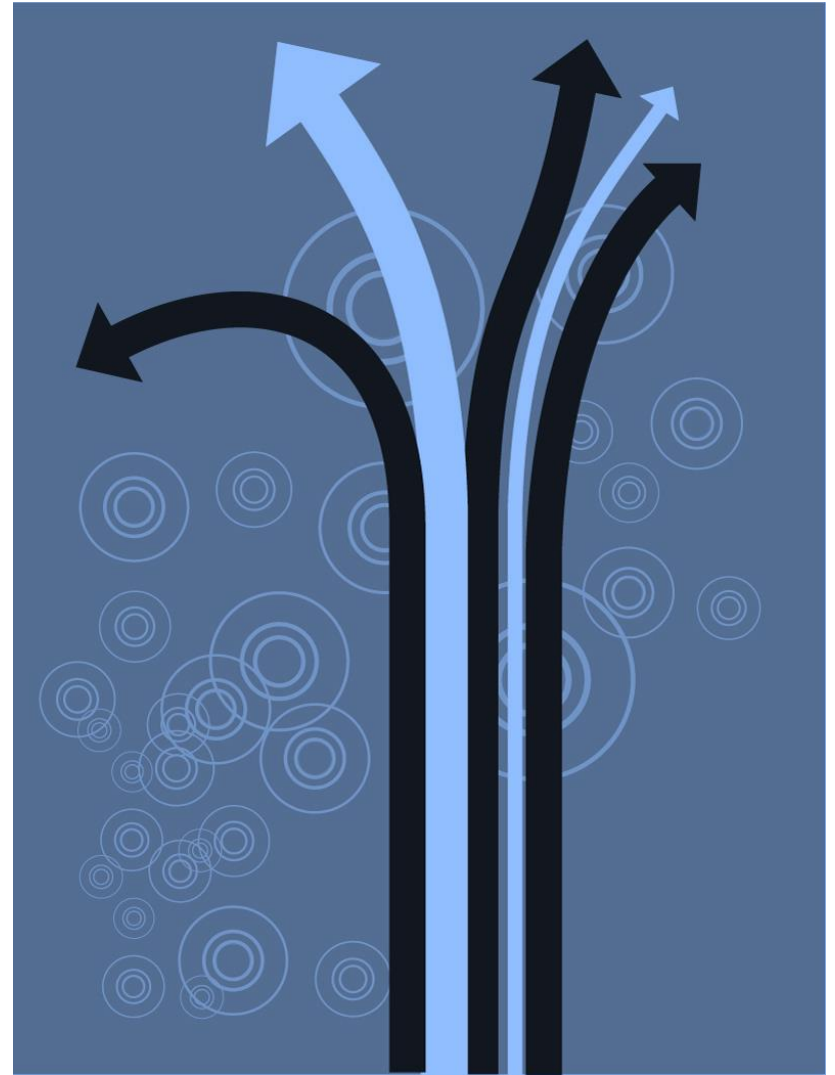
Oxygen tank  
could be used  
for confined  
oxygen storage.

Compass  
backhead.

Images courtesy of NASA

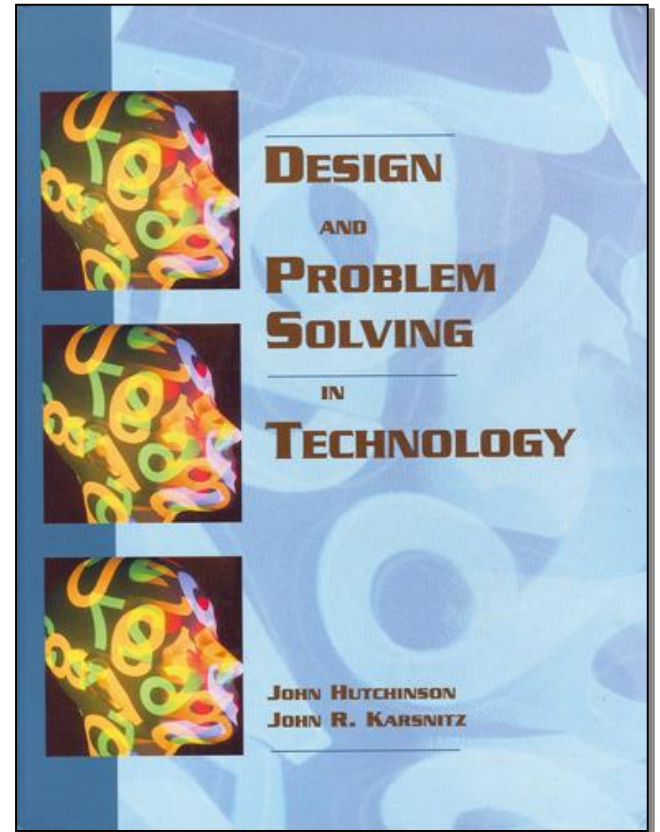
# Design Process

*Various design processes are used across different technical fields. The following are examples.*



# Design Process Example

1. Identify problems and opportunities
2. Frame a design brief
3. Investigate and research
4. Generate alternative solutions
5. Choose a solution
6. Developmental work
7. Model and prototype
8. Test and evaluate
9. Redesign and improve

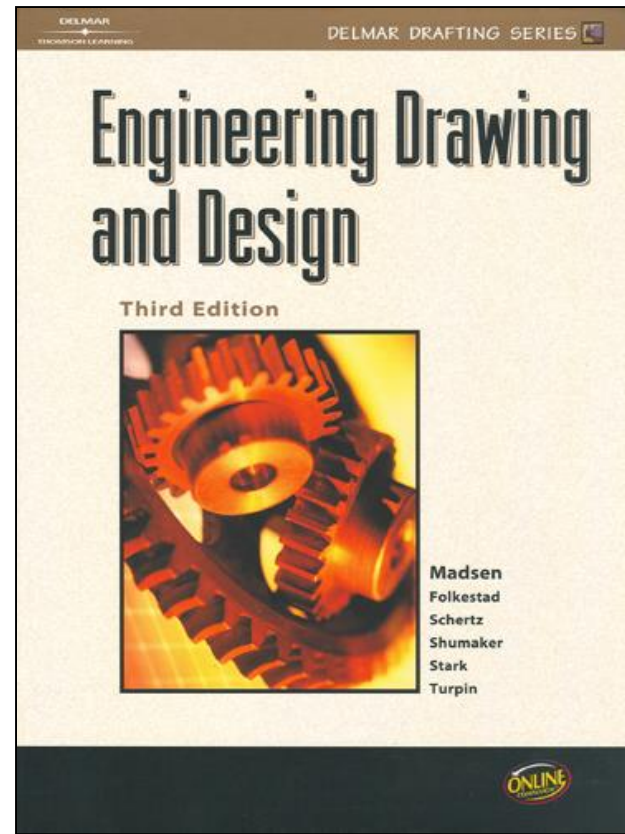


*Design and Problem Solving in  
Technology*



# Design Process Example

1. Identify the need
2. Define the criteria
3. Explore/research/investigate
4. Generate alternate solutions
5. Choose a solution
6. Develop the solution
7. Model/prototype
8. Test and evaluate
9. Redesign and improve

