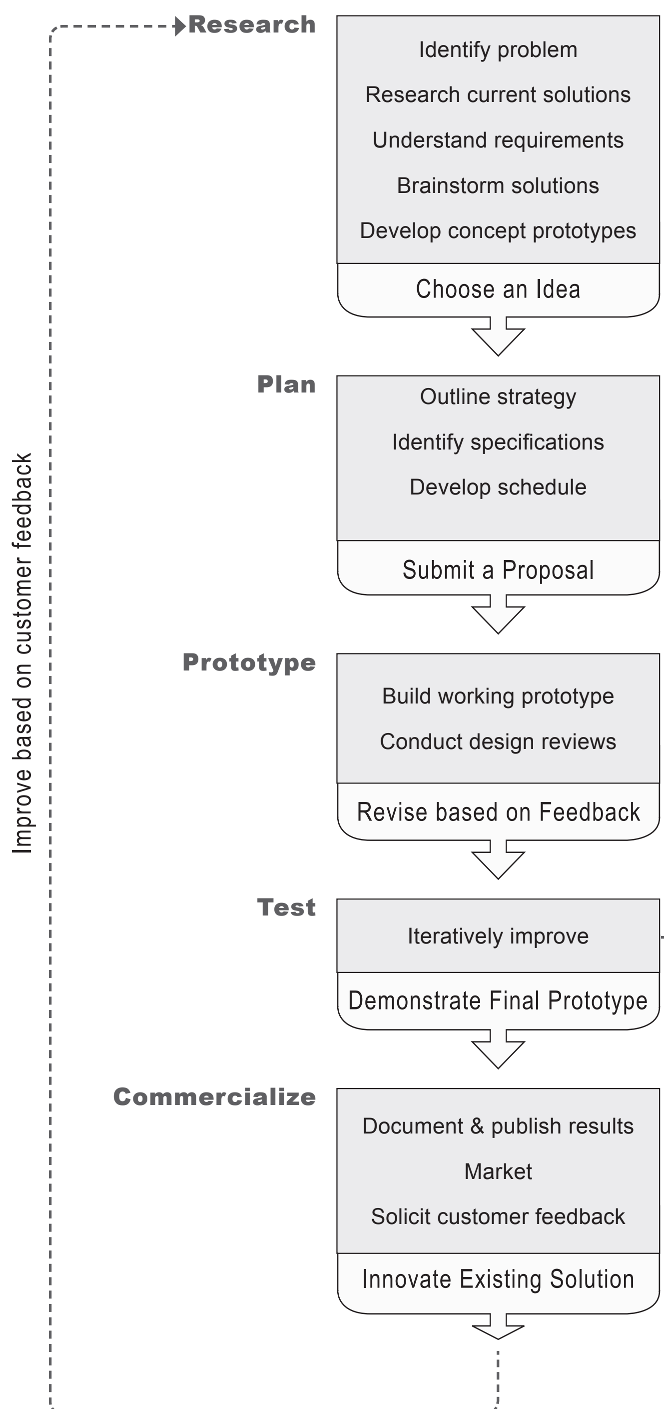
Project Planning • What is Engineering Process?

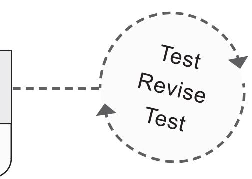
Engineering Process



The dictionary describes a "process" as a series of actions, changes, or functions bringing about a result. Engineers, scientist, and researchers use a process when they solve a problem.

The first step in solving a problem is to clearly define the problem. The team may think that they have identified the problem, when in fact they may have only considered part of the problem, which typically leads to a partial solution. Once the problem has been clearly identified, the team can begin to brainstorm and propose solutions.

The first three steps of the problem-solving model: define the problem, brainstorm, and propose solutions, may be done concurrently. If the team moves too quickly from one step to the next, they may not have thoroughly identified the problem, brainstormed sufficiently, or proposed enough potential solutions to consider all of the alternatives available. When that happens, most teams find themselves returning to the beginning and to start over again. The next couple of steps: developing prototypes, testing, design reviews, and receiving feedback from others, are all important steps in the engineering process. Before a team begins to build their final solution, it is important that they model and test several ideas.



After that is done they will want to present their ideas to others. Sometimes, problem solvers miss potential solutions because they haven't considered all options.

Preparation for the design review and the feedback the team receives will move them closer to a working solution. Design is an iterative process. Even when the team has a working solution, they will want to consider improvements based on their testing.

