



GE105

Introduction to Engineering Design

College of Engineering

King Saud University

Lecture 2.

An Overview of Engineering Design

FALL 2016

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)

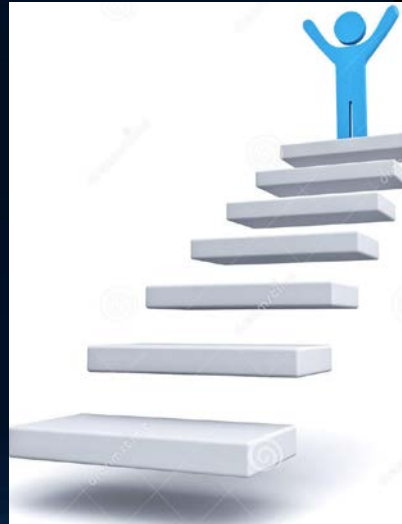
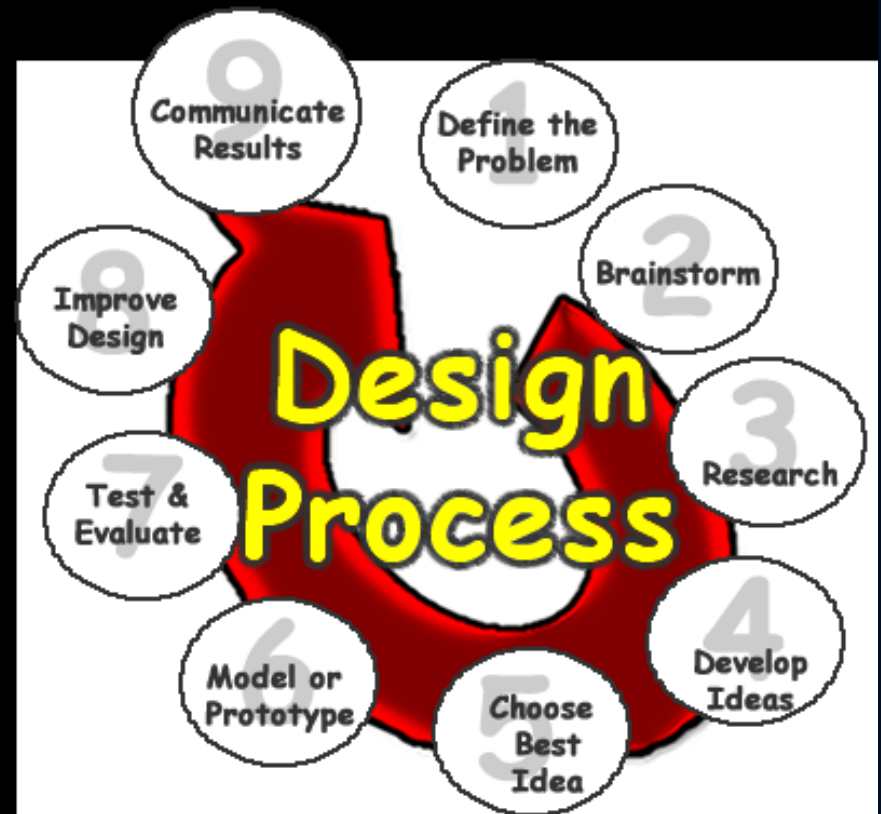
- Every Engineering Department* must include a major engineering design experience that builds upon the fundamental concepts of: **mathematics, basic sciences, humanities, social sciences, engineering topics, and communication skills**



- 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*”

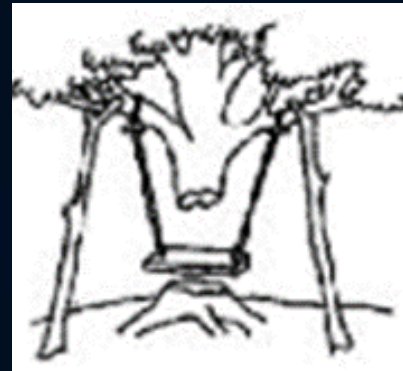
Importance of Accurate Objective and Statement **



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



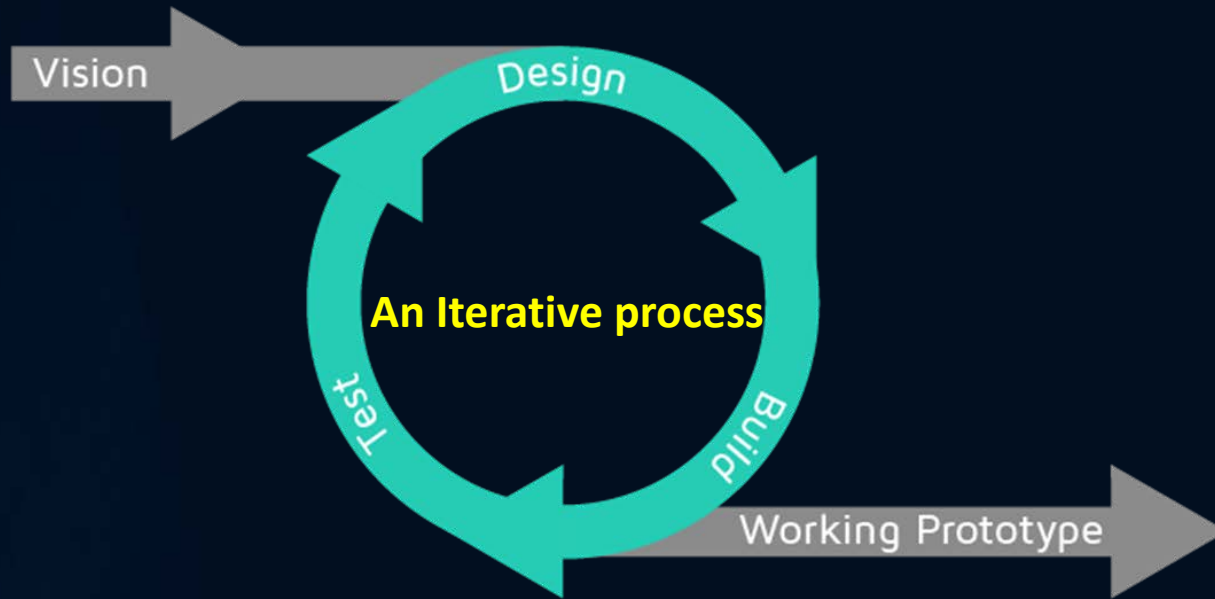
One possible solution!!

- 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*

