BE-102

Design & Engineering

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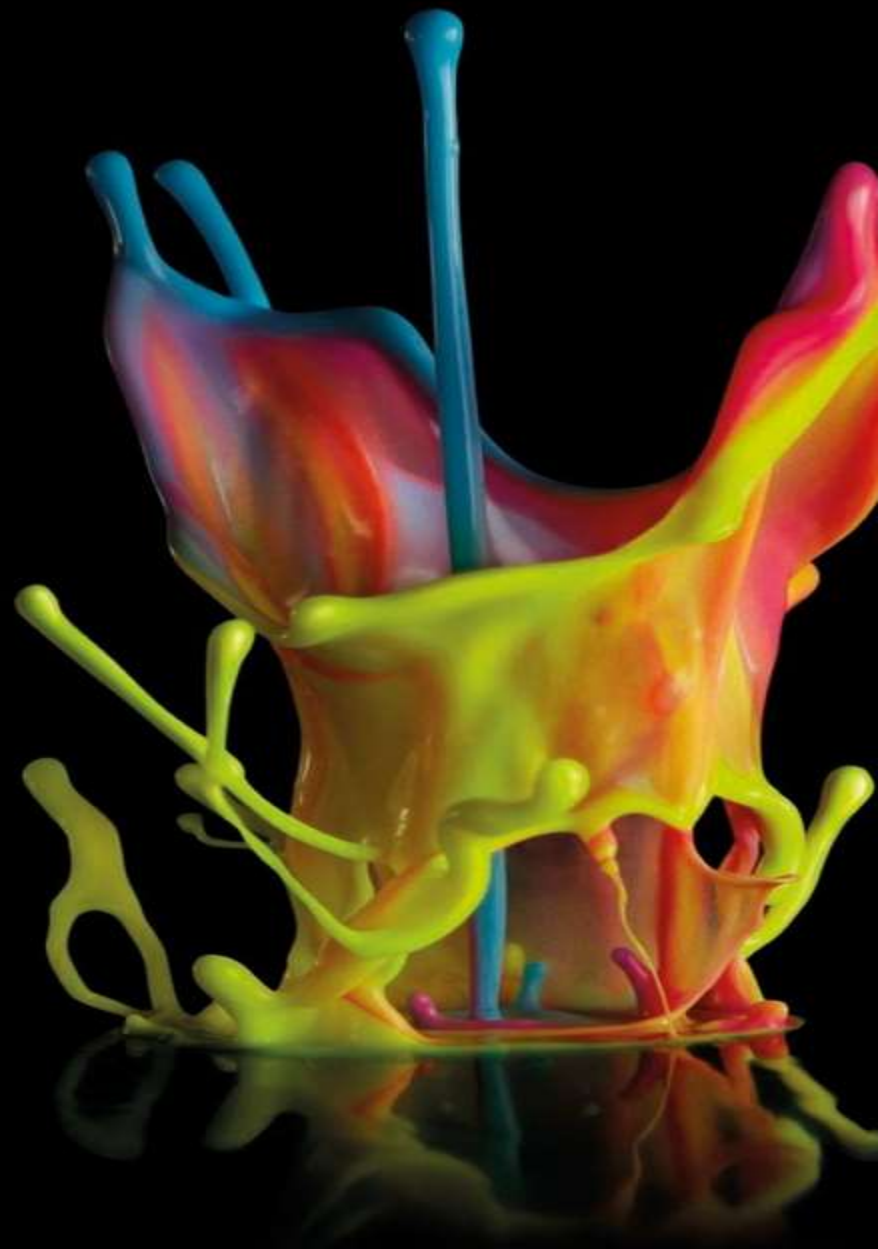
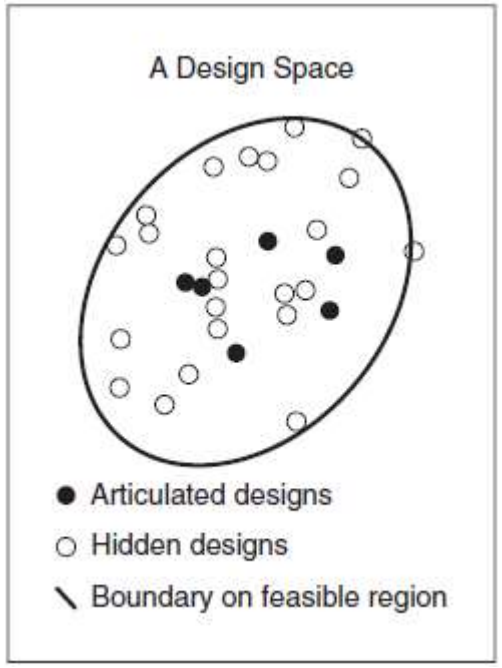


Design Space

The set of all possible designs is an n-dimensional hyperspace called a design space

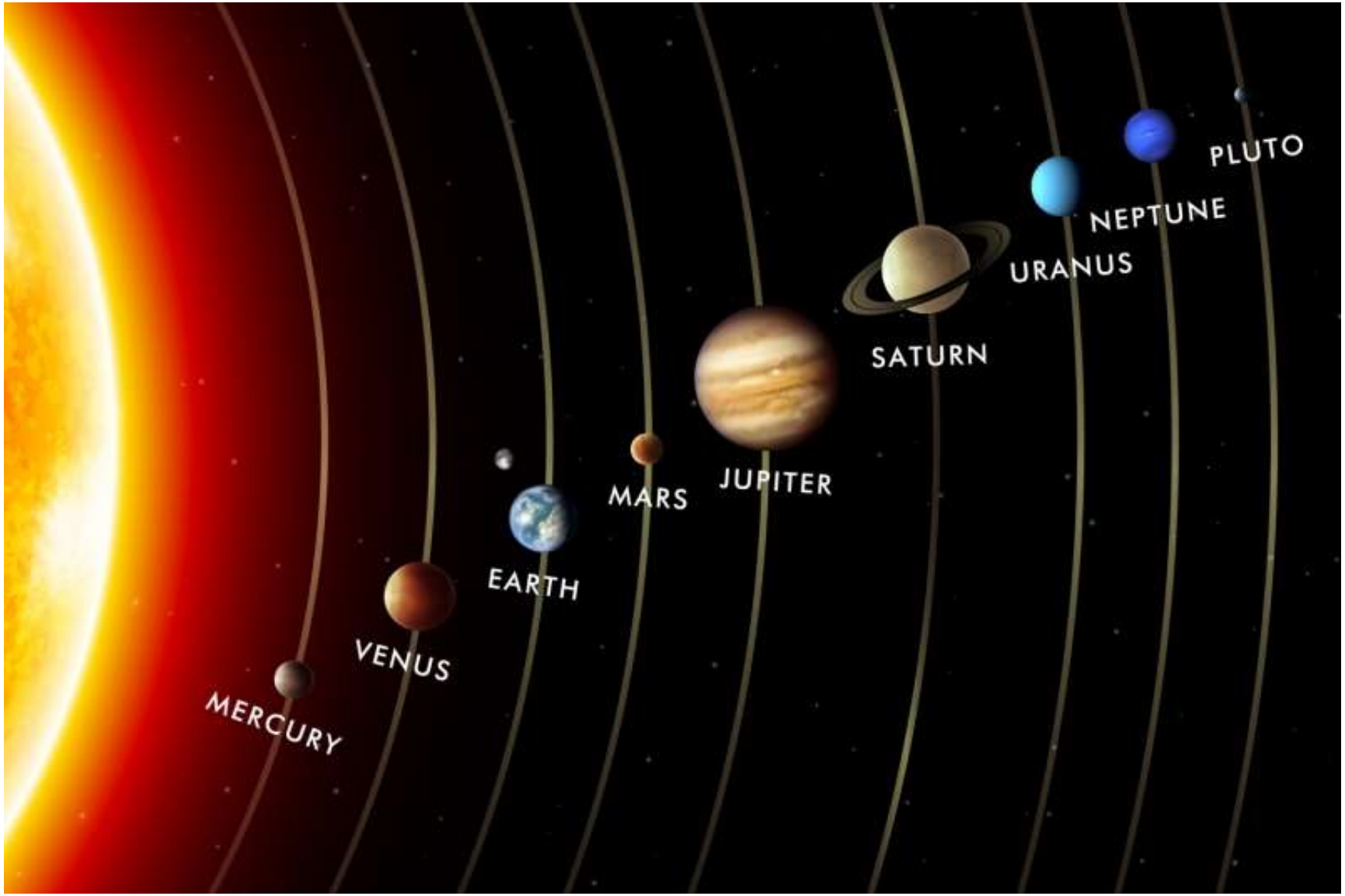
Where, n= The number of different engineering characteristics it takes to fully describe the design



feasible designs created in response to the articulation of a design task is pictured as a problem space or a design space that consists of states as shown in Fig.

