ChE 383 Chemical Engineering Design Workshop:

Workshop #1:

Needs findings
Problem statement
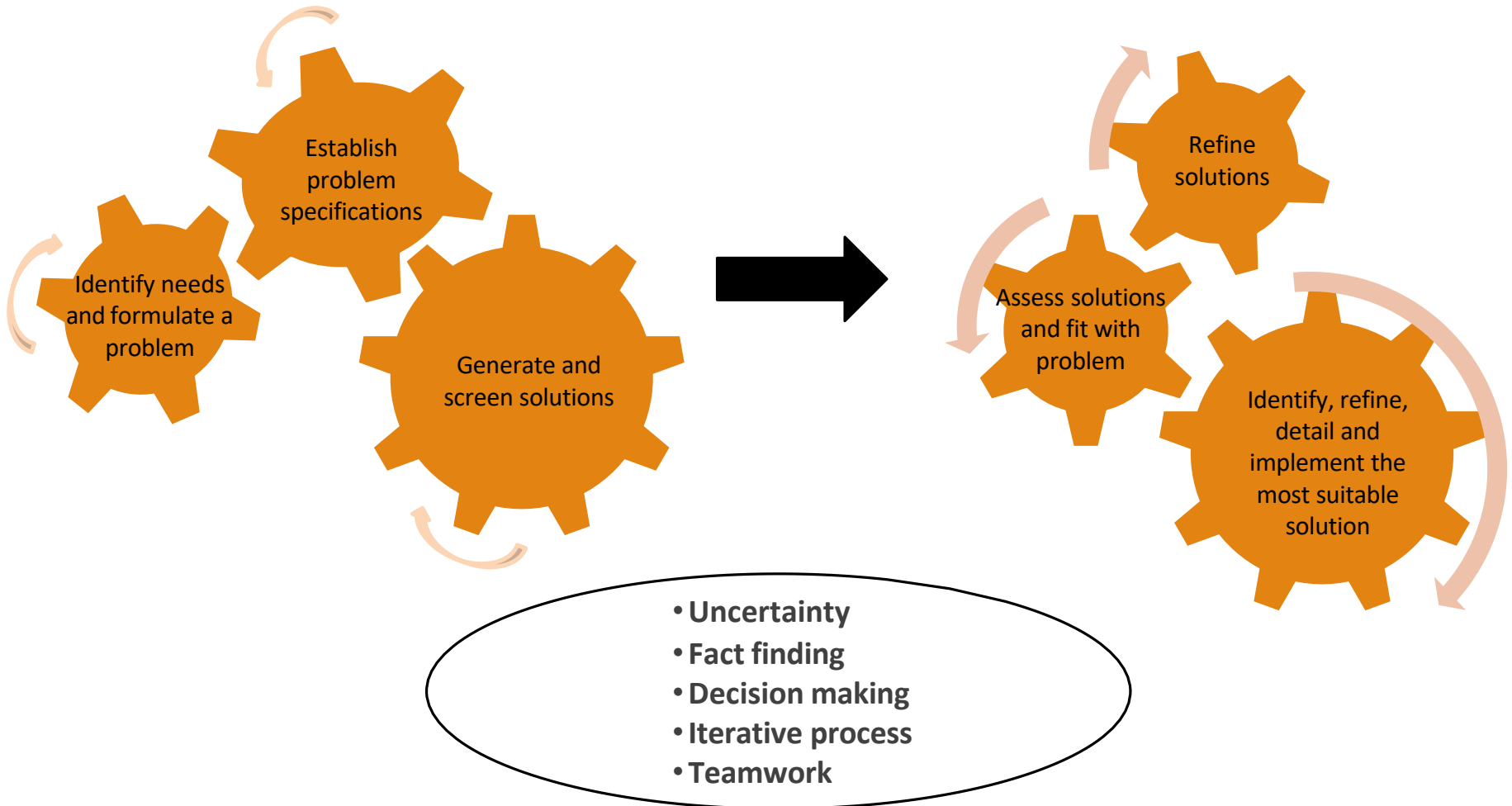
Eric Croiset
Credits: Lena Ahmadi

Engineering Design

"integrates mathematics, natural sciences, engineering sciences and complementary studies in order to develop elements, systems and processes <u>to meet specific needs</u>. It is a creative, iterative, and open-ended process, subject to constraints which may be governed by standards of legislation to varying degree depending upon the discipline."

Canadian Engineering Accreditation Board (CEAB)

https://engineerscanada.ca/sites/default/files/accreditation/2021-2022-cycle/accreditation-criteria-procedures-2020.pdf

Engineering design process

Engineer(ing) Team

- Systems thinking

- Analysis

- Judgement

- Information searching

- Technical knowledge

- Adaptability

- Planning

- Project management

- Teamwork

- Communication

Considerations

- Who you like or what you like?

- What skills set?

