Using UL Xplorlabs: Extraction to E-waste
Engineering Design Process Tool
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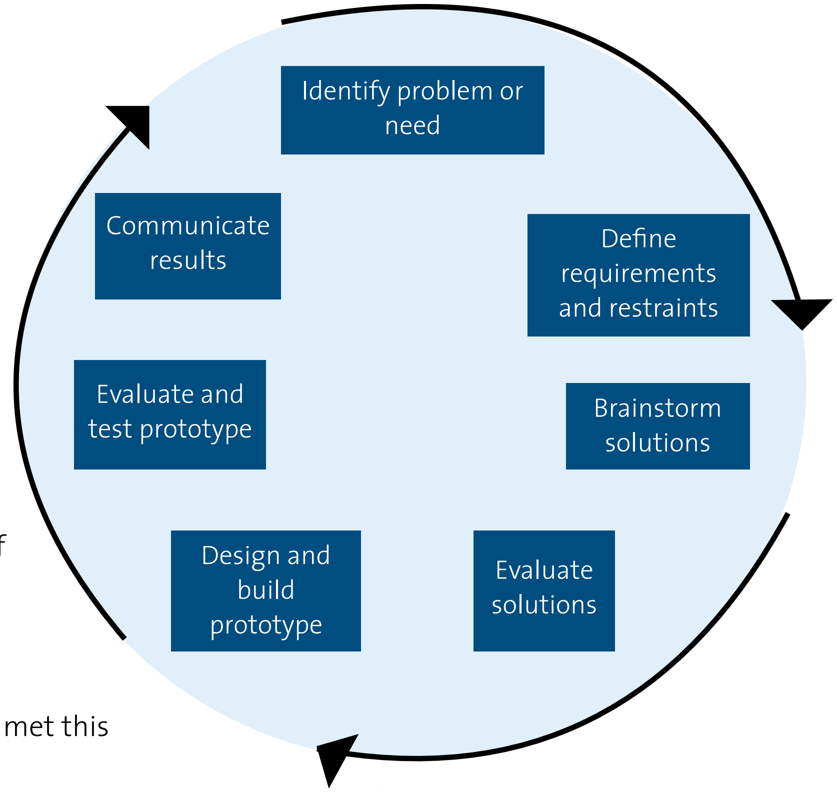

Flowchart Attribution: Steven Krause

Engineering design usually follows a general methodology from defining a problem to exploring possible solutions, testing and improving those designs (design optimization), and then sharing the design and its justifications based on data. You may have seen this process described in many ways; for example, a circle or a flow chart. No matter how you prefer to illustrate this process, the four boxes on the next page will be a central part of your process.

We're going to start with the Solutions Videos from Extraction to E-waste. These videos are solution ideas ready to be evaluated. Your students are tasked with **evaluating these proposed solutions**. To do this, they'll need to work in all parts of the design process:

1. Backing way up to discover what the problem was all about (problem definition)
2. Identifying other potential ideas or historical shifts that have or have not met this challenge
3. Determining what testing limits the solution would need to meet to be a "success"
4. Now that we know more about the problem, let's evaluate the proposed solution in the video
5. Finally, prepare a final product to demonstrate your knowledge of the entire problem and how this solution works and doesn't work to meet the problem. Examples:
    a. Prepare a critique of the solution proposed in the video. Who does it take care of? Who does it leave out? Which stakeholder's perspective does it privilege?
    b. Make an accompanying white paper/pamphlet/handout that explains more about the problem and why this solution works or doesn't work. (more advanced) Include metrics for populations affected and estimated costs.
    c. Propose a strategy to test this solution. Who would need to be involved?

1. START HERE:

*The module's Solution Videos are each a description of one idea to solve a problem in the Battery Supply Chain. (Students could all work on the same one if tightly bound to your learning objectives; groups could choose based on interest; or, you could divide them so that all videos are utilized.) If we were engineers, we'd still need to optimize that solution and test it to see whether it meets our criteria.

But first, we'll need to understand the whole problem, so we will need to dive into the module to explore the factors that contributed to the solution.

2. Problem Definition	3. Design Exploration	4. Design Optimization	5. Design Communication
What is the problem? A solution would need to resolve THESE concerns to be a success: (If you're more familiar with your engineering design...) • Constraints (limits, mins, max, requirements) • Criteria (trying to achieve these as much as possible. • Stakeholders	Brainstorm all kinds of possible solutions to this problem that you see in the modules, solutions that have been tried in the past, and solutions that you can think up now. Ideas: • Use a Venn Diagram graphic organizer to compare two solutions identifying which has outstanding positive or negative attributes or side-effects.	Does the proposed solution meet the needs that you've discovered for this problem? How might you alter the solution to meet more of the needs you've discovered? What data would you need to see to evaluate the solution as a success?	Communicate the solution and your justification for the solution based on the exploration you've conducted. Show the video and provide your supplemental materials. Answer questions from others using your experiences in the module to justify your reasoning.

Example 1: Dematerialization

Dematerialization reduces the need for raw materials to enter the supply chain. Sound good? Well what was the problem that we're talking about? How can we test for the success of this strategy? Why were raw materials a problem in the first place?
The examples in the video included:

- Less physical paper (going digital)
- Smaller cell phones with smaller/fewer components
- Shared economy (lawnmower or car)

Example 2: Mechanization and Automation

Okay, this will make the battery production process less risky, but why is making batteries risky?

The video suggested that mechanization and automation will help with the following problems:

- Dangerous to humans (Who's affected?)
- Production steps are dangerous (In what ways?)
- Harmful chemicals (Which?)