- Each state is a different conceptual design. The space has a boundary that encloses only the feasible designs, many of which are unknown to the designer
- The space is more than three dimensions because there are so many characteristics that can categorize a design (e.g., cost, performance, weight, size, etc.)

Design Space Analogy



A stationary solar system is a useful analogy for a design space

A stationary solar system is a useful analogy for a design space.

- ✓ Each planet or star in the system is different from the others.
- ✓ Each known body in the space is a potential solution to the design task.
- ✓ There are also a number of undiscovered planets and stars.
- ✓ These represent designs that no one has articulated.
- ✓ The vastness of outer space is also a good analogy for a design space.

There are many, many, many, different solutions for any design problem. The number of potential solutions can be as high as the order of n where n is equal to the number of different engineering characteristics it takes to fully describe the design.

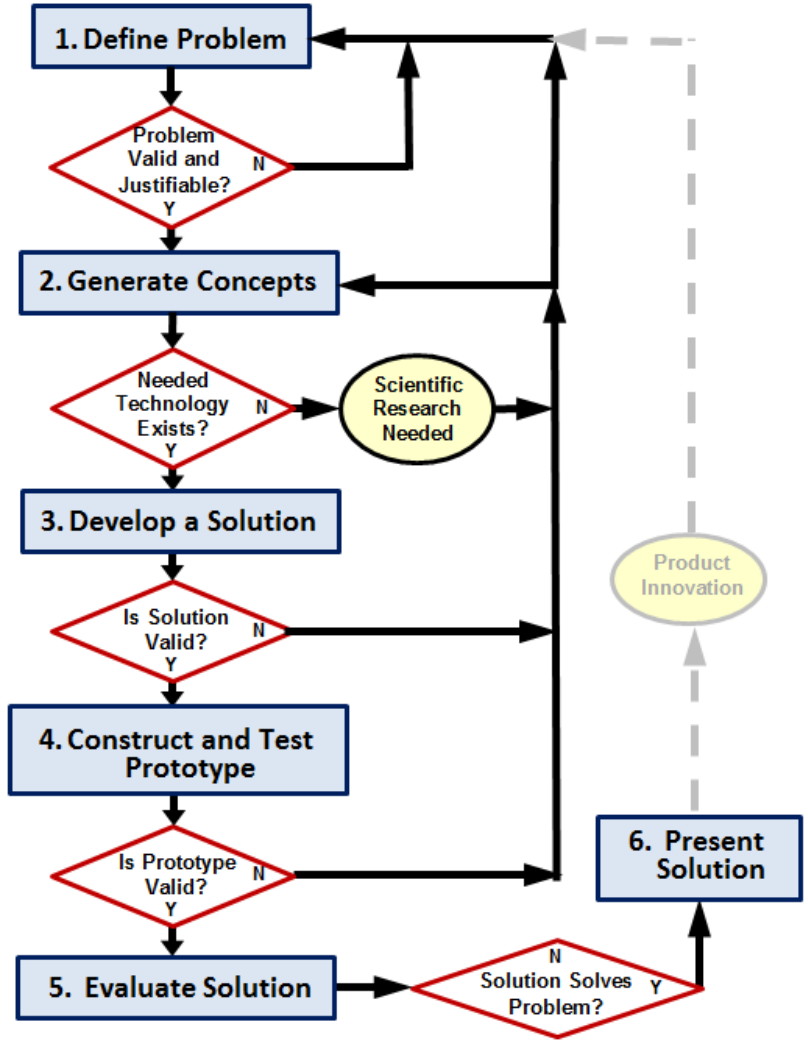
Design Process

Designs did not miraculously appear but originated in the minds of human beings and took time to develop.
Engineering is the creative process of turning abstract ideas into physical representations (products or systems).

‘There are scientific methods that everyone can adopt to develop optimised DESIGNS’

Design Process

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



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*

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.*

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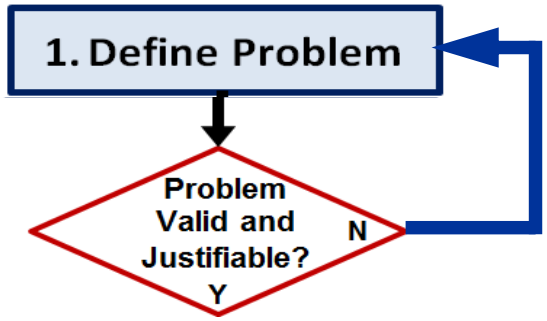
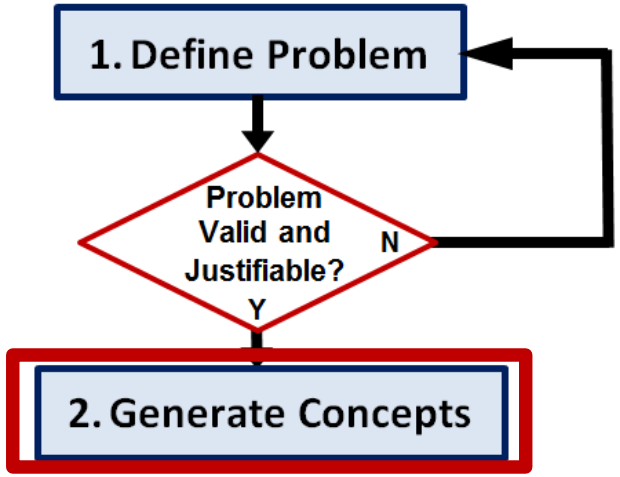


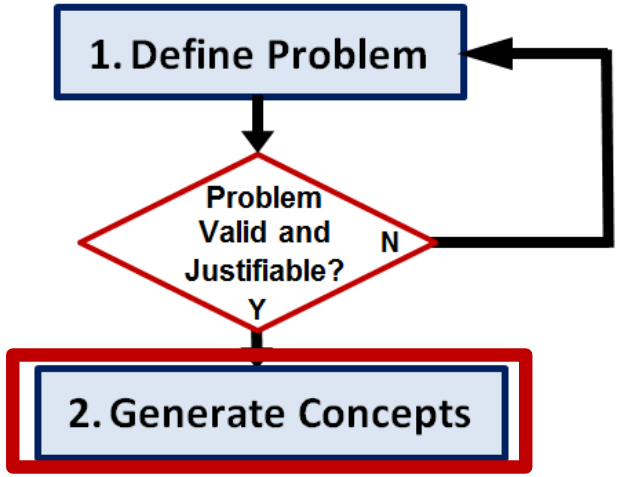
In some cases, if the problem is not valid or justifiable, the designer must define a new problem.