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Definitions of the word 'Engineering'

- Derived from the Latin *ingenium*, engineering means something like brilliant idea, flash of genius. The word was created in the 16th century and originally described a profession that we would probably call an artistic inventor.
- Engineering is the principled application of science, methods, tools, and experience to the production of designed objects.
- Includes chemical engineering and materials techniques, civil engineering, electrical and electronics engineering, surveying, industrial engineering, metallurgical engineering, mining engineering, mechanical engineering, agricultural and forestry engineering techniques, fishery engineering techniques.
- Science, work, or profession of planning, building, or managing engines, machines, roads, bridges, canals, railroads, etc. (Old French *engin* = skill, which stems from Latin *ingenium* = ability to invent, brilliance, genius.)
- Analysis and/or design work requiring licensing through formal education, experience and the use of mathematics and the applied sciences.
- The art and science by which the mechanical properties of matter are made useful to man in structures and machines.
- The art of doing something well with one dollar what any idiot can do with two (or was it the other way around?).
- The use of scientific knowledge and trial-and-error to design systems.
- Engineering comprises any kind of activity which aims at either solving a problem or completing a task related to the definition, design and specification of a product

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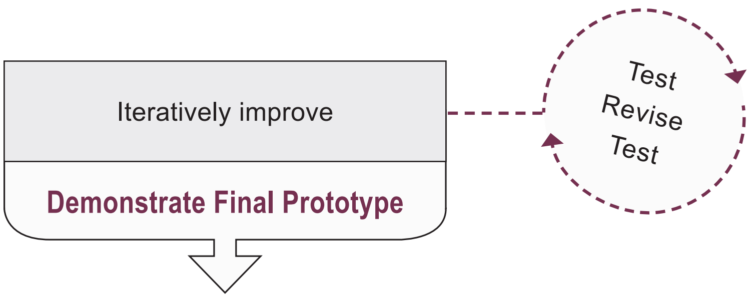
Iterative Development

Iterative development is the process of testing and continually making improvements to a product before it is finalized. In this process, multiple iterations of the product are developed, each iteration being closer to the final product than the last.

Iterative development happens in the Test portion of the Engineering Process. By now, the team has constructed a prototype, and is testing it to see how well it works. Undoubtedly, though, things will go wrong and the prototype will not perform as planned, so changes will need to be made. The group will make the necessary changes, and test again to see if the problem was solved. This cycle of continually building, testing and revising is the groundwork of the iterative development process.



Example: Line-tracking robot

1. Research how to make a line tracking robot
2. Plan out how to build robot and program
3. Build robot and program
4. Set up line and test robot
5. Testing shows that robot does not recognize line
6. Solution: reset threshold of Switch block and download program
7. Test again. Testing shows that robot moves too fast
8. Solution: lower motor power and download program
9. Test again: robot travels in circles at end of line. Robot is tracking too far!
10. Solution: reset the Loop, so that it goes for an amount of time
11. Test again. Robot tracks line well
12. Demonstrate and document results

As you can see through this example, the robot did not track the line properly the first time. Nor did it work well the second time. The robot designers found, through testing, many problems that they did not foresee. This is why iterative testing and revision are so important during the design process.

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Evaluating a Prototype

When creating a prototype, you'll test it often to see if it does what you expect. However, sometimes during testing you'll notice more than one thing that needs to be improved. Try to focus your testing on certain things, preferably the last things that you changed. This will keep you from getting overwhelmed by the scope of the work that needs to be done. Pick a single aspect of the robot's performance to evaluate during each test, and try it a few times to get a good idea of how it will behave. It is also useful to fill out a rubric of the criterion, and then rate the robot on how well it meets it.

Here are some steps for useful prototype testing:

1. Have a product ready to test. There's no sense in testing if it isn't ready yet.
2. Decide what you expect the robot to do. What constitutes a "failure"? What would require you to redesign? Write this down.
3. Try it! Write down exactly what happened.
4. Repeat the test. Unless the robot completely fell apart the first time, try the test a few more times to get a better idea of how it behaves.
5. Assess the robot. How well did its performance align with what you expected?

I am testing to see if the robotic arm works when it picks up a ball.					
Criteria	Perfectly: works 100 of the time	Well; works most of the time	Mediocre; works half the time	Poorly; only worked a few times	Not At All
Robot gets to Ball		x			
Gears Stay Meshed			x		
Arm returns to its original position				x	

Comments: