

WHAT IS TINKERING?

In the context of engineering and robotics, to "tinker" means to playfully and experimentally explore, build, and improve robotic systems through a hands-on, trial-and-error process. While traditional engineering follows a structured, problem-solving design process, tinkering is a more fluid, creative, and iterative approach.

HOW IS TINKERING APPLICABLE IN ENGINEERING ROBOTS?

- A mindset for hands-on experimentation. Tinkering encourages engineers to learn by exploring and doing, rather than only by following instructions. This process involves taking things apart, building new things, and figuring out how components work together through physical interaction.
- Iterative and open-ended process. Tinkering is a cyclical process of making, breaking, and remaking. Engineers continually reassess their goals and explore new possibilities as they engage with the project, rather than sticking to a fixed blueprint from the start.
- Learning from failure. A critical part of the tinkering process is learning from what doesn't work. Rather than being a failure, making mistakes and troubleshooting problems is a valuable learning opportunity that helps refine a design.
- Developing a deeper understanding. By experimenting with and manipulating materials, engineers gain an intuitive sense of how various components—such as circuits, motors, and sensors—interact. This knowledge goes beyond theoretical understanding and is crucial for creating innovative solutions.

- Pathway to innovation. Tinkering allows for outside-the-box thinking, which can enhance an engineer's ability to envision possibilities beyond conventional uses. Many famous inventors started as tinkerers, using experimentation to make discoveries.
- Low-floor, high-ceiling approach. This concept is often used in educational settings but applies to professional engineering as well. Tinkering has "low floors" because it's easy to get started, but "high ceilings" because there's no limit to the complexity of a project. This makes it a great way to grow and expand technical skills.

TINKERING VS. FORMAL ENGINEERING

Aspect	Tinkering	Formal Engineering
Starting point	"What can I do with this?" or playful exploration.	A defined need, problem, or desire.
Process	Fluid, experimental, iterative, and learner-driven.	Structured and involves research, definition, and specific criteria.
Mindset	Emphasis on the process of discovery.	Emphasis on achieving a specific, functional end-product.
Outcome	Can lead to unexpected and creative innovations.	A solution that meets the initial set of requirements and constraints.