

The Art of Engineering

Robert Hartmann



Courtesy of IDEO



Key Concepts from Previous Chapters

- 1 Importance of Teamwork
- 1 The Work of Engineers

Great art can have a powerful influence on your emotions.

It might make you feel awestruck or reflective, it might fill you with rage or exuberance, or it might lead you to question something about yourself or the world. An artist's role in society is to create works that bring out an emotional response.

But art is not just something you find in a museum or a performance hall. There is a little art in every product that you use every day. The most successful products—and by successful I mean the ones that people are likely to buy and use—don't just work well, they also look and feel “just right.” This brings up two important questions: Do engineers have to be artists to design technologies that appeal to people? And to what extent are artists engineers? After all, artists do alter the natural world to meet human desires.

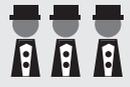
There are no correct answers to these questions. Certainly, engineering and the arts both play an important role in the design of new technologies and products. That’s something I have learned a lot about in recent years.

My name is Robert Hartmann, but most people call me Bob. I’m an electrical engineer at IDEO, a design firm based in California. While growing up, I was much more interested in numbers and sports than I was in, say, sculpture or photography. But when I look back, I’ve always loved to create things as much as any artist does.

When Texas Instruments came out with a programmable calculator in the 80s, I used it to invent a baseball game. And when I got my hands on my first personal computer, my friends and I programmed it to simulate motorcycle jumping and the motion of the planets. True, I might not have been making “art,” but I was creating things to satisfy my own curiosity and others’ as well—much like an artist would.

I had a difficult time deciding whether to study computer science or electrical engineering. I eventually decided to study electrical engineering at Union College in Schenectady, New York. I thought this field offered more chances for me to build things and seemed more hands-on than just using a computer.

When I graduated, I got a job working in Boston, at Polaroid’s R&D Department—that’s Research and Development—where I engineered new products. Polaroid is famous for developing instant cameras for the mass market. At one time hundreds of thousands of people in the United States and many European countries owned instant cameras. Polaroid also creates more expensive devices sold to niche markets. *Niche markets* are specialized markets that have fewer customers who are willing to pay more. When I was working at Polaroid, hospitals were one of our