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

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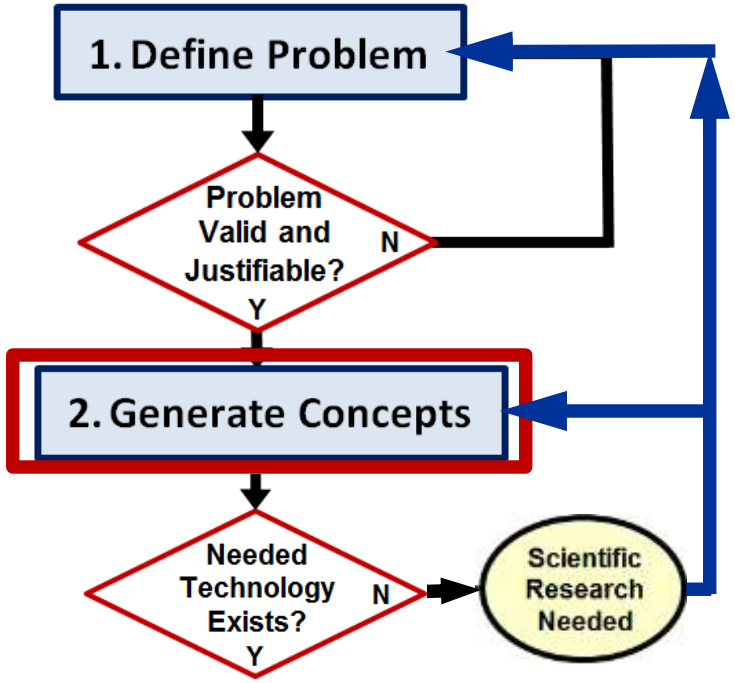
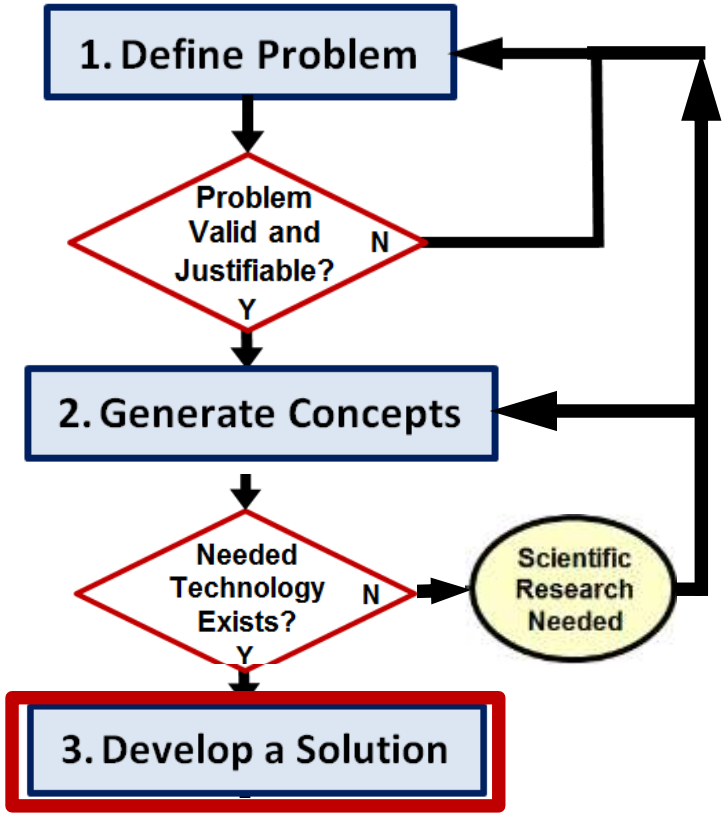
- Brainstorm possible solutions
- Consider additional design goals
- Apply STEM principles
- Select an approach
- *Decision Matrix*



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

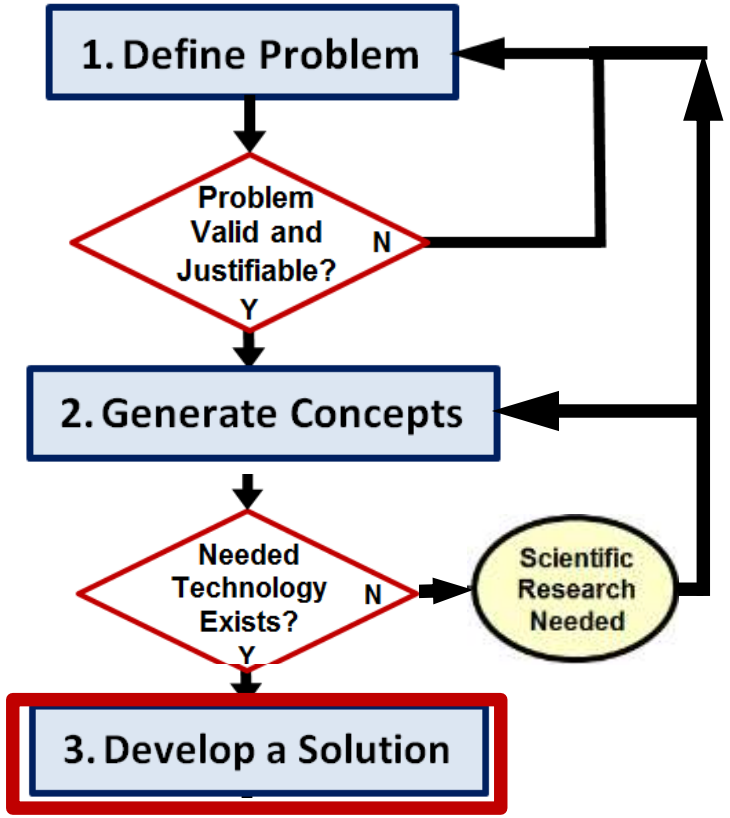
Develop a Solution

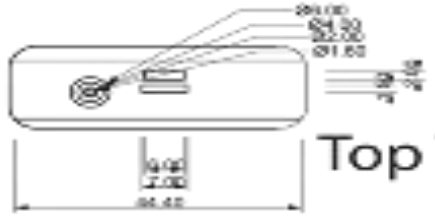
- Create detailed design solution
- Justify the solution path
- *Technical Drawings*



