Introduction to Engineering Design I

Today:

Introduction to the design process

Designing modular systems

Recap: The CDIO Approach

- **Conceive**
  - What is the problem, how could we begin to solve it?
- **Design**
  - Figuring out the best approach to the problem
- **Implement**
  - Creating a solution that best meets all of your objectives
- **Operate**
  - How does the system work in the real world and how can it be better?

Exercise (5 minutes):

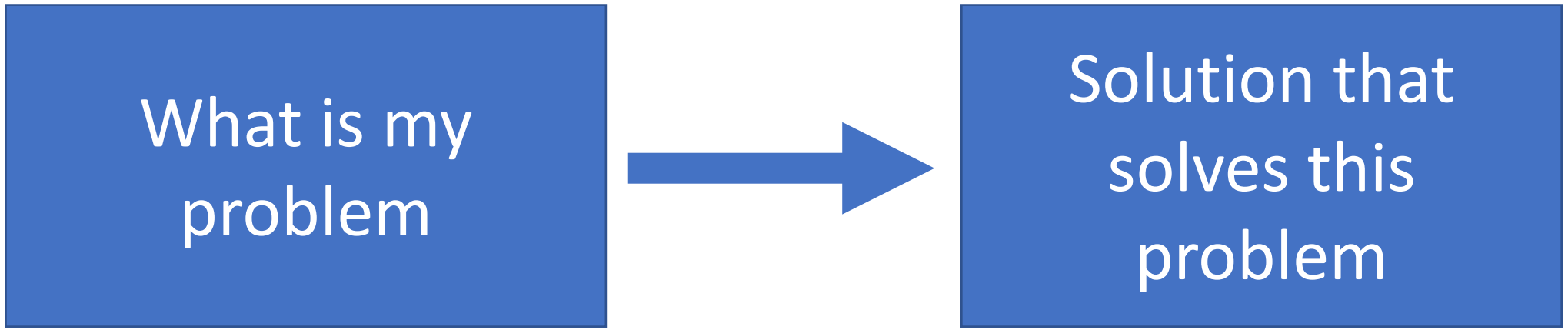
1. Get in groups of 3
2. Come up with a team name
3. Task:
    1. Come up with 2 ways for one person to get from Karaganda to Astana
    2. Be specific – describe in detail
        1. How long will it take?
        2. How much will it cost?
        3. Why is this the best option?

Teams Present

- What did you come up with?
- How did you come up with it?
- Why is your solution good?

How can we design better systems?

- A more systematic approach to designing systems



- Not creating the solution first

Steps

1. Define Problem Statement
2. Define System Objectives
3. Define System Requirements (Top level Requirements)
4. Define Subsystem Objectives
5. Define Subsystem Requirements
6. Repeat and Refine

Example for today: Transportation

- Why do we have so many different types of transportation?
- Do we really need cars, buses, planes, trains?
- How did engineers come up with these things?


RUSSIAN FEDERATION
RUSSIAN FEDERATION
Volga
Kustanay
Petropavlosk (Kiziliar)
Makinsk
Pavlodar
Uralsk
Aktyubinsk
Arkalyk
Astana (Akmola)
Semipalatinsk
Karaganda
Turgay
Emba
KAZAKHSTAN
Ayaguz
Zaysan
Atyrau
Baykonyr Space Center
Aralsk
Balkhash
Lake Balkhash
Dzhusaly
Kzyl-Orda (Ak-Mechet)
ARAL SEA
Aktau
Turkestan
Karatau
Dzambul
Almaty
CHINA
Bishkek
ELEVATION:
2 000 m
1 000 m
500 m
200 m
0
under sea level
AZERB.
Baku
Chimkent
KYRGYZ REP.
CASPIAN SEA
TURKMEN.
UZBEK.
Tashkent
0 200 400 600 km
TAJIK.
Travelsmaps.com

Scenario

1. I am traveling alone from Karaganda to Astana
2. I have one box with me, 50cm x 50cm x 50cm
3. I am going to make this trip every week for 5 years
4. I want to travel there in 4 hours or less

Facts:

- Astana and Karaganda are ~200km apart

1. Define Your Problem Statement

- What is the thing you are trying to solve?

