

Engineering Design

The Engineering Design Process

Did you know that engineers use a design process that is similar to the scientific process used by scientists?

Both processes involve systematic approaches to solving problems, but while scientists focus on understanding natural phenomena, engineers focus on creating practical solutions to real-world challenges.



The Engineering Design Process

In the engineering design process, creativity and collaboration are very important. Engineers start by identifying a problem, exploring possible solutions, and keep improving their designs through testing and improvement.

Engineers rely on this iterative process—a repetitive cycle of testing, refining, and improving ideas or designs—to develop effective, efficient, and often groundbreaking solutions, whether constructing bridges, designing apps, or advancing clean energy systems.



Ask

In this step of the process, we will clearly define the problem, identify what the design must achieve and recognize potential challenges or limitations that could make it more difficult to build.

1. Write a clear statement of the problem you are solving.
 - What is the issue or need?
 - Why is solving this problem important?
2. List the goals or features your solution must meet to be successful.
 - What must the design achieve?
 - What performance standards are required?
 - Include measurable objectives if possible.
3. List the limitations or challenges that could impact your design.
 - What resources are limited (time, materials, budget)?
 - Are there specific physical, environmental, or social factors to consider?
 - Are there rules, regulations, or ethical concerns to address?



Imagine

Now it's time to generate ideas to solve your problem! Work with your team to brainstorm creative and innovative solutions. Follow these guidelines for your brainstorming session:



Review the Problem, Criteria, and Constraints:

- Remind everyone of the problem you are solving.
- Go over the design criteria and constraints to ensure the ideas align with the project goals.

Let Your Imagination Run Wild:

- Share as many ideas as possible, no matter how unconventional or outlandish they seem.
- Avoid criticizing or evaluating ideas during this stage—focus on creativity and quantity.

Document:

- Use visuals like sketches, diagrams, or sticky notes to organize and communicate ideas effectively.
- After the brainstorming session, review all the ideas together.
- Highlight the most promising ones that align with your problem, criteria, and constraints.

Plan

In the plan phase, your team will turn brainstorming ideas into a focused and actionable design. Start by reviewing all the ideas you generated in your brainstorming session. As a group, discuss the strengths and weaknesses of each idea, considering how well they meet the problem's criteria and constraints.

Use questions like:

- **Which idea best solves the problem?**
- **Does it align with our criteria and work within our constraints?**
- **Is it practical and achievable with the materials and time available?**

Once you've selected the best idea, create a detailed sketch of your proposed redesign. Include labels and dimensions to make your vision clear. Think about how your changes will improve the car's performance, such as speed, stability, or energy efficiency.

Next, make a list of all the materials and tools you'll need to bring your design to life. Be specific—include quantities and alternatives for materials if possible. A clear plan will save time and help you identify any challenges before building.



Create

It's time to bring your design to life! Start by checking your sketch and materials list, and assign roles—measuring, assembling, and ensuring everything fits.

Follow your plan step by step, but stay flexible if something doesn't work perfectly. Focus on accurate measurements and strong connections for a sturdy build.

Test parts as you go to catch problems early, and note any changes you make. Work together and stay creative to make your Sprint Car the best it can be!



Test

It's time for another test run! In this phase we will conduct another trail run of our car. We we log the performance and compare it to our benchmark data!



Test

A component of this phase is analyzing our data. Let's look at measures of central tendency and standard deviation as a way of gauging how our improvements impacted performance.

Measures of Central Tendency

1. **Mean (Average):** Add all the values and divide by the total number of values.
2. **Median:** The middle value when the data is arranged in order.
3. **Mode:** The value that appears most frequently.
4. **Standard Deviation:** Measures how spread out the data is from the mean.

Improve

Use what you learned from testing to make your design better, and repeat the process for a stronger solution!