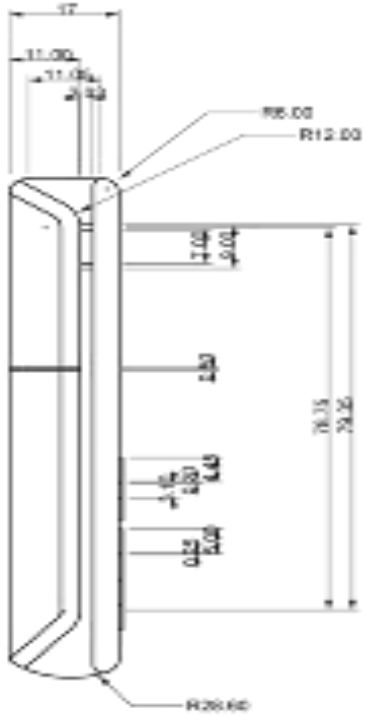
Develop a Solution

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

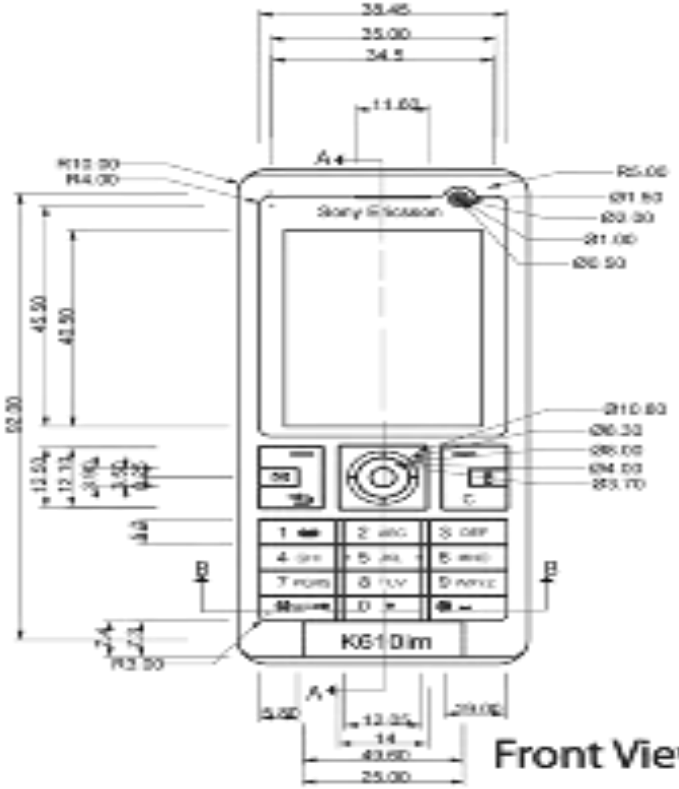




Top View

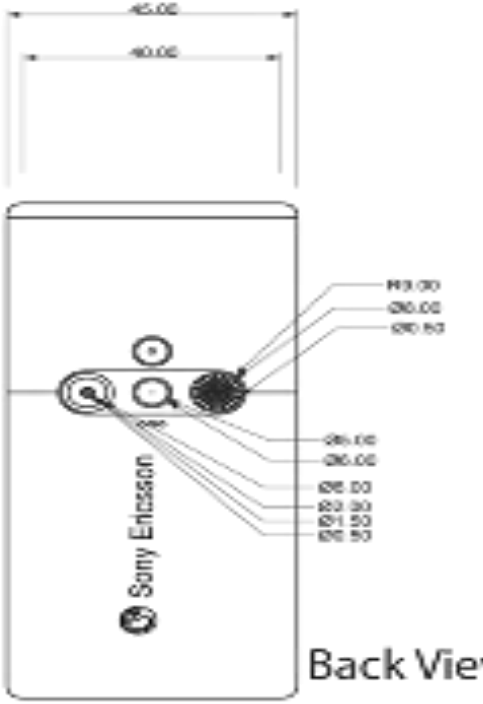


Left View

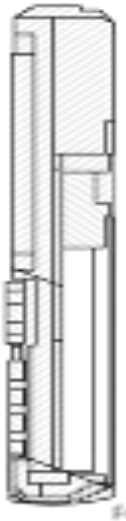


Front View

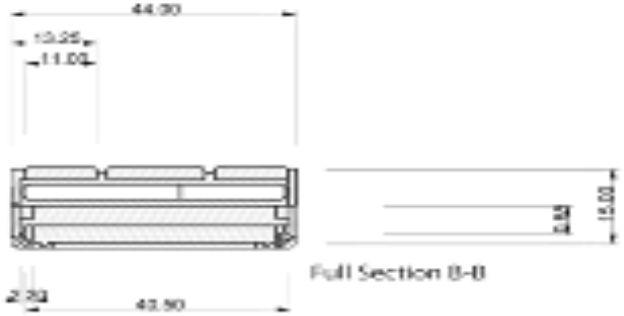
Right View



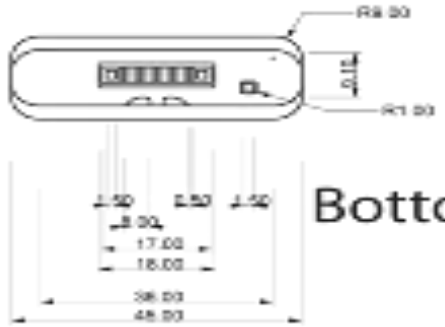
Back View



Full Section A-A

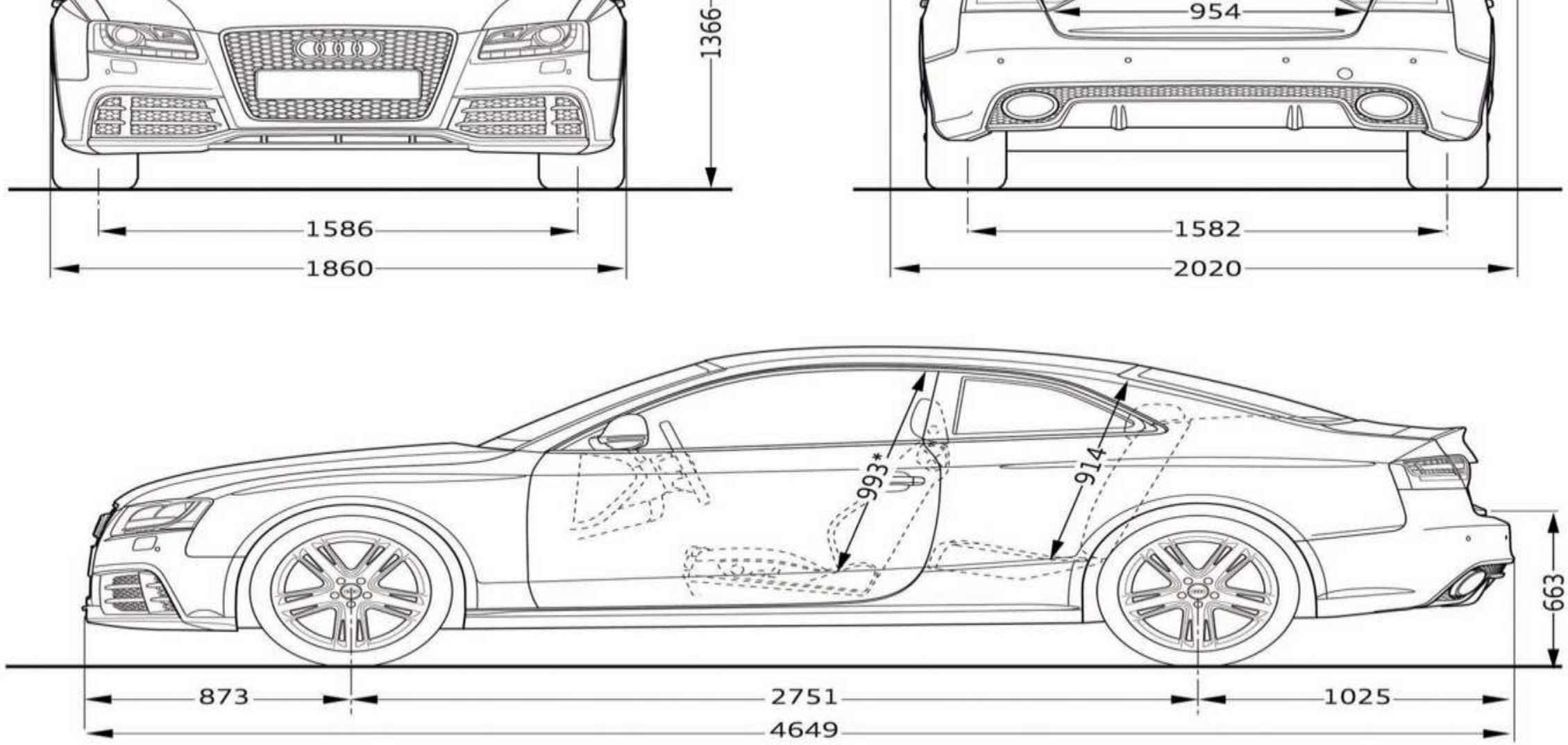


Full Section B-B



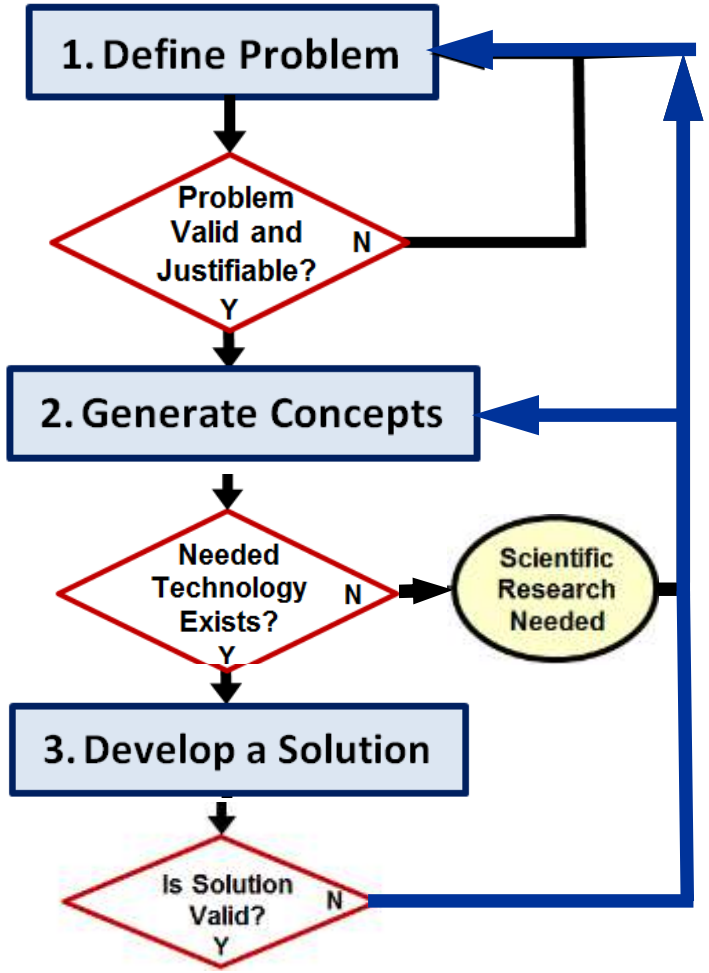
Bottom View

PRODUCT & INDUSTRIAL DESIGN	
DIGITAL DRAFTING	
DR:KOH JIA ROU JASLYN	DATE: 23/05/
CHK:	SCALE: 2:1
DWG NO: ENG DWG - 02	



Develop a Solution

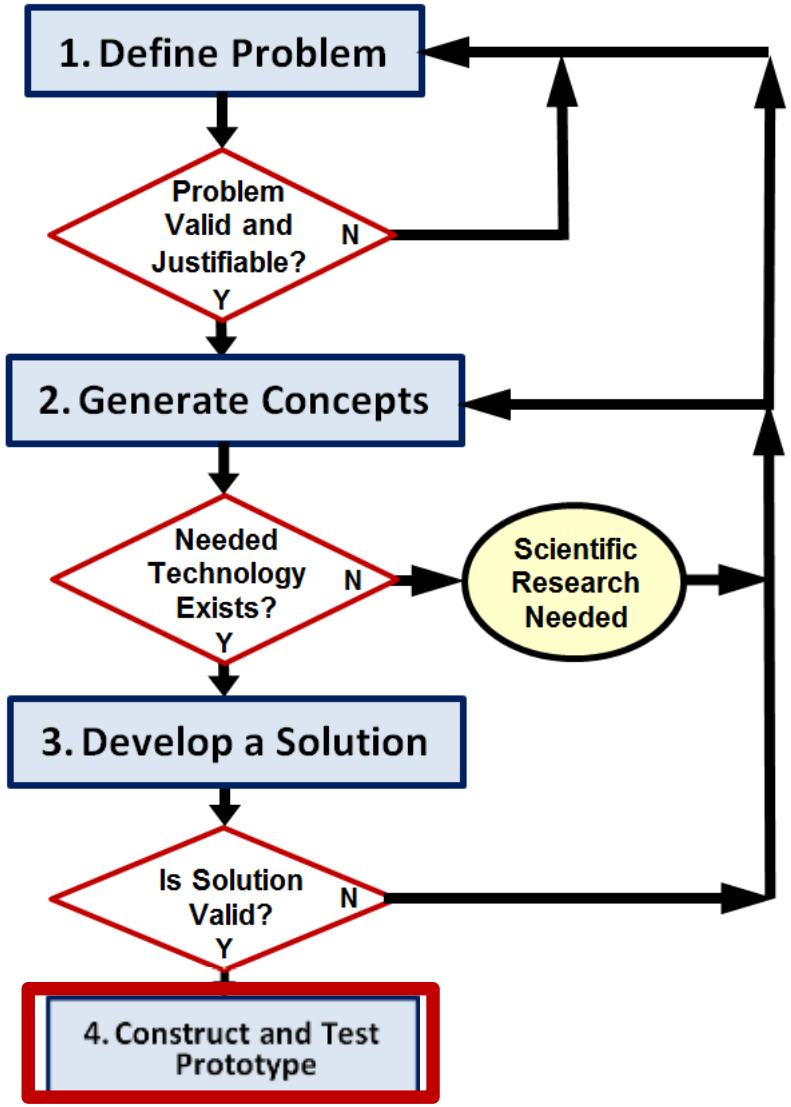
- Select an approach
  - *Decision Matrix*