2. Define System Objectives

- What does my system need to do?
- Break up my problem statement

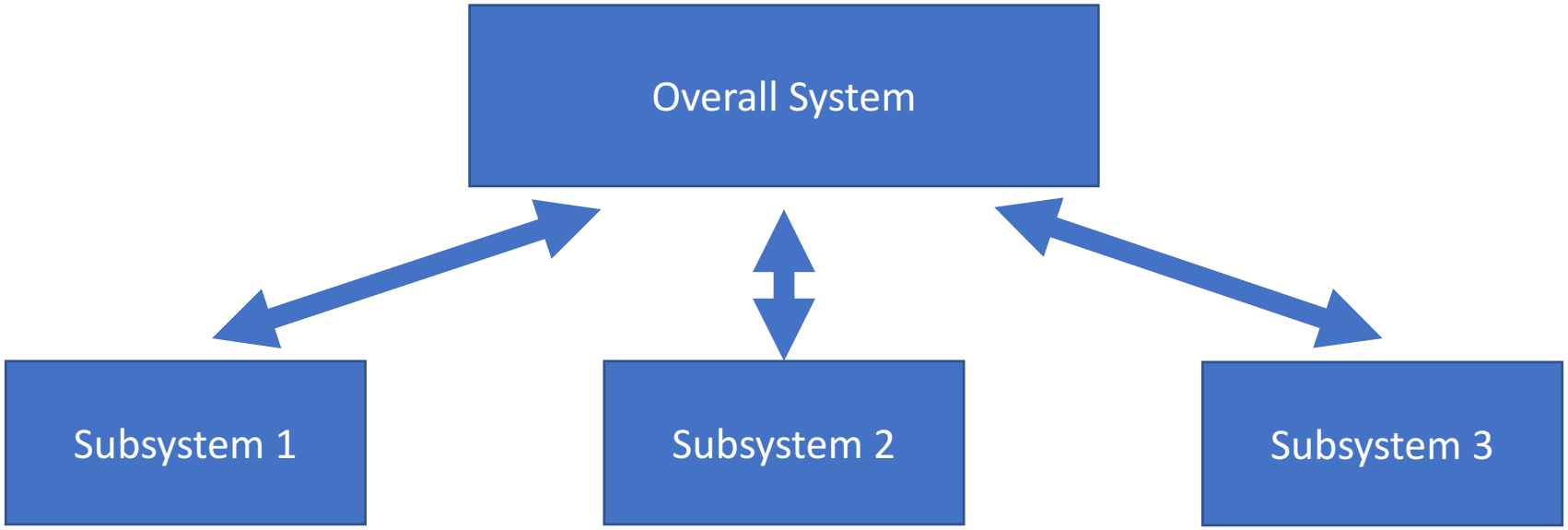
3. Define Your System Requirements

- What are the criteria for accomplishing the system objectives
- How do I know that a system objective has been completed or not?

“The system shall do this thing, and it shall do it this well”

4. Define Subsystems and Subsystem Objectives

- How can I break my problem up into smaller ones?



5. Define Subsystem Requirements

- What are the criteria for accomplishing the subsystem objectives
- How do I know that a subsystem objective has been completed or not?

“The subsystem shall do this thing, and it shall do it this well”

Subsystem requirements accomplish system requirements

6. Repeat and Refine

- How can I improve?
- What if I get new or better information?

Modularization

- Breaking the big problem down into smaller problems

Approach to designing systems

- System Objectives
- System requirements
- Subsystem objectives
- subsystem requirements

Key things to remember

- Problem solving is easier when we can break big problems into smaller ones!