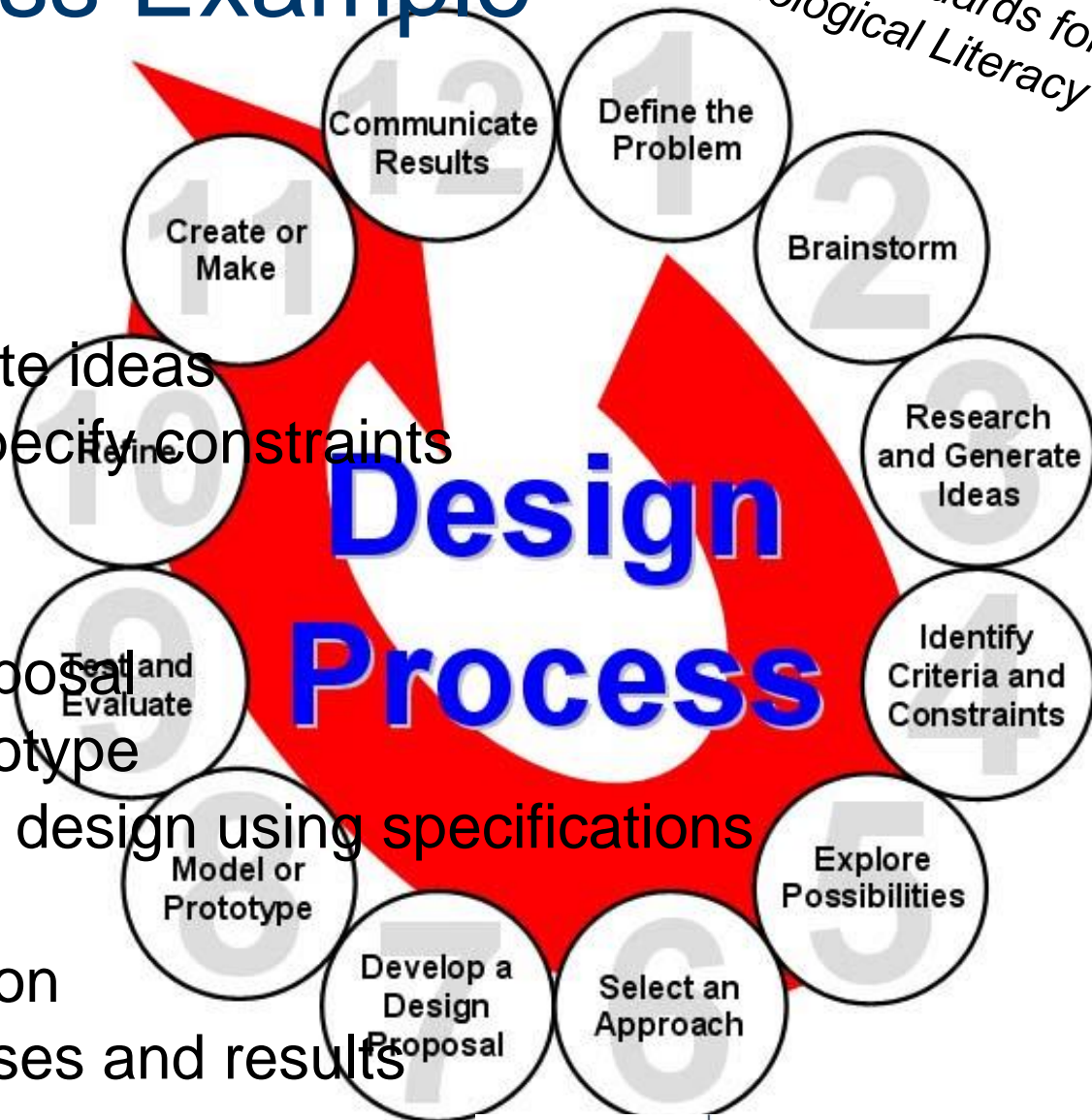


*Engineering Drawing and Design*  
(3<sup>rd</sup> edition)

# Design Process Example

ITEA Standards for  
Technological Literacy

1. Define the problem
2. Brainstorm
3. Research and generate ideas
4. Identify criteria and specify constraints
5. Explore possibilities
6. Select an approach
7. Develop a design proposal
8. Make a model or prototype
9. Test and evaluate the design using specifications
10. Refine the design
11. Create or make solution
12. Communicate processes and results

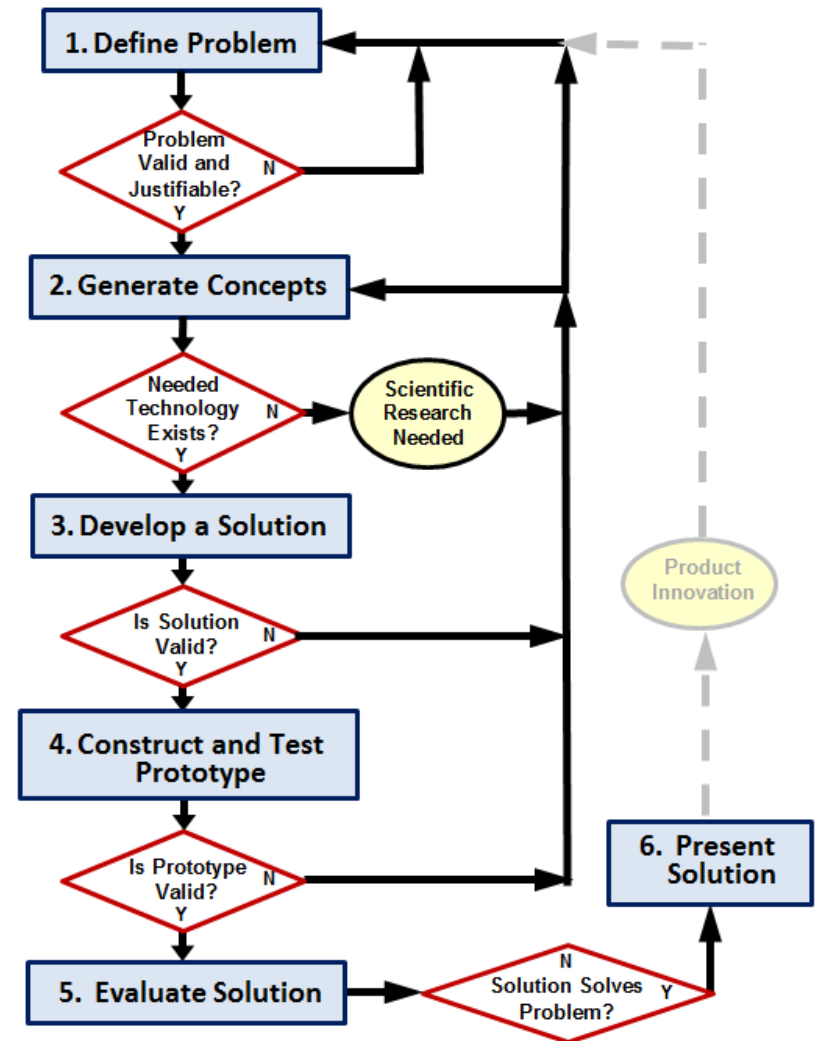




# Design Process used in IED

1. Define the Problem
2. Generate Concepts
3. Develop a Solution
4. Construct and Test a Prototype
5. Evaluate the Solution
6. Present the Solution