- What goals?
  - Grades
  - Competition
  - Entrepreneurship

- What team management expectations?

Engineering design and ChE curriculum

1A to 3A
- Fundamentals and applications of chemical engineering
- Problem solving tools

3B
ChE 383
- Introduction to the **engineering design** process
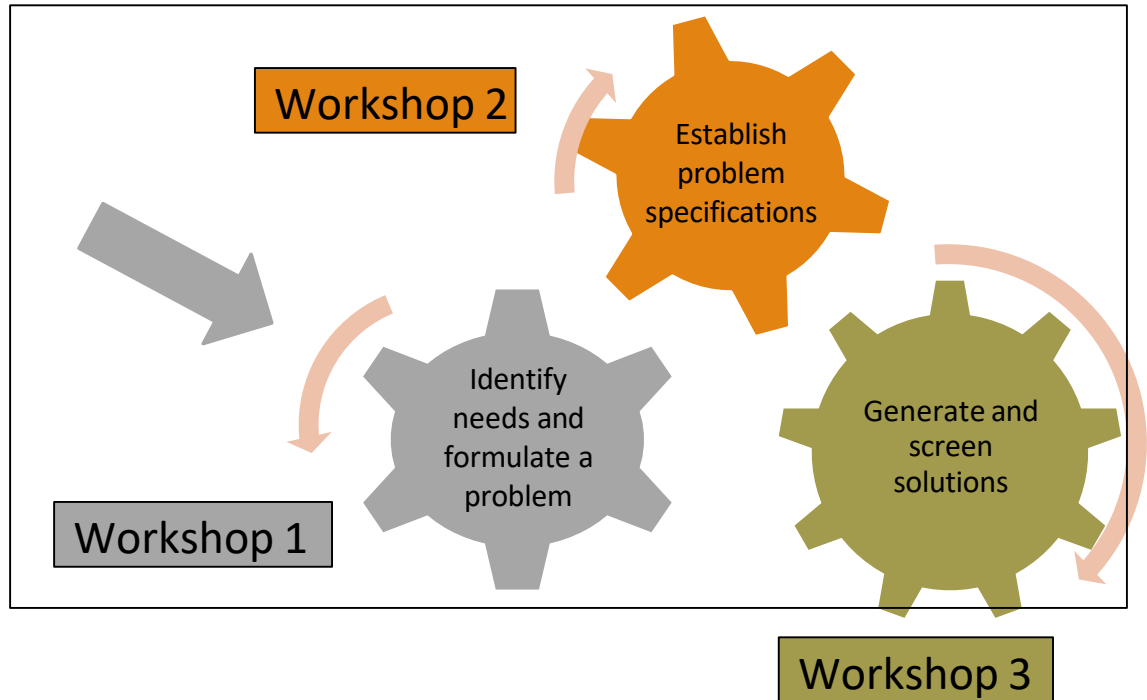- Capstone **design** project: needs findings and problem statement and specification

4A
ChE 482
- Capstone **design** project
- Solution generation and refinement
- Investigation

4B
ChE 483
- Capstone **design** project
- Detailed design
- Communication

Today

- Conduct needs findings and stakeholders identification
- Formulate a problem statement

Engineering design Needs Stakeholders

In engineering design you are addressing the needs of society in sustainable ways by developing and implementing a solution.

The first step in engineering design should focus on the needs findings

- ◦ What are those needs?
- ◦ Who are the stakeholders affected by those needs?

Engineering design Problem statement

In engineering design you are addressing the needs of society in sustainable ways by developing and implementing a solution.

Once needs and stakeholders have been identified, the second step is to delineate (scope) the needs, i.e. what will you be addressing (constitutes the problem statement):

A *short* description of the problem you are solving. It should clearly define the issues and provide context.

The Problem Statement

A short description of the problem you are solving. It should clearly define the issues and provide context.

- What questions should it answer?

- Is it a real problem?

- How will you know that you have solved (or not) the problem?

Problem Statement

What questions should it answer?

5W

Who?

What?

Where?

When?

Why?

5W

-Who?
-What?

Who?

Who is affected by the problem?

Specific groups, organizations, customers, etc.

What?

What are the boundaries of the problem, e.g. organizational, work flow, geographic, customer, segments, etc.

What is the issue?

What is the impact of the issue?

What impact is the issue causing?

What will happen when it is fixed?

What would happen if we didn't solve the problem?

5W

-Where?
-When?

Where?

Where is the issue occurring?

Only in certain locations, processes, products, etc.

When?

When does the issue occur?

When does it need to be fixed?

5W

-Why?

Why?

Why is it important that we fix the problem?

What impact does it have on the business?

What impact does it have on the customers?

What impact does it have on stakeholders, e.g. employees, suppliers, customers, shareholders, etc.

5W

Each of the (5W) answers will help to zero in on the specific issue(s) and frame the **Problem Statement**.

