

1.7 Engineering Design Process

Part 2 – Understand: Brainstorming and Design Requirements and Constraints

Summary

Students brainstorm solutions to their design problem and set requirements and constraints for the solution to their selected design problem.

Learning Objectives

After this class, students will be able to:

- Put into practice good brainstorming techniques.
- Write specific design requirements and constraints.

Materials

- Copies of the Brainstorming Worksheet (at least 2 per student).
- Copies of the SCAMPER Questions (1 copy per team).

Time

80 minutes

Procedure/Pacing

Brainstorming

1. Review rules of brainstorming:
 - a. Quantity over quality. Your first ideas will likely be your worst. You must get these out of the way to get to the really good ideas.
 - b. Wild ideas are welcome. The crazier the better.
 - c. Hitchhiking is encouraged. Add to, further develop, or improve ideas of teammates.
 - d. Criticism is not allowed. There are no bad ideas at this stage.
2. Have students break into their groups. Give each student a brainstorming matrix sheet. There will be 4 rounds of initial brainstorming. 7 minutes each round. For the first round, students write or draw ideas in the “Round 1” column on their sheet. Students individually come up with as many ideas as they can in the given 7 minutes. At the end of Round 1, they pass the sheet to the group

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member to their right and begin Round 2. Again they have 7 minutes in which to come up with more ideas (writing or drawing them in the “Round 2” column of the sheet just passed to them). These ideas can be new, or can be hitchhiked from ideas they see in the Round 1 column. At the end of Round 2, the sheets are again passed to the team member to the right. This procedure continues until all 4 columns have been filled (4 rounds). If they are having trouble coming up with ideas, students should refer to the SCAMPR handout they received last class (extras are available).

3. After the 4 rounds, have the students look at all of their sheets eliminating any duplicate ideas. They should then discuss ideas as a team, further adding to any ideas on any sheet (20 - 25 minutes). This can be done on further sheets as needed.
4. Once the groups have come up with as many ideas as they can, it is time to eliminate ideas (20 – 25 minutes).
 - a. Eliminate any ideas that are not fundamentally different, i.e. any ideas that work in about the same way. Can these similar ideas be combined? Can you eliminate one in favor of another?
 - b. Eliminate any ideas that are not legal.
 - c. Eliminate any idea that is not feasible, i.e. any ideas that you really can’t make work. These would include things like a tele-transporter to get from one end of the school to another. It would be great, but is not likely to be possible.
 - d. Eliminate anything that clearly would violate a design constraint (a must-have for design, e.g. safety).
5. The goal of elimination is to reduce the list to 5 – 6 ideas.
6. Each team member should write these resulting 5 – 6 ideas in their notebook. Everyone should turn in his or her brainstorming sheets for the day.

Design Requirements and Constraints

1. Review the categories for Design Requirements and Constraints:
 - a.

In-Class Assignment

Assignment 1.6i: Research

Resources

Google Patents (Google search engine for the USPTO)

<https://patents.google.com/>

Google Scholar (Google search engine for scholarly literature)

<https://scholar.google.com/>

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Homework

Assignment 1.7h: Engineering Design Process Part 2 – Design

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