



GE106

Introduction to Engineering Design

College of Engineering

King Saud University

## Lecture 7.

# *Problem Formulation Case Studies*

FALL 2022

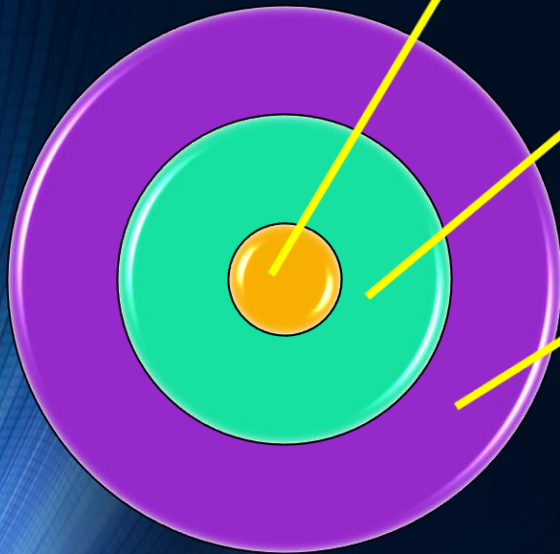
# Remember!

Before solving a problem, answer:

**Why**  
(very few know this)

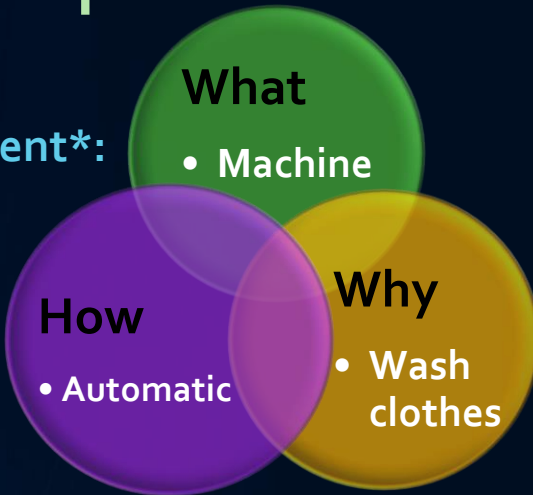
**How**  
(some know this)

**What**  
(everyone knows this)



# Example 1:

Statement\*:



Needs:

- Device to wash clothes
- Can be easily operated
- Can be started by operating the timer manually
- Variation of rotating speed for different types of clothes

- Dry clothes
- Capacity up to 5 kg
- Can use voltage 110 V / 220 V
- Low power consumption/wattage less than 100 Watts
- Portable washing machine
- Noise level must not exceed 65 dB
- Must be safe
- Filter for the water
- Water inlet and outlet
- Cost must not exceed 500 SR
- Weight must be less than 100 N

## Constraints

- Capacity: up to 5 kg
- Noise level less than 65 dB
- Size: 1 m x 0.9 m x 0.5 m
- Weight not more than 100 N (10 kg mass)
- Cost less than 500 SR
- After drying no water drop from the clothes
- 110 / 220 volts
- Portable
- Life more than 5 Years
- Electric consumption less than 100 W.h (Watt-hours)



## Criteria

- High effectiveness of cleaning the clothes
- High durability
- Easy to use (simple)
- High number of cloth types

# Safety Specifications

- If overloaded, the machine shouldn't start
- Maximum water level to prevent water waist and dangerous current short-cuts.
- Electrical grounding
- Stop spinner if the door is opened
- Kids protection by motor isolation



## Problem Formulation [paragraph(s)]

Design a **simple** washing machine that **can wash different types of clothes** and dry them by **various spinning** speeds. The machine should be **5 kg capacity** and **easily manipulated**. Its size should be limited to **1 m / 0.9 m / 0.5m** and its **weight is not to exceed 100 N**. The washing machine must be **portable** and able to function using **110 V or 220 V voltage**. The machine consumption and cost should be respectively limited to **100 watt-hours** and to **500 SR**. The minimum life duration of the machine should be **5 years**.

The machine should have a water level to prevent water waist and be **grounded** to avoid electrical shortcuts. Besides, it shouldn't start if overloaded and must stop spinning if its door is open. A motor isolation for kids protection is also a must.



## Needed Information to be gathered :

- Motor power to be used
- Speed for various types of clothes
- Timing needed to clean common types of clothes and dry them
- Common types of clothes to be washed
- Characteristics of each type of clothes (spinning speed, adequate washing temperature...etc.)



## Example 2

Statement: Need a simple device to crash cans

### Needs Analysis:

- Design a simple device to crash cans (soft drinks)
- The final product is recyclable (green design)
- Does not occupy large space
- High strength material
- It costs 80 – 100 SR
- High safety
- Design for kids
- Light weight (portable)
- Easy to use
- Easy to maintain
- Heavy and large base (does not tip over)
- Will be operated by human power\* (foot, hands, or both)
- Using available materials/components





## Primary objective:

- To design a simple, easy to use device to crash cans

## Secondary objective:

- The device should be easy to construct, easy to maintain, marketable and portable



## Constraints:

- The cost should not exceed 100 SR
- The weight should not exceed 5 kg
- Applied Force should be less than 30 N\*
- Does not tip over

## Criteria\*:

- Low cost
- Light weight
- Low force
- High safety
- Simple to manufacture



## Needed Information\* \*:

- Type of materials used
- Typical existing devices in the market
- Different can sizes
- Mechanism for applying force

## Example # 3

**Statement: Need a device for securing a coffee cup near the driver's seat of an automobile**

### Need Analysis\*

- ▶ Coffee cup holder for car (near the driver seat)
- ▶ Locking system to prevent the cup from spilling
- ▶ It does not interfere with the proper operation of the car
- ▶ Adaptable to a wide variety of vehicles
- ▶ Detachable (designed to be unfastened or disconnected without damage)
- ▶ Easy to use
- ▶ Durable material for various temperatures
- ▶ No need to modify car interior
- ▶ Cost not exceed 50 SR
- ▶ Flexibility of coffee cup size



## Primary Objectives

- ▶ A device for securing a coffee cup near the driver's seat of an automobile

## Secondary Objectives:

- ▶ The device should be detachable
- ▶ No modification of car interior is needed



## Constraints

- ▶ Spilling free
- ▶ Does not interfere with the driver
- ▶ Size max: 200 x 150 x 150 mm (H x W x L)
- ▶ Weight not to exceed 0.5 kg
- ▶ Cost less than SR 50
- ▶ 2 years lifetime

## Criteria

- ▶ Simple
- ▶ Easy to install and dispatch
- ▶ Durable
- ▶ Strong attachment to the car
- ▶ High adaptability to car types
- ▶ High adaptability to cup sizes



## Problem Formulation

Design a **simple device** for **securing a coffee cup** near the driver's seat of an automobile that **prevents the cup from spilling**. The **device** should **not interfere** with the proper operation of the **driver** and should be **adaptable** to a wide variety of vehicles and coffee cup size. The device should be easy to install and detach and no interior modification of the car should be needed. The maximum size and weight if the device are respectively  $200 \times 150 \times 150 \text{ mm}^3$  and 2 kg. It should also be durable, offering a minimum of two years lifetime and a cost of less than 50 SR.

## Needed Information\*

- ▶ Average amount of coffee in cup
- ▶ Average coffee cup size and weight
- ▶ Coffee cup material
- ▶ General car interior layout/design
- ▶ Temperature inside the car (max/min)
- ▶ Available relevant holder designs in the market

