



GE106

Introduction to Engineering Design

College of Engineering

King Saud University

Lecture 2. *An Overview of Engineering Design*

FALL 2022

Importance of Engineering Design

- **70%** of a product's total cost (design, manufacturing and installation) is determined by its design
- Studies have shown that **50 to 80%** of the life cycle costs* of products (maintenance, energy, etc.) are influenced by engineering design
- **Costs Include:**
 - Material costs
 - Facilities
 - Tooling
 - Labor
 - Other support costs



What is Engineering Design?

- Engineering design is the **process** of devising a system, component or process to meet desired needs.
- In this process, basic sciences and engineering are applied to optimally convert resources to meet a stated objective.



- Among the fundamental blocks of this process are: objectives, criteria, synthesis, analysis, construction, testing, and evaluation.
- In addition to these blocks It is essential to consider realistic constraints such as economic factors, safety, reliability, aesthetics, ethics and social factors.

An ABET Requirement (Accreditation Board for Engineering and Technology)

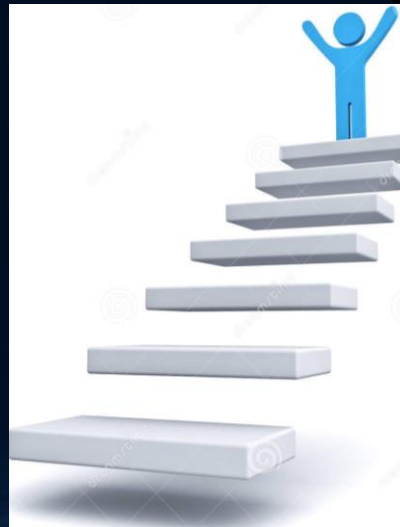
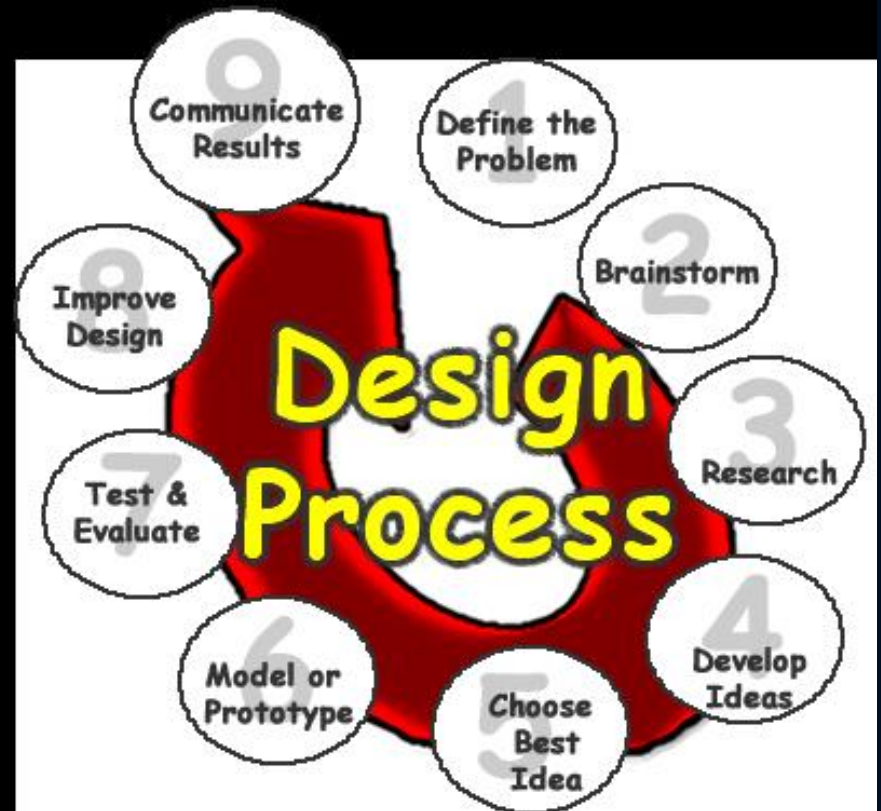
- Every Engineering Department* must include a major engineering design experience that builds upon the fundamental concepts of: **mathematics, basic sciences, humanities, social sciences, engineering topics, and communication skills**



- The scope of the design experience within a program should match the requirements of practice within that discipline
- All design work should not be done in isolation by individual students; team efforts are encouraged where appropriate

The Design Process Steps

1. Define the Problem
2. Brainstorm for creative ideas
3. Search and *research*
4. Develop Ideas
5. Analyze alternative solutions and choose the best one