*This design process was developed based on the University of Maryland - College Park - IRB Research Project*



# Design Process

- Design process used in IED is an example of ***one*** design process
- Many design processes exist and are effective
- Consistently applying a single clearly defined design process provides a basis for understanding

# Define the Problem

## 1. Define Problem

- Identify a problem
- Validate the problem
  - *Who says it is a problem?*
  - *Needs and wants*
  - *Prior solutions*
- Justify the problem
  - *Is the problem worth solving?*
- Create design requirements (specifications)
  - *Criteria and constraints*
- *Design Brief*

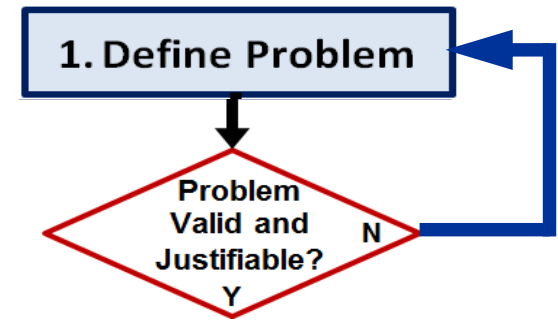
# Define the Problem

- *Design Brief*
  - *A written plan that identifies a problem to be solved, its criteria, and its constraints.*
  - *Used to encourage thinking of all aspects of a problem before attempting a solution.*

1. Define Problem

# Define the Problem

- Identify a problem
- Validate the problem
  - *Who says it is a problem?*
  - *Needs and wants*
  - *Prior solutions*
- Justify the problem
  - *Is the problem worth solving?*
- Create design requirements (specifications)
  - *Criteria and constraints*
- *Design Brief*

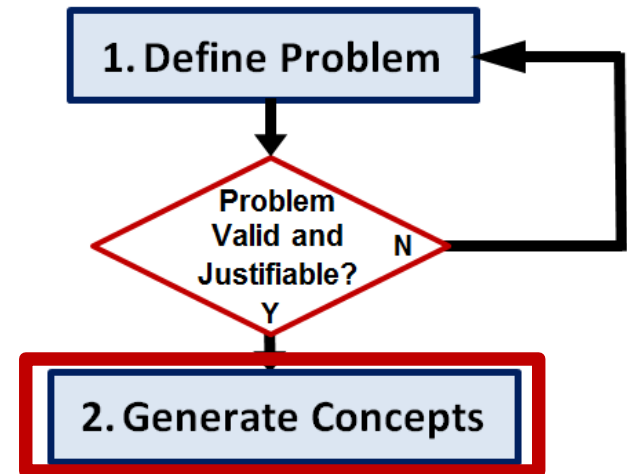


In some cases, if the problem is not valid or justifiable, the designer must define a new problem.



# Generate Concepts

- Research
- **Brainstorm** possible solutions
- Consider additional design goals
- Apply STEM principles
- Select an approach
- *Decision Matrix*



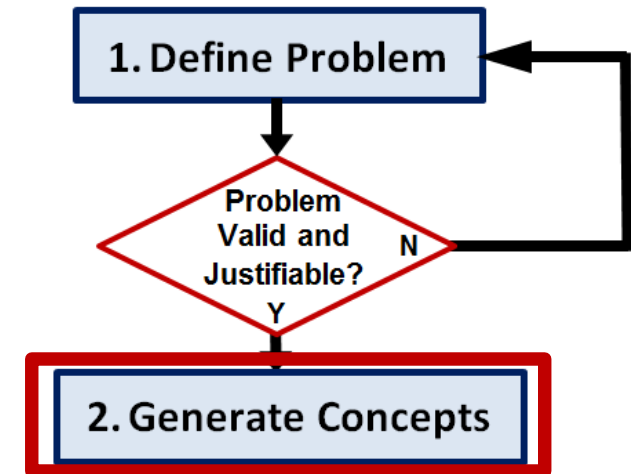
# Generate Concepts

- Decision Matrix*

- A tool used to compare design solutions against one another, using specific criteria.

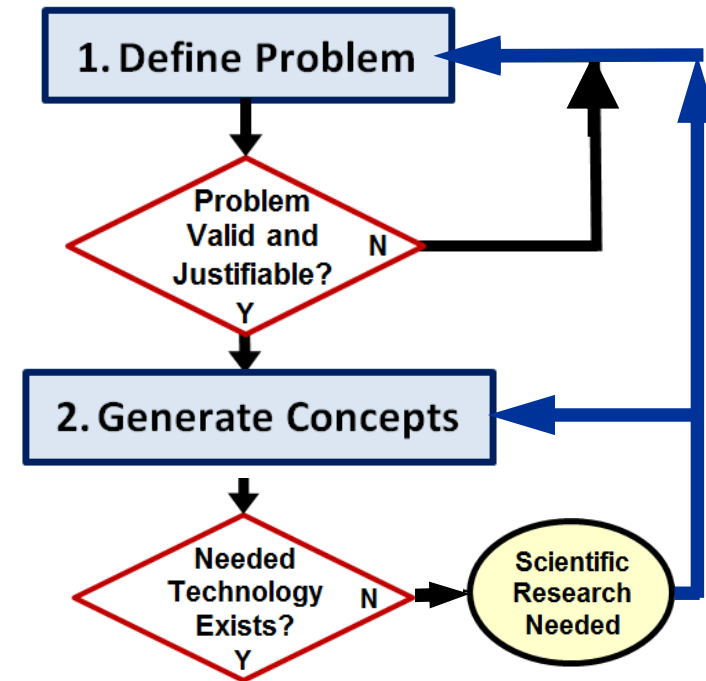
	cost	complexity	Development Time	Total
Idea #1	3	2	1	6
Idea #2	1	1	2	4
Idea #3	4	2	4	10
Idea #4	2	3	4	9
Idea #5	4	1	3	8
Idea #6	3	4	4	11