- Create detailed design solution
  - *Technical Drawings*
- Justify the solution path

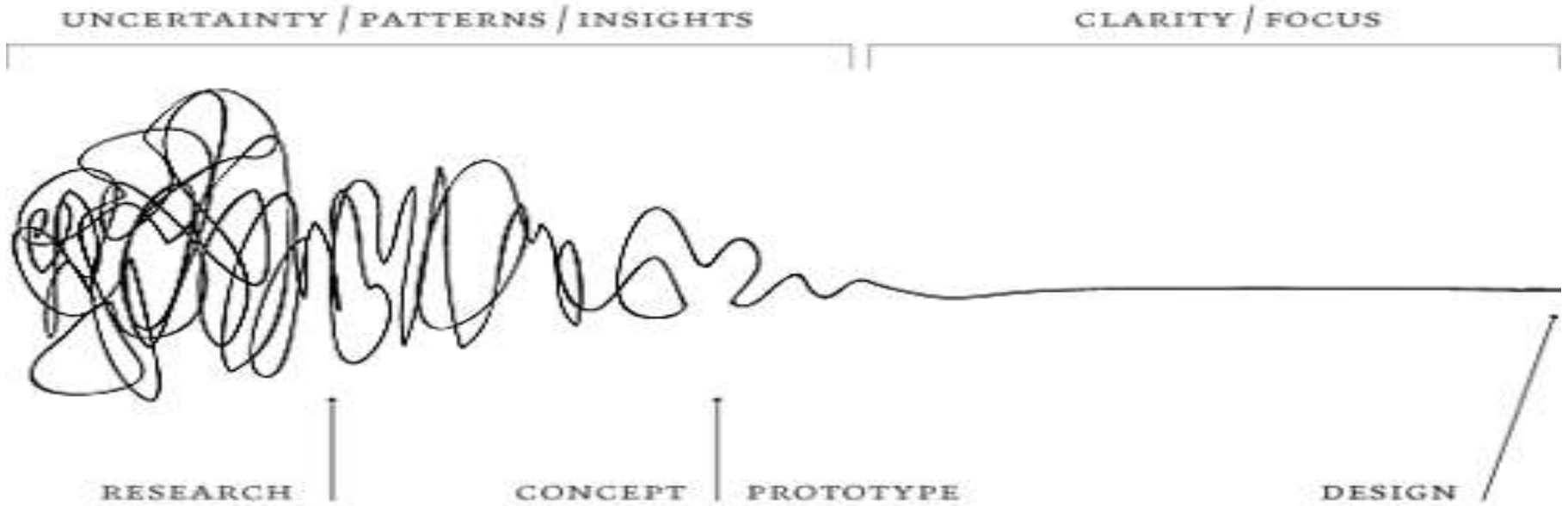


If a solution is found to be invalid or cannot be justified, the designer must return to a previous step in the design process.

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*





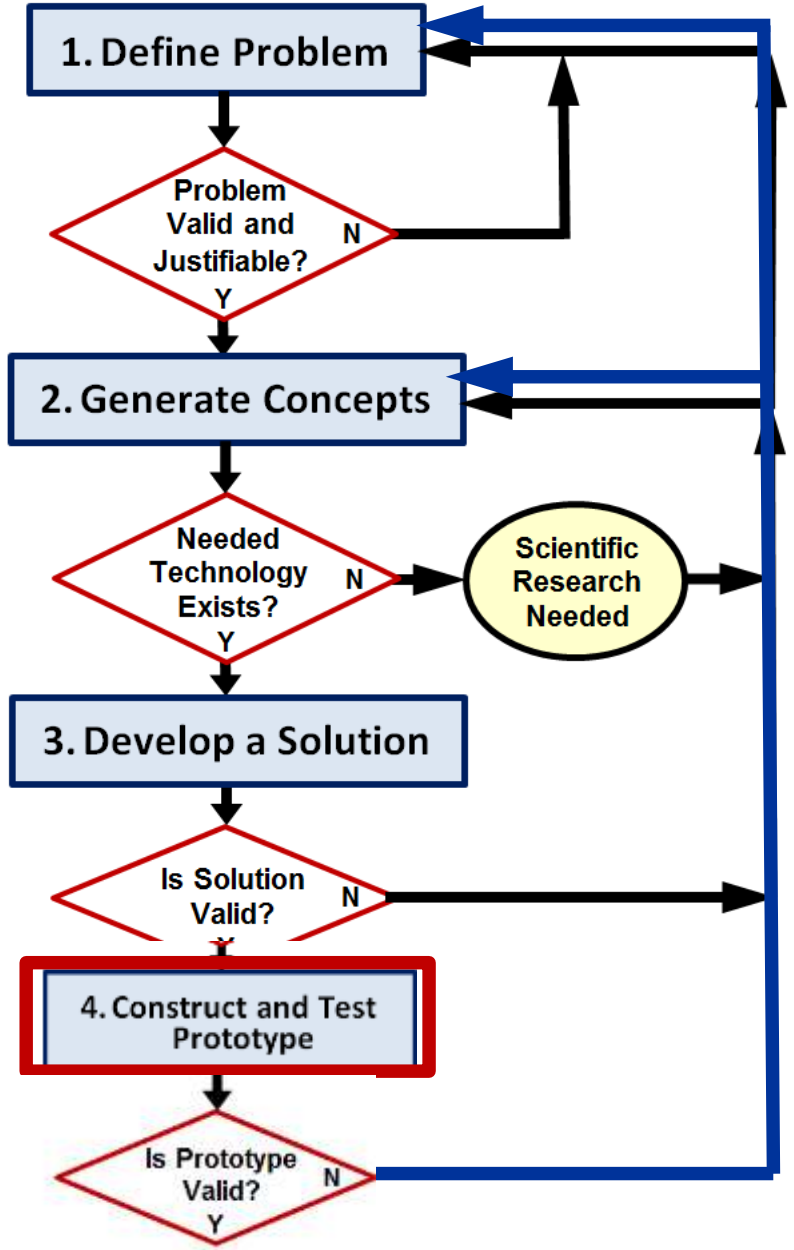
Prototyping: The first stage of testing and implementation of a new product, called prototyping, consists of building a prototype of the product-the first fully operational production of the complete design solution. A prototype is not fully tested and may not work or operate as intended. The purpose of the prototype is to test the design solution under real conditions.