6. Model or prototype
7. Test and Evaluate
8. Improve if needed
9. Communicate results

Problem Statement

- This is the single most important step in the design process
- Only when you can specify the problem can you hope to achieve your goal
- Loss of efforts and efficiency occurs when trying to solve unclear problems
- If this step is done incorrectly or incompletely it results in a failure of the design
- It is important to define the *true problem* one is solving, not just the symptoms of the problem or the perceived problem



Objectives

- Objectives are a function of needs
- Objectives should be **SMART**
 - Specific
 - Measurable
 - Achievable
 - Realistic
 - Time-bounded

Step 1: Problem Statement

Problem Statement:

“The current box is easily damaged during transportation”

Objective

“Design a stronger box for our new product”

Another Objective

“Design an improved box*”

Importance of Accurate Objective and Statement **



Problem
Definition



Design



Installation



Customer
Need

Step 2: Brainstorming

- Think “outside the box”
- Generate creative ideas
- Explore other members’ ideas
- Avoid criticism/judgment

(do not criticize during brainstorming!
Criticism will be applied at a later stage)



Step 3: Search and Research

- **Search:** for finding a product or checking the price of an item
- **Research*:** finding the answers to more complicated questions or looking at multiple aspects of an issue
- **Possible resources:** Publications, Internet, Market, Patent listings, Sales catalogs, Experts



Step 4: List and Evaluate Alternative Solutions



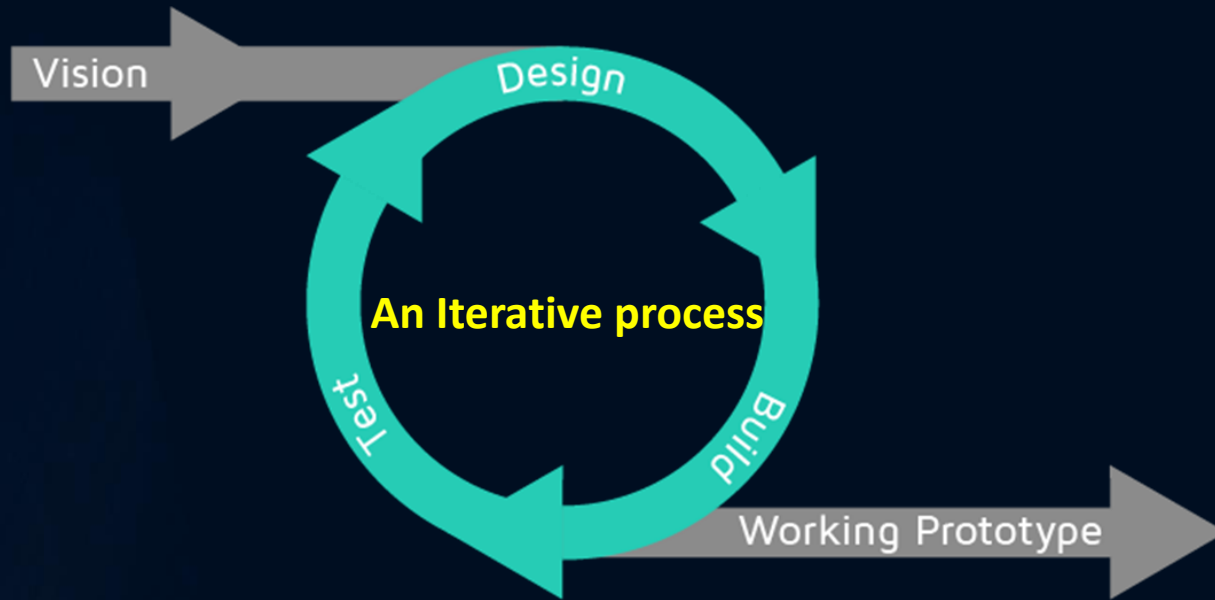
One possible solution!!

- Be critical
- Edison: "It is easy to obtain 100 patents if you also have 5000 unsuccessful inventions*"

Step 5: Choose the Best Solution

	Weight	Rate for Design 1	Rate for Design 2	Rate for Design 3
1. Cost				
2. Production difficulty				
3. Size, weight, strength				
4. Appearance				
5. Convenience				
6. Safety				
7. Legal issues				
8. Reliability/durability				
9. Customer appeal				
TOTAL points	100	points=rate*weight		

Step 6: Construction, Analysis and Testing



Step 7: Final Evaluation

Develop the best design



Step 8: Communication

Communicate and report on all the final details of the design through:

- Engineering Notebook (logbook)
- Written reports
- Technical presentation
- Training material, catalogue, manuals*