4	3	2	1	2	1
Best			Worst	Yes	No



# Generate Concepts

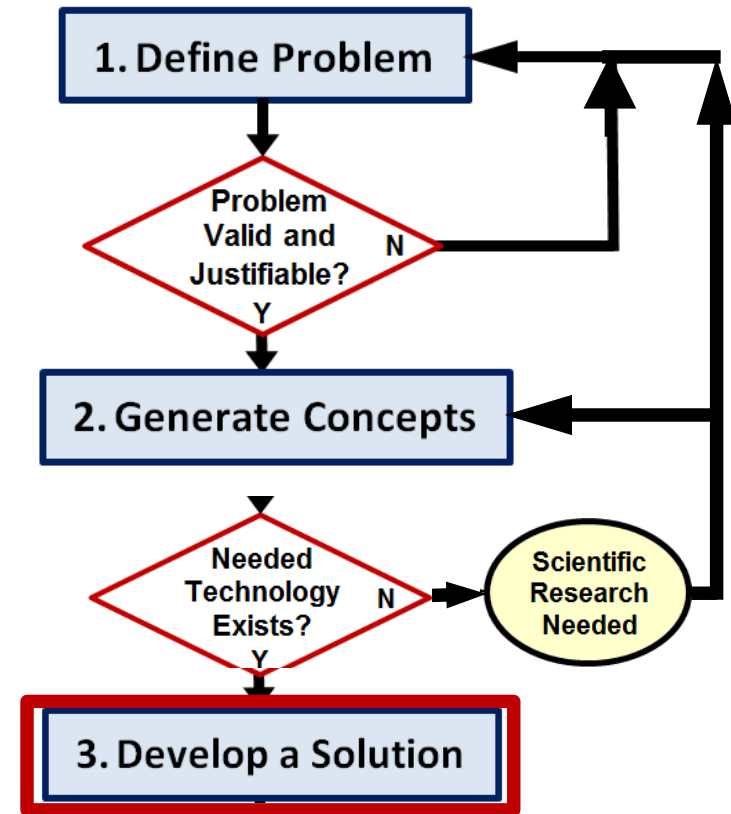
- Research
- Brainstorm possible solutions
- Consider additional design goals
- Apply STEM principles
- Select an approach
- *Decision Matrix*



If the technology necessary to develop the solution does not exist, scientific research may be necessary to pursue a solution.

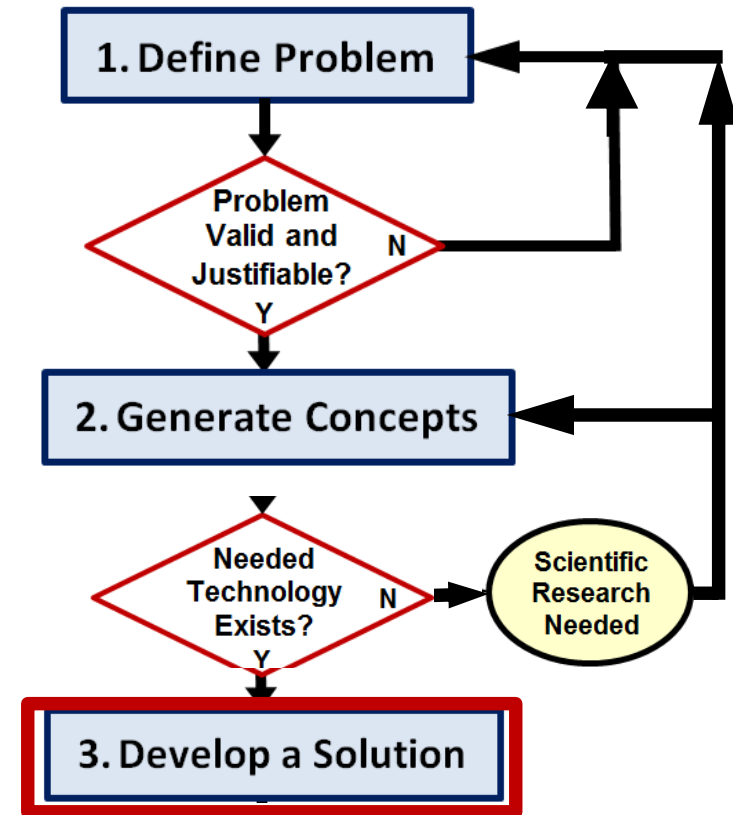
# Develop a Solution

- Create detailed design solution
- Justify the solution path
- *Technical Drawings*



# Develop a Solution

- *Technical Drawings*
  - Drawings that provide technical information necessary to produce a product.
    - material, size, shape
    - assembly, if necessary