Aircraft wind tunnel test

Construct and Test a Prototype

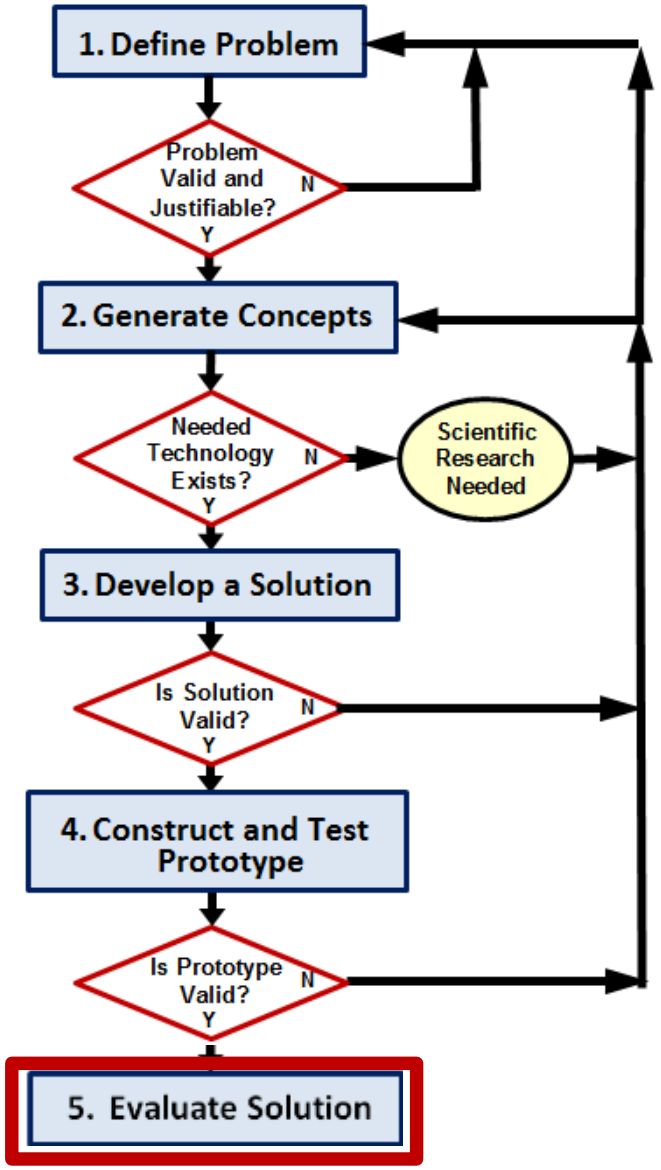
- Construct a testable prototype
- Plan prototype testing
  - *Performance*
  - *Usability*
- T
- T

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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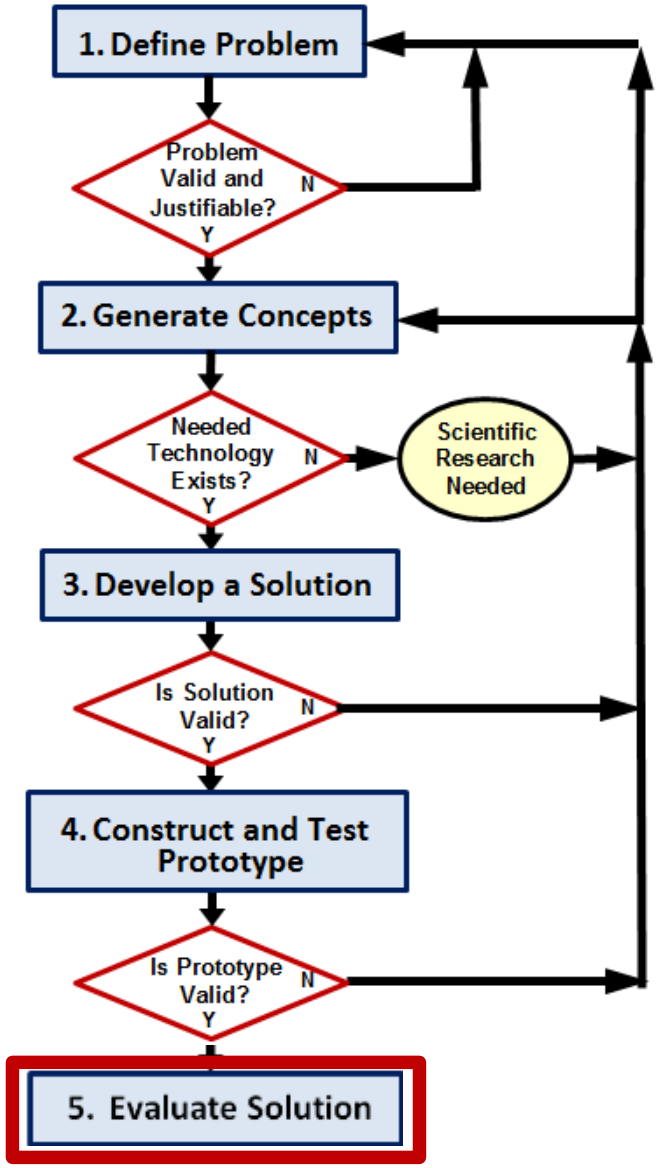