Your **problem statement** should be <u>solvable</u>. That is, it should take a reasonable amount of time to formulate, try and deploy a potential solution.

Your **problem statement** should be <u>measurable</u>. That is, you should be able to measure its achievement.

Canadian Engineering Grand Challenges (CEGC)

- Created by Engineering Deans of Canada

- Set of six Grand Engineering Challenges, global with a Canadian context

- Reflects the unique characteristics of the people, natural landscape and challenges faced by Canadians

- To address societal problems

- Rooted in the climate crisis that we face

- Can be related to the UN SDGs

- To inspire engineering professionals and students to solve these problems together and with other disciplines

https://engineeringdeans.ca/en/call-to-action-canadian-engineering-grand-challenges-published/

CEGC Resilient Infrastructure

- What are examples of infrastructure?

- Do all Canadians have the same access to (resilient) infrastructure?

- What are the challenges facing existing infrastructure?

- What are the needs of Canadians for resilient infrastructure?

THE RIGHT TIME IS NOW

RESILIENT INFRASTRUCTURE
CANADIAN ENGINEERING GRAND CHALLENGES

CEGC Affordable and sustainable energy

- What are examples of energy usage?

- Do all Canadians have access to (affordable and sustainable) energy?

- What are the challenges facing Canadians and their current energy access and usage?

- What are the needs of Canadians for affordable and sustainable energy?

CEGC Safe water in our communities

- What are examples of water usage?

- Do all Canadians have the same access to safe water?

- What are the challenges facing Canadians and their water access and usage?

- What are strategies that can provide safe water to all Canadians?

CEGC Safe and sustainable cities

- What are the current needs of Canadians living in cities?

- What are examples of safe and sustainable cities?

- What are strategies to provide safe and sustainable cities to all Canadians?

CEGC Inclusive and sustainable industrialization

- How does industrialization contribute to the wellbeing of Canadians?

- What are current modes of industrialization?

- What are challenges facing the current modes of industrialization?

- What are strategies to support inclusive and sustainable industrialization?

CEGC Inclusive STEM education

- What is the current access to STEM education?

- What are the needs of Canadians for inclusive access to STEM education?

- What are strategies to offer inclusive STEM education to all Canadians?
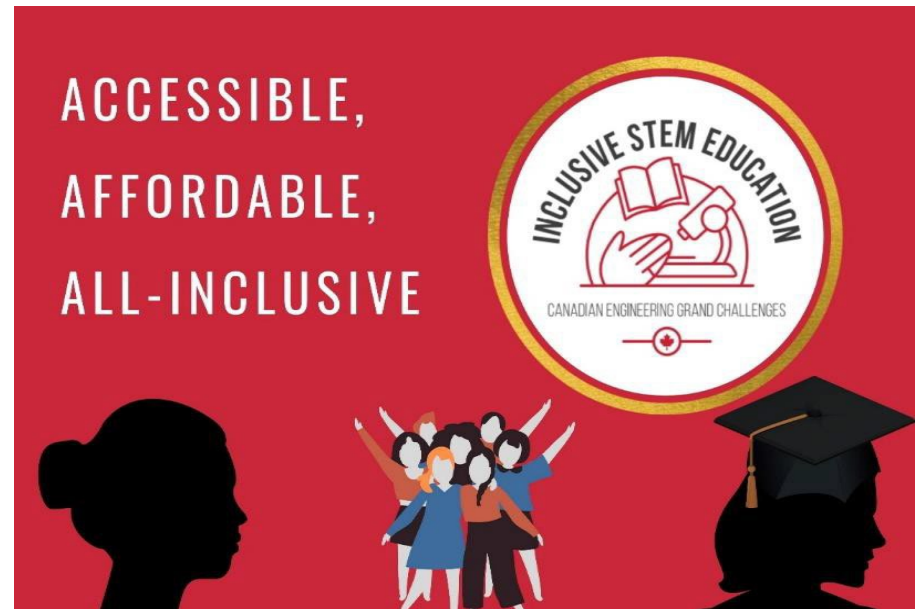
Workshop 1

Tasks

Needs findings and problem statement: Tasks
See instructions provided in the Learn site

A: **Form a group** of 3 or 4 students (sign up on Learn) same as class google spreadsheet:

B: **Individually** identify the needs and stakeholders for:
- Situation related to one Canadian Engineering Grand Challenges (CEGC)

C: **Team,** select one own choice needs and one CEGC needs
- Make revisions as needed
- Formulate a problem statement

D: **Use the outcome for assignment 1**

Next Week: Problem Definition....

In design you are solving a *problem* for a *client.* To do this, you need to answer two questions

- ◦ Needs analysis: what problem does the client actually need to be solved?
- ◦ Design specification: what specific, measurable constraints and objectives should be satisfied?

First do this informally and without any particular structure or guidance. Then, revisit that analysis.