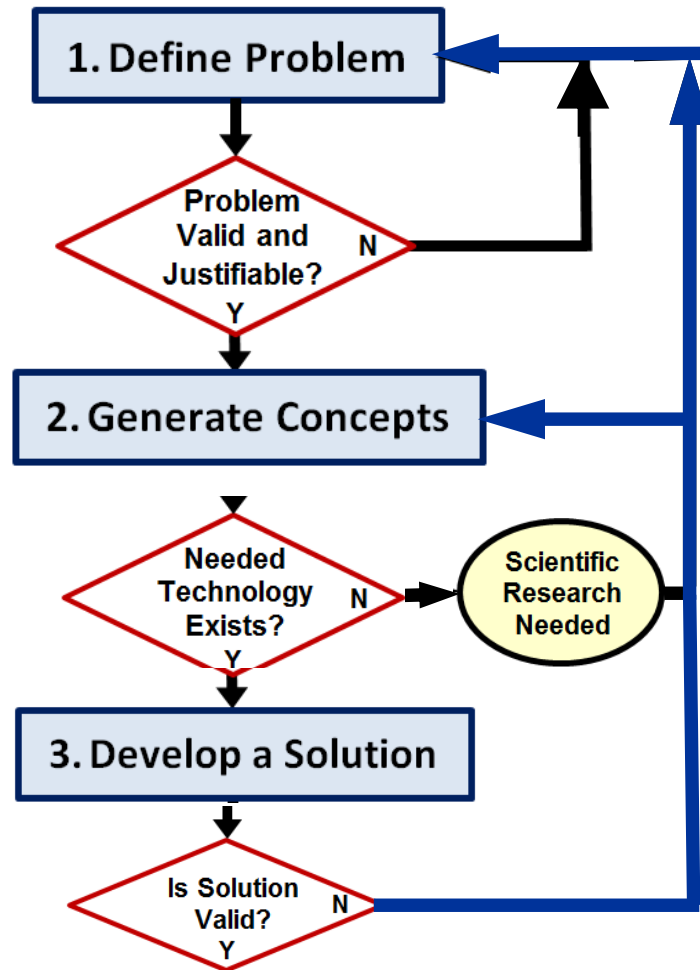




# Develop a Solution

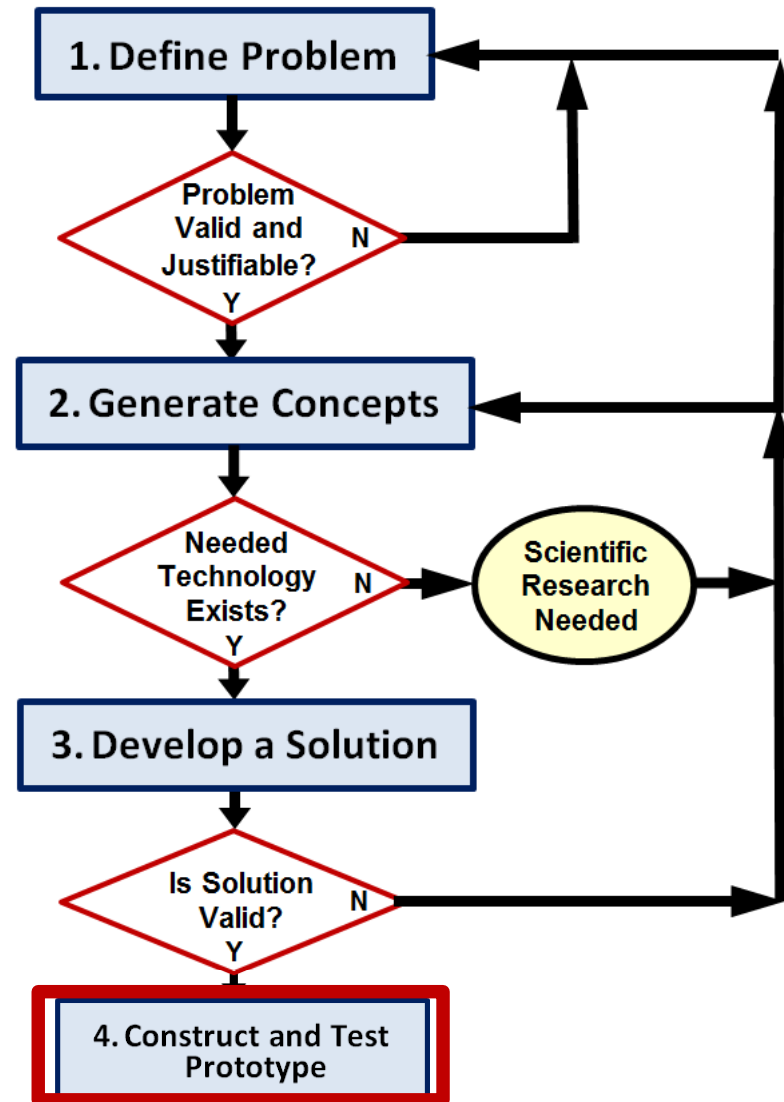
- Create detailed design solution
  - *Technical Drawings*
- Justify the solution path

If a solution is found to be invalid or cannot be justified, the designer must return to a previous step in the design process.



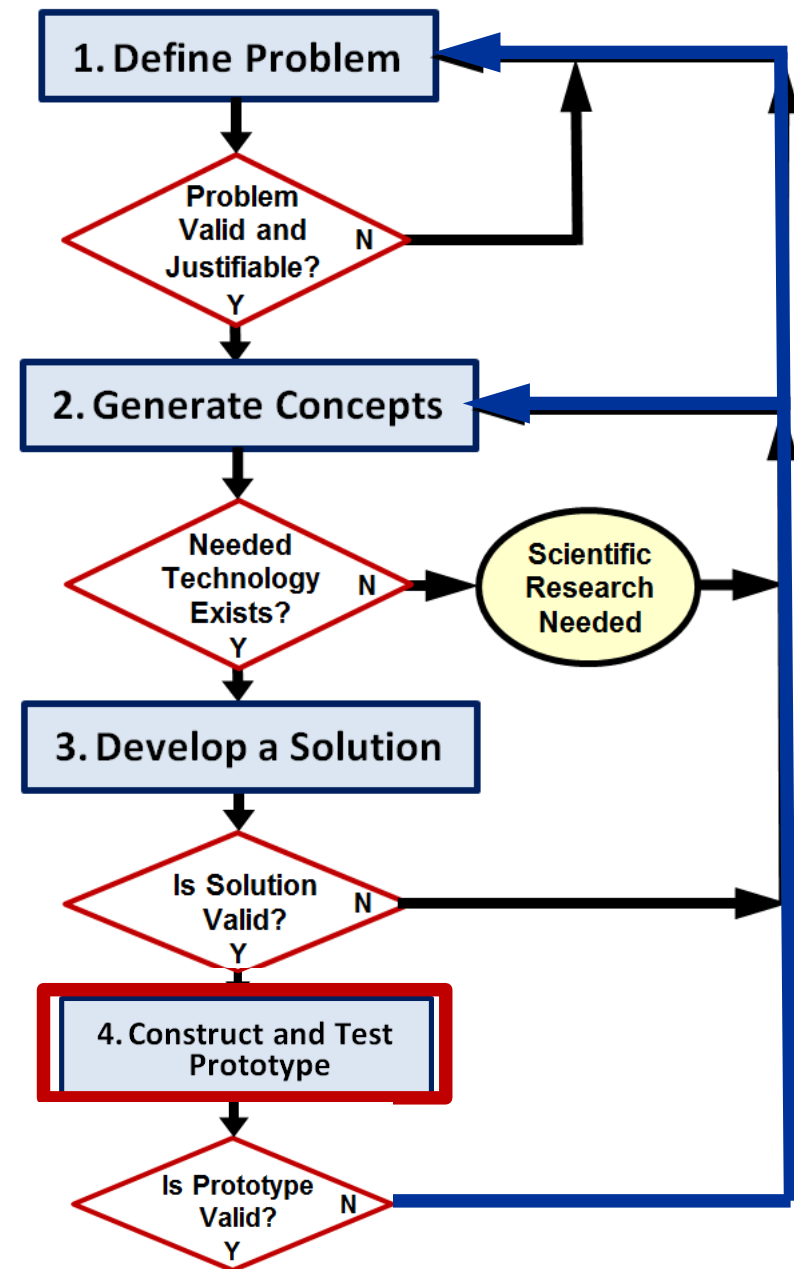
# Construct and Test a Prototype

- Construct a testable prototype
- Plan prototype testing
  - *Performance*
  - *Usability*
  - *Durability*
- Test prototype
  - collect test data
  - analyze test data
- *Test Report*



