ENGG1000 T1 2020

Engineering Design Process – Problem Statement

A Structured Approach to Stating the Problem

Introduction

Often, an initial problem statement is ambiguous, overly prescriptive, or has implicit boundary conditions that restrict the variety of solutions to a narrow range. Conversely, a lack of precision can lead to exploring possible solutions to the wrong problem. Many times, our initial interpretation of a problem statement is biased by preconceived notions or our first ideas about a solution. In some cases, a deeper understanding of a problem statement comes after a long trial and painful failure. This defining and redefining of the problem statement continues throughout the design process. The more accurate it is in the first instance the more time can be saved. Understanding and writing the problem statement is, therefore, an important step in the design and innovation process.

For this activity, individually and in teams, you will develop a working problem statement that will guide your decision as you progress through the design process. There are many structured approaches to formulating the problem – a number of these approaches are described in the lecture material and Chapter 3 of the *Engineering Design* textbook. You will use one or more of the techniques outlined in Chapter 3. These include questioning the client (ie, the authors of the project brief or their representatives) and brainstorming.

Individuals will develop problem statements along with objectives (goals) and constraints.

Then teams will use techniques described in Chapter 3 and the facilitation guide to refine their individual problem statements, resulting in a single working problem statement for the entire team.

Individual work

Read the relevant sections of the text (Section 3.1 as well as Chapter 1 and 2 if you have not read them already). Develop your own individual problem statement, including objectives and constraints. Try to complete this during your week 2 mentoring session.

Group work

Once everyone has formulated their individual problem statements, the task is to refine these into a cohesive, robust, efficient team problem statement that will help your team to complete the design task. The emphasis in this stage is to clarify all the issues and possible meanings associated with the task. Try to complete this using the facilitation guide (Steps 1-5), or using another appropriate methodology, either during your week 2 mentoring session or during a team meeting before your week 3 mentoring session.

Facilitation Guide

The following facilitation guide is one suggested method in moving from your individual problem statement to a refined problem statement to use for your entire team.

Roles

A team member will take the role of facilitator for the team activities during this stage of the design process. This guide is for the facilitator to use during the meeting. The facilitator should still be a participant in the process. Another team member needs to take the role of scribe, and to prepare minutes of the meeting. Try to take turns for these roles within your team.

Note: All students should have considered the lecture material and Chapter 3 of 'Engineering Design', and developed a problem statement. Carry out a quick check to see if the team members are prepared and ready for the activity. If most members are not prepared, the team should consider and agree on what needs to be done, and schedule another meeting.

Step 1. Consider all statements

Ask each member in turn to present their problem statement. Make sure that each person is encouraged and listened to fairly. Don't judge the response at this stage. Ask clarification questions if the problem statements are not clear. Such questions may be:

- What do you mean by ……..?
- How did you arrive at that way of seeing the problem?

Ask the team to give brief feedback on each person's statement. Start with the positive aspects before any criticism is made, for example:

- What is most effective about this statement?
- Does it meet all the criteria?
- How could it be improved?

Step 2. Refining the statement in subgroups

Arrange for the team to split into 3-4 subgroups. If you are a student acting as facilitator you will need to join a subgroup. Each subgroup is to select a different statement – one that was not written by a member of that subgroup. Ask each subgroup to refine their problem statement. Set a time for this task, such as 10 or 15 minutes.

Step 3. Reconsider the project brief

Bring the whole team back together to reconsider the project brief. Set up a whiteboard, sheet of paper or computer file, using the columns below, to help structure and analyse the brief. Ask each subgroup to feedback the main ideas that arose from their analysis, and the resulting problem restatement. Keep questions brief at this point, such as asking for a clarification or a justification. Examples are:

- Are you assuming ….?
- What is a justification for ….?
- What makes you think ….?
- What do you mean by ….?

Construct a table of objectives and constraints. Use indentation to indicate sub-objectives. You might use Post-it notes so that you can rearrange the tree as you go. Issues that need further consideration or research may be noted.

Objectives	Constraints	Key issues	Action

Step 4

You can now develop the team's problem statement. This should be a comprehensive statement, taking account of the issues identified in this exercise. Discuss how a statement could be written that includes all the major points. Try to reach agreement on one statement. Possible questions are:

- How can we sequence these main points?
- How can we organise the problem statement to include all the key points?
- Is the statement succinct?
- Is the statement clear?
- Is it sufficiently broad to allow sufficient scope for further development?
- Is it free of unnecessary constraints?

Step 5

Review the 'Key Issues' column to identify what needs to be learned. Agree on an action plan involving who will follow up on what aspect (and when), so that this can be reported back to the team at the beginning of the next stage of the design process. The scribe should note agreed follow-up tasks in the action column of the meeting minutes.

1. Present your refined individual problem statement to your team. Note their feedback or suggestions.
2. Break into a few subgroups of 2-3 and select a problem statement that was not written by a member of the subgroup. Use brainstorming or another method to refine the problem statement.
3. As a team, write a working problem statement. Note the date and time and put a big red box around your problem statement. Later, you can reflect on your first attempt at a problem statement.

Be sure to note the date and time, as well as the names of the participants, for your entries. Your problem statement and the evolution of the team problem statement is an important document, ensure it is in your diary.

Assessed Content and Format

Task Description

Prepare a 1.5-2 minute speech to present individually to your peers in your week 3 mentoring session. It is important for you to present your own thoughts and ideas first, then say how the team refined those ideas into the final problem statement. Remember, you **must** bring a copy of your individual problem statement to class to show your team and mentor. Your individual presentation should include the following:

- The significance of problem statements in the design process
- Your original problem you generated individually
- What processes and considerations you considered during its formulation
- How your team refined your collective problem statements into a cohesive, robust, efficient problem statement and some thoughts on how the process improved on your initial statement.

Marking Guideline

Marking for this assessment is weighted 50% by the mentor and 50% by the students of other teams in the mentoring session, taken as the mean of other students marks. Final marks will be put through a moderation process to ensure fair marking and consistency.

Marking Rubric

Criteria	Non-Attempt (0)	Unsatisfactory (0.3)	Satisfactory (0.65)	Excellent (1)
Demonstrate understanding into why the problem statement is an important aspect of a design project	O	O	O	O
Provide their own problem statement and explain why they initially felt it was appropriate as a complete problem statement	O	O	O	O
Reflect upon the changes between their own and the team's problem statement and how the facilitation process improved your initial statement	O	O	O	O
Spoke clearly and with authority while maintaining eye contact	O	O	O	O
Overall impression of the presentation	O	O	O	O
Individual Problem Statement Cited (Demonstrator Only – no mark associated)	O			O