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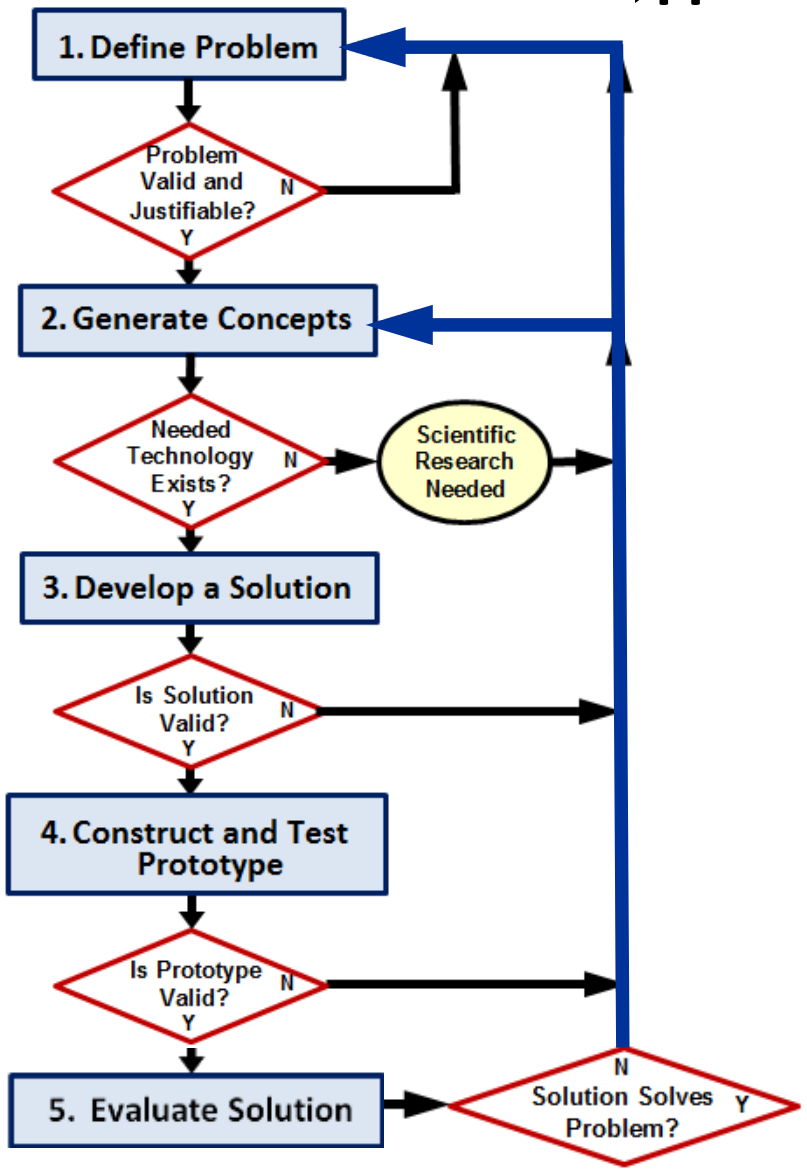
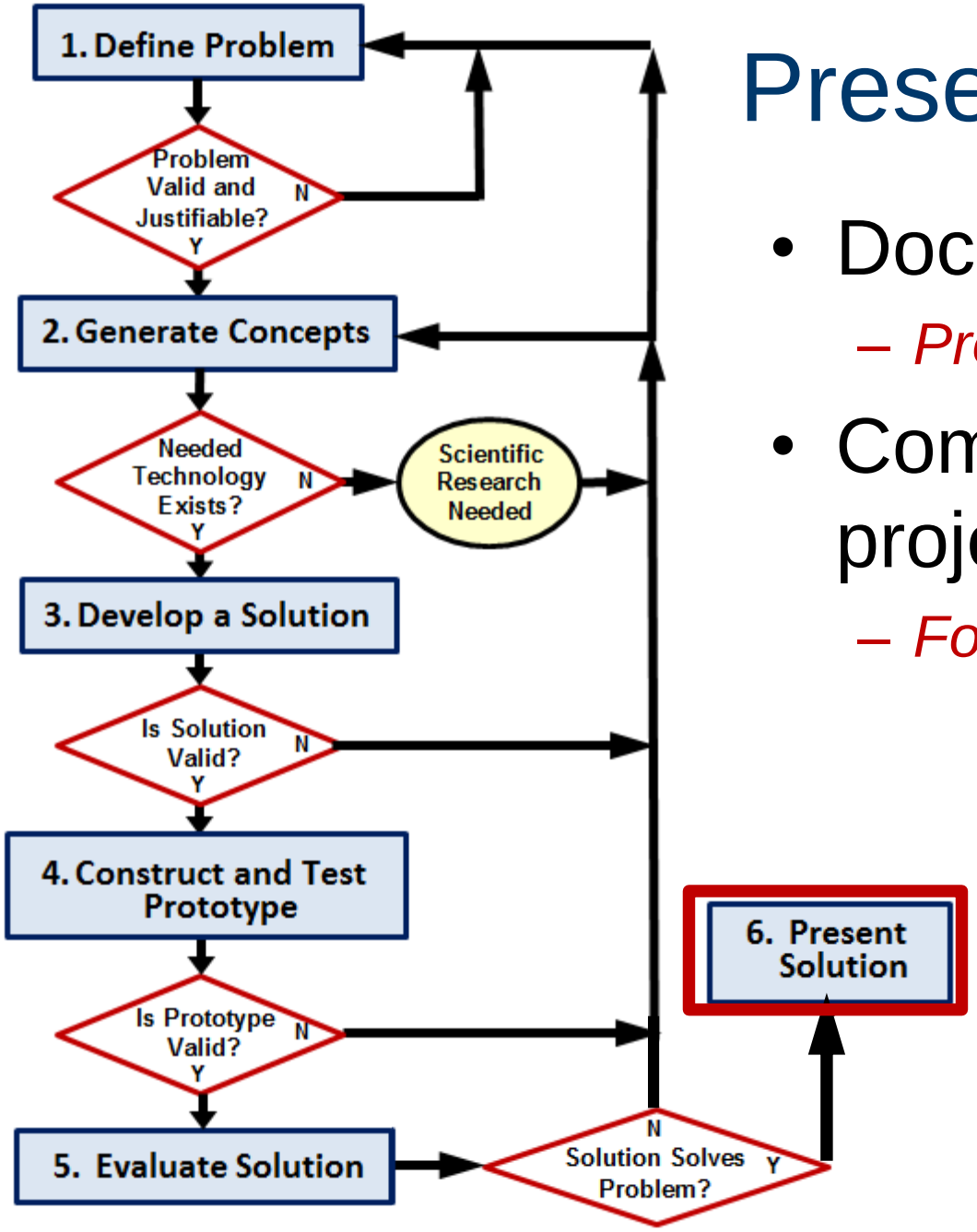


Does the solution solve the problem?