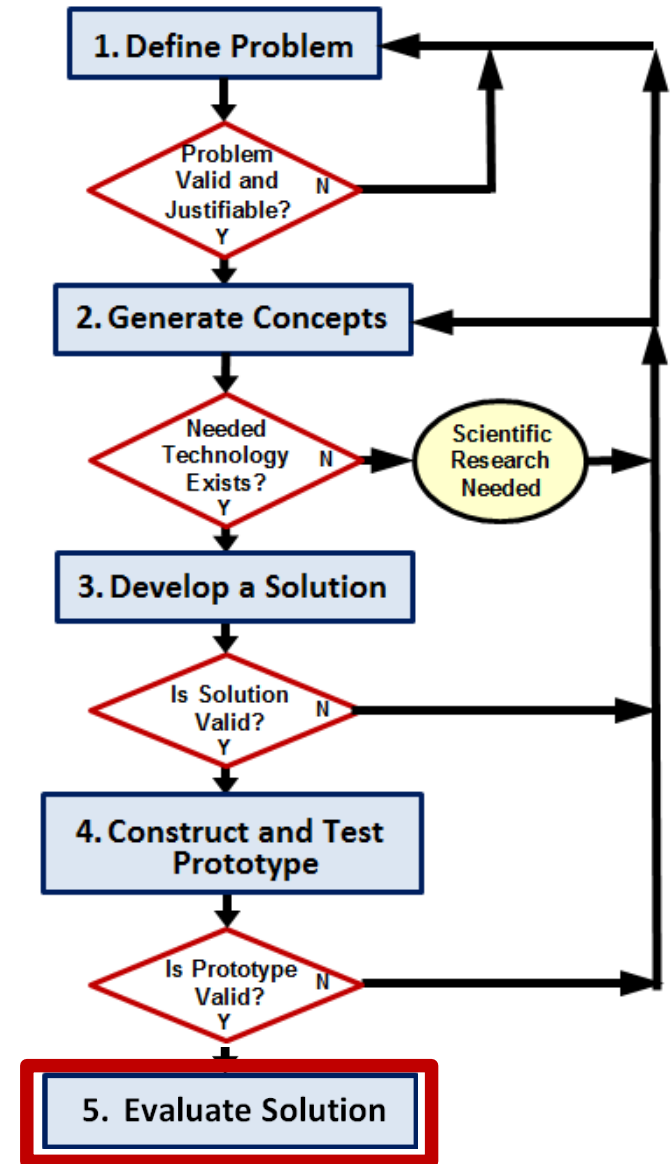
# Construct and Test a Prototype

- Construct a testable prototype
- Plan prototype testing
  - *Performance*
  - *Usability*
- If a testable prototype cannot be built or test data analysis indicates a flawed design, the designer must return to a previous step of the design process.



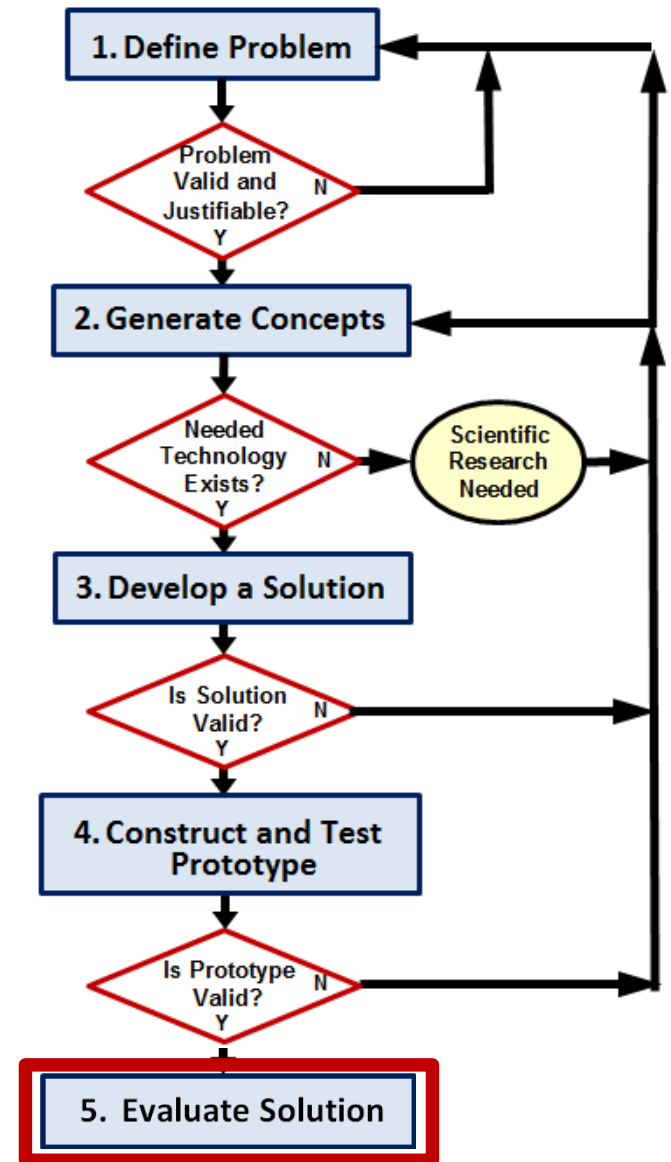
# Evaluate the Solution

- Evaluate solution effectiveness
- Reflect on design
  - *Recommend improvements*
- Optimize/Redesign the solution
  - *[Return to prior design process steps, if necessary]*
  - *Revise design documents*
- *Project Recommendations*



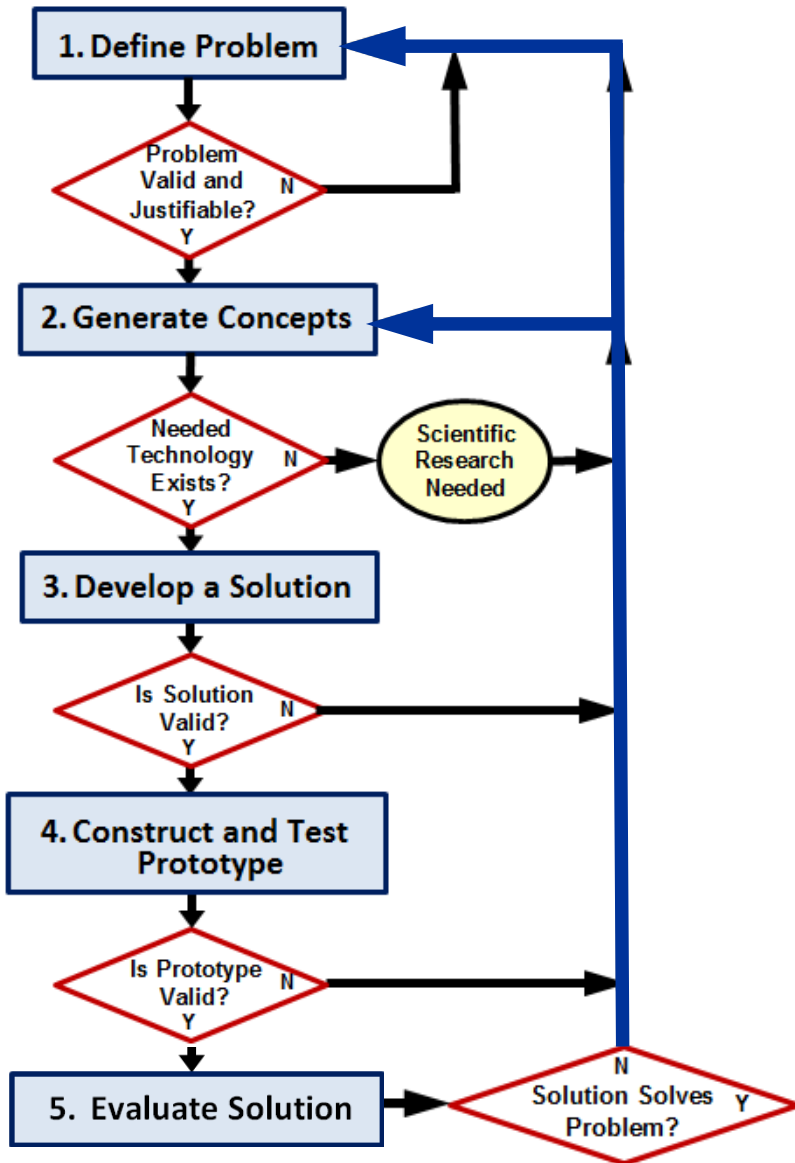
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# Evaluate the Solution

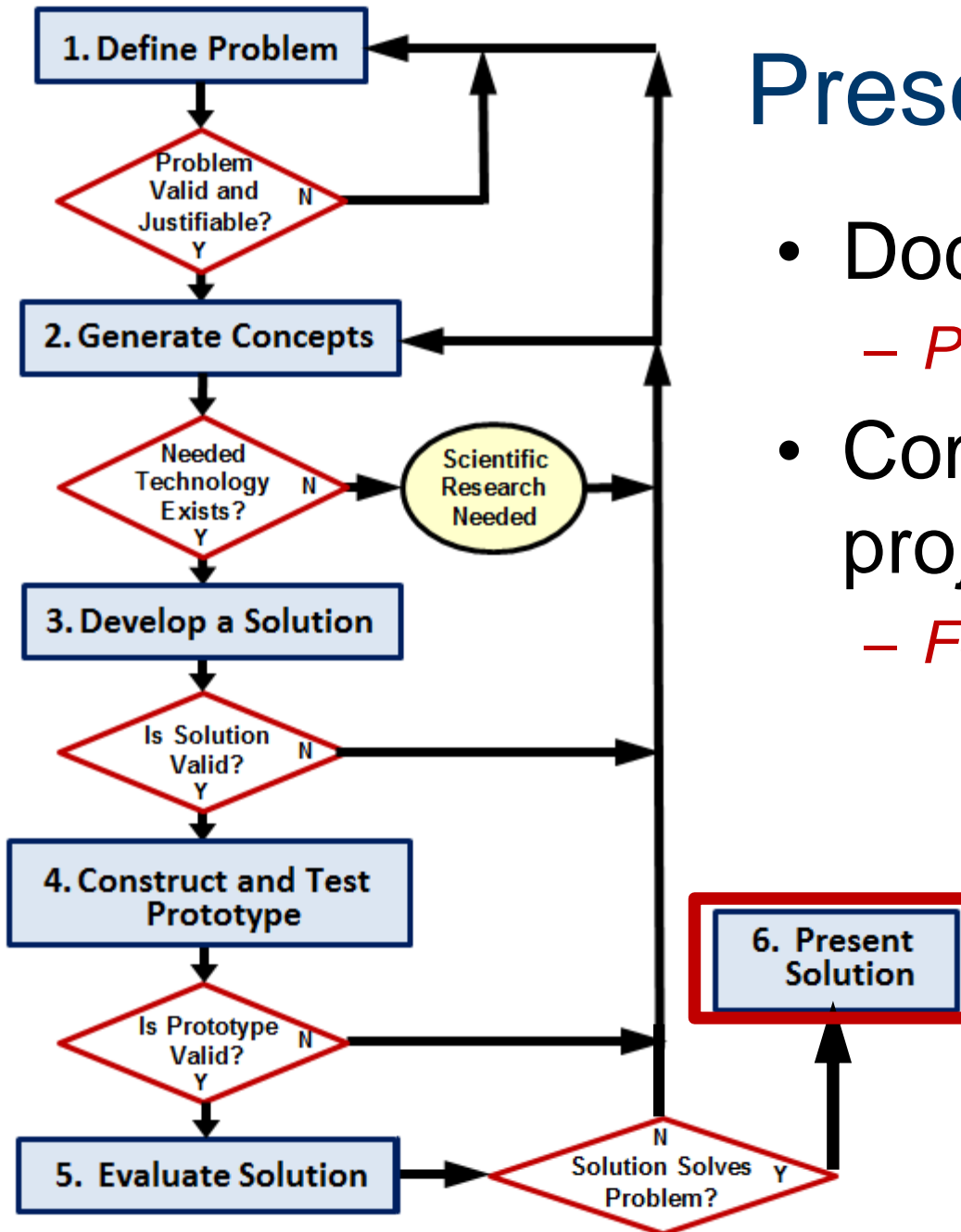


Does the solution solve the problem?

If not, the designer must return to a previous step of the design process.