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

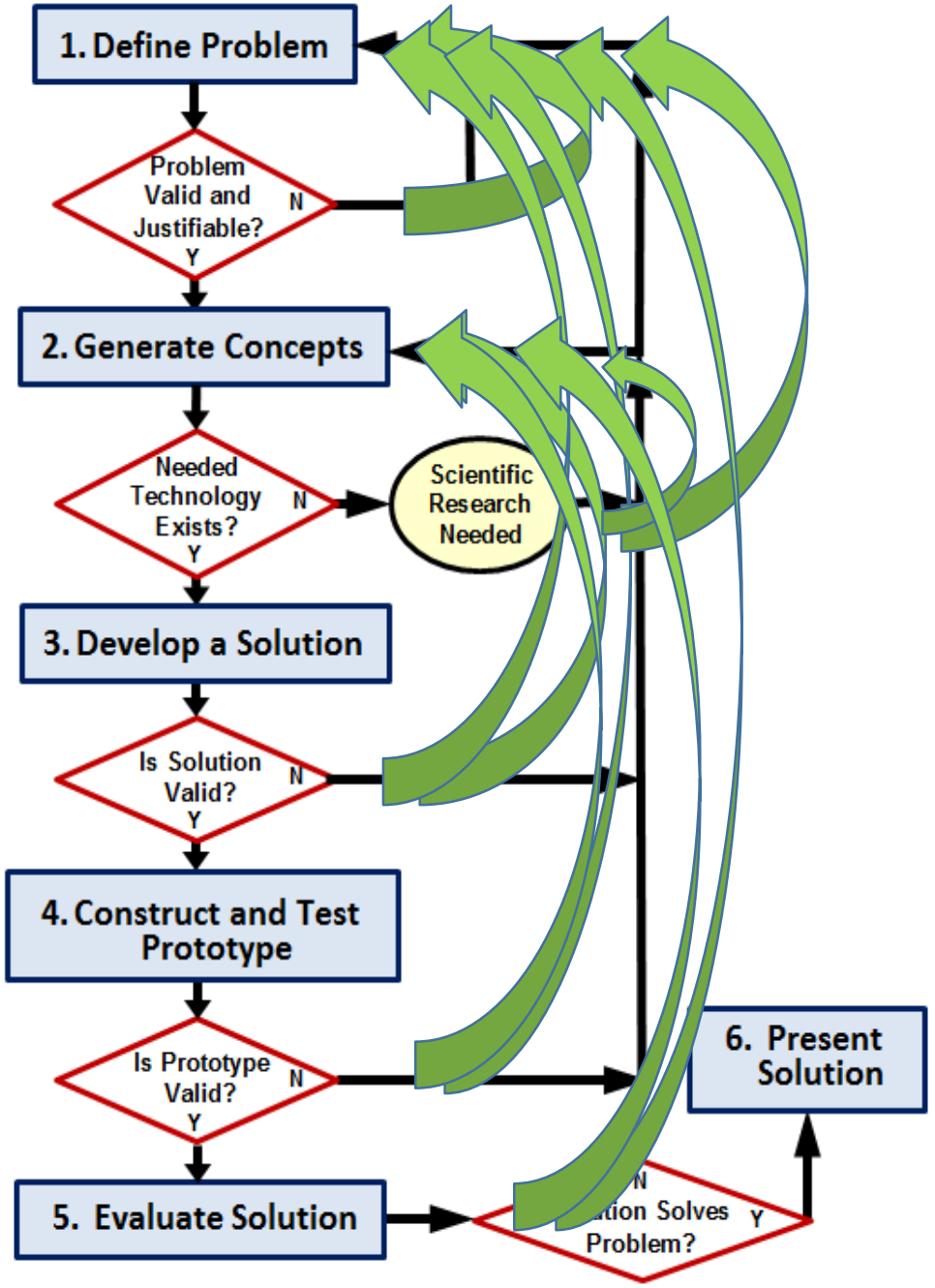


Present the Solution

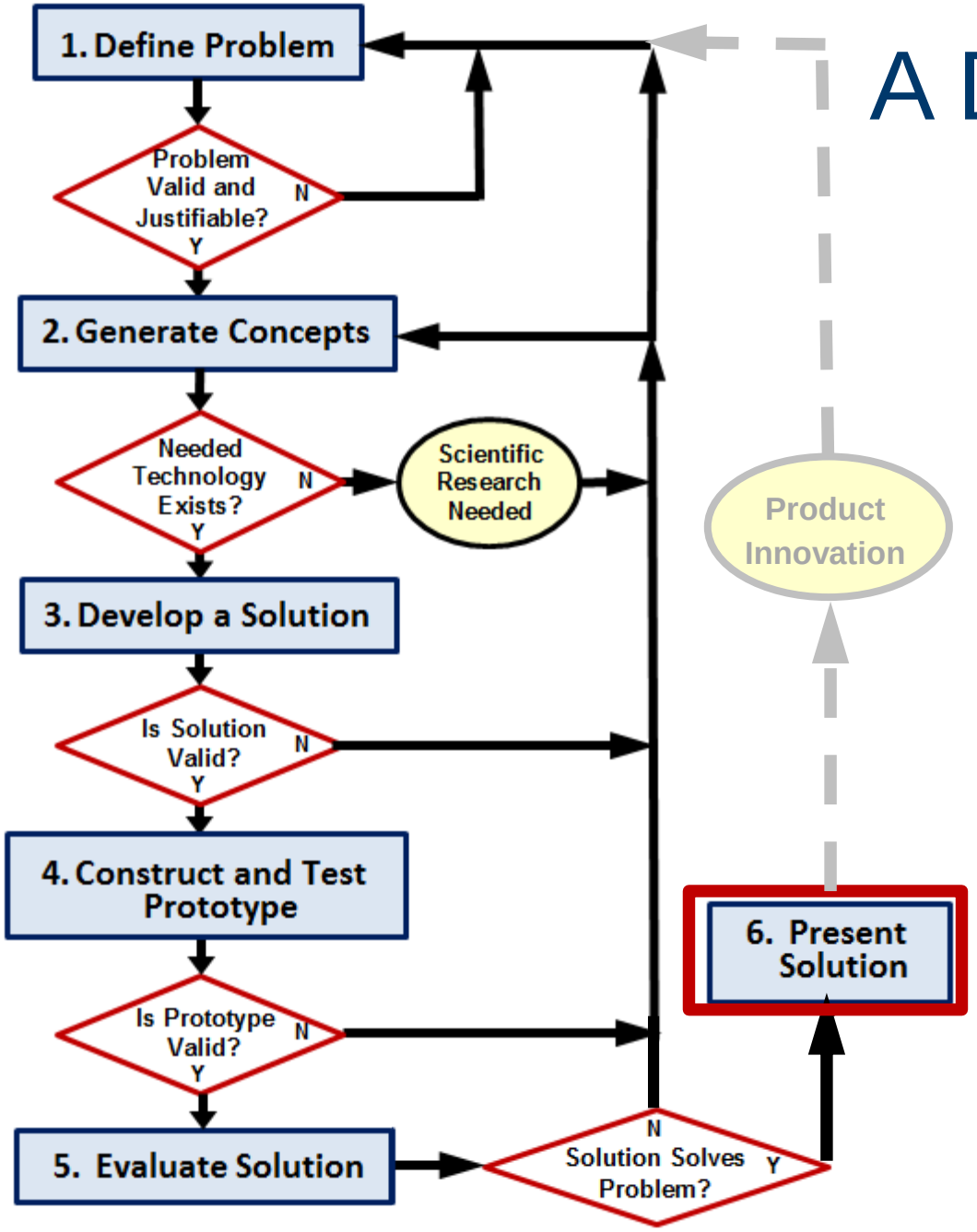
- Document the project
  - *Project Portfolio*
- Communicate the project
  - *Formal Presentation*

Design Process

- Iterative

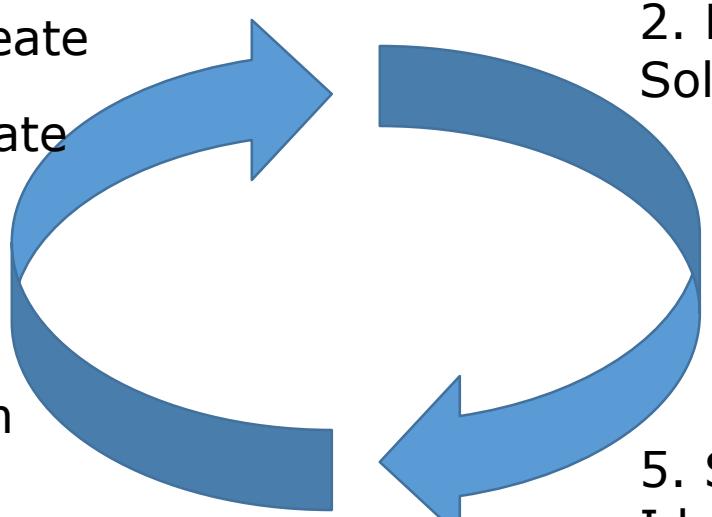


A Design Process



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

Detailed Design Process



12. Communicate Results

1. Define a Problem

11. Refine/Create

2. Brainstorm Possible Solutions

10. Test & Evaluate

3. Generate ideas

9. Prototype

4. Research Ideas & Explore Possibilities

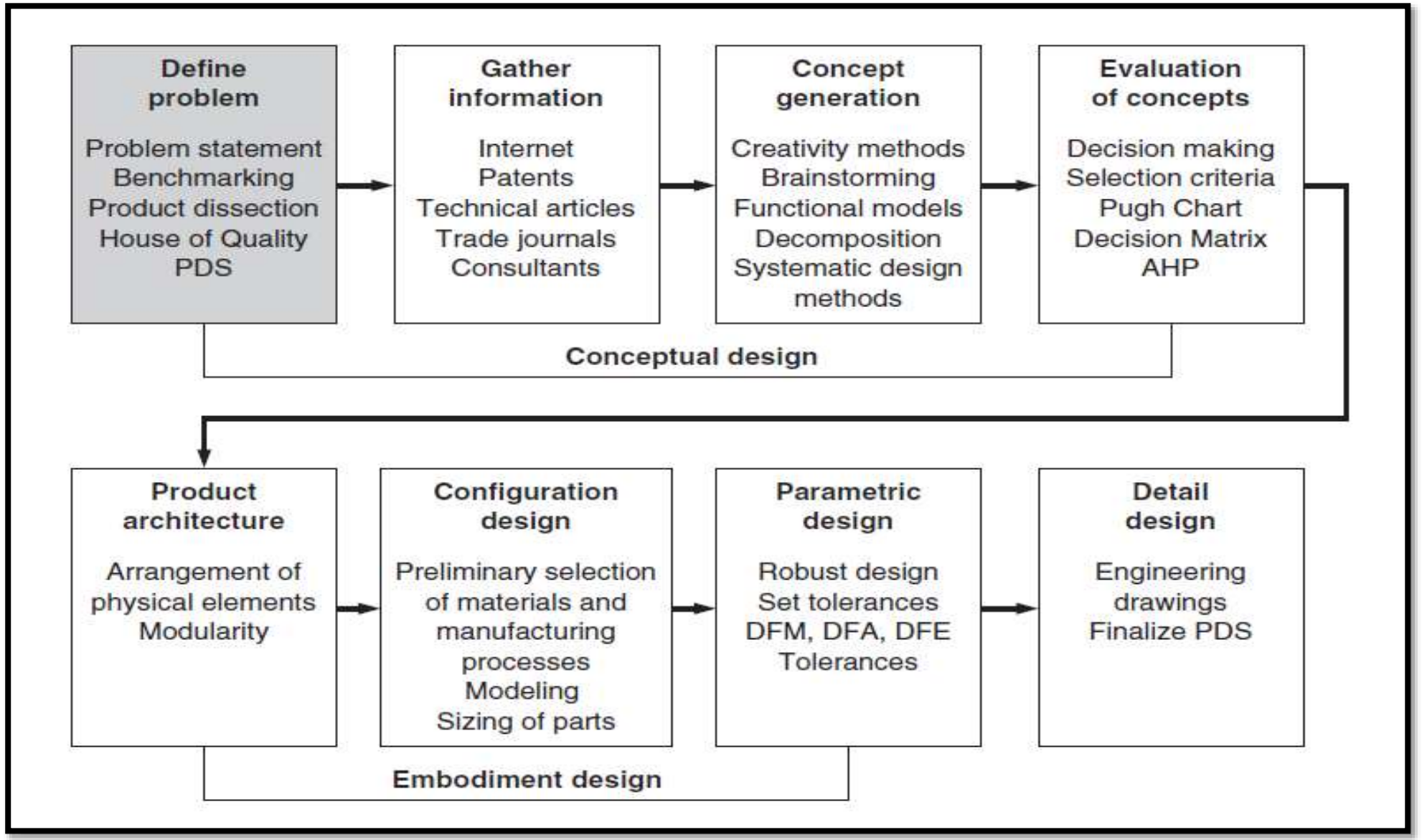
8. Develop Written Design Proposal

5. Specify Criteria & Identify Constraints

7. Select an Approach

6. Consider Alternative Solutions

Product Development Process



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