# Present the Solution

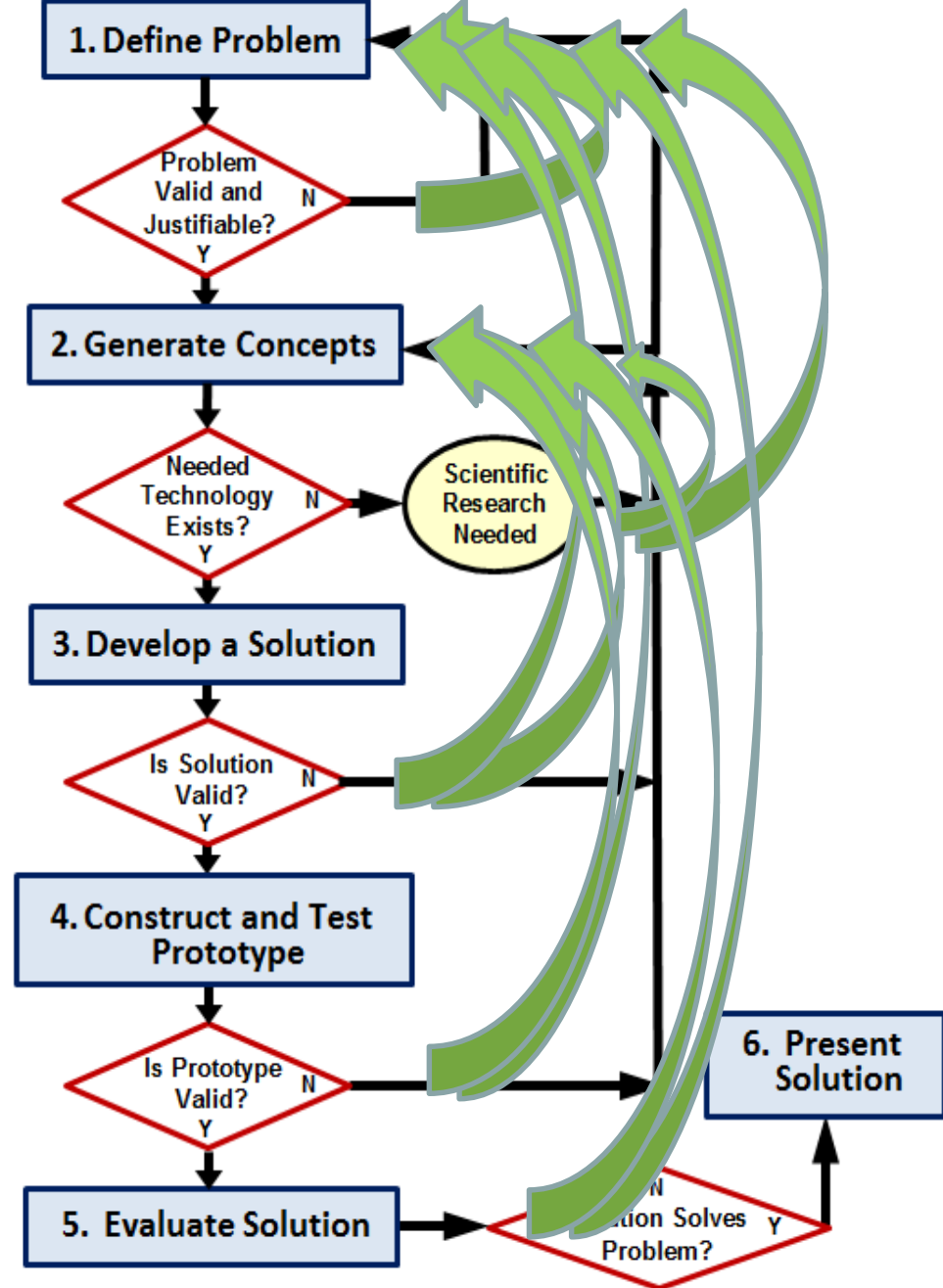
- Document the project
  - *Project Portfolio*
- Communicate the project
  - *Formal Presentation*



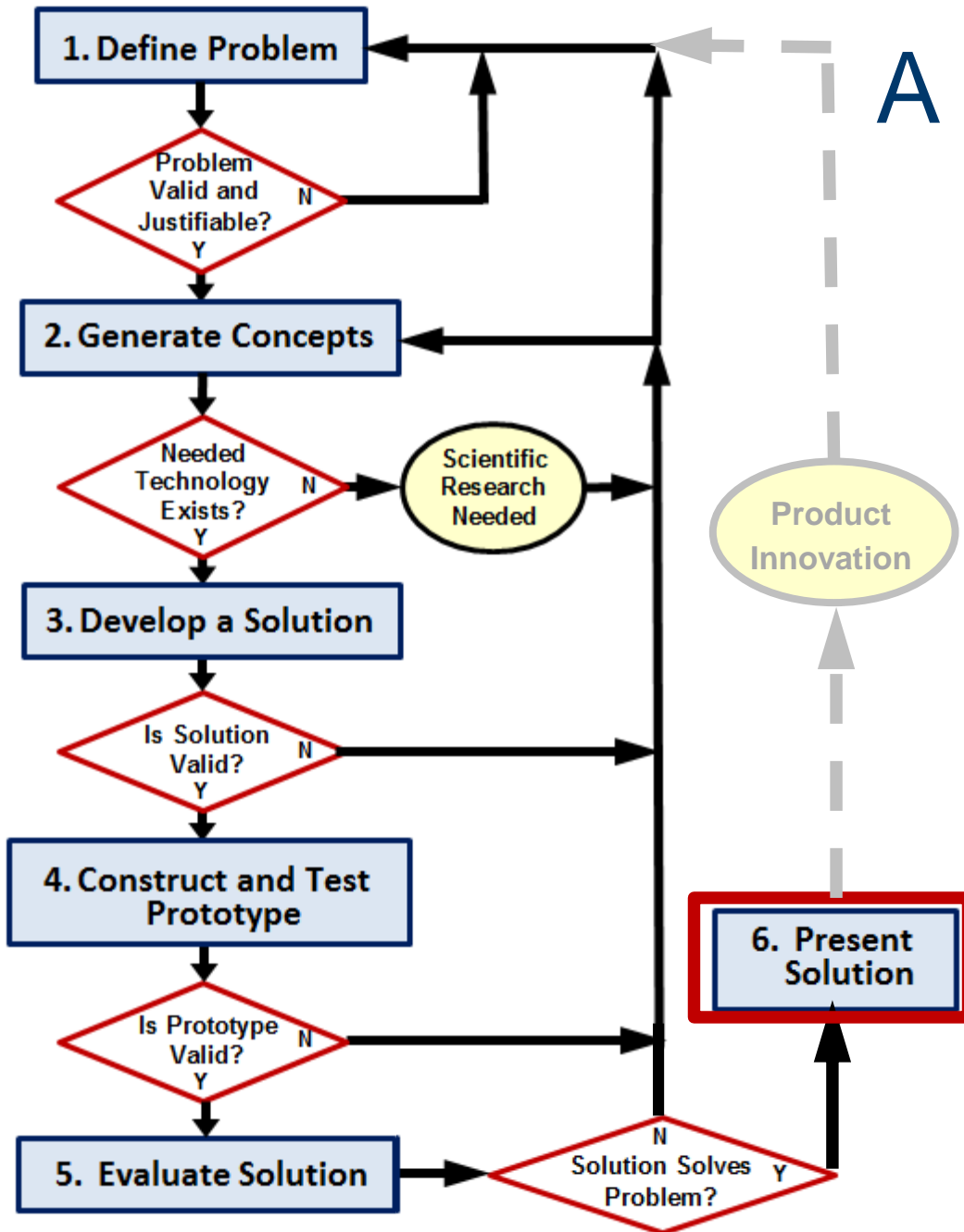
# Design Process

- Iterative

- a process that repeats a series of steps over and over until the desired outcome is obtained



# A Design Process



Product improvement or redesign will require the designer to repeat the design process.

# Image Resources

National Aeronautics and Space Administration (NASA). (n.d.).  
*NASA image exchange*. Retrieved from <http://nix.nasa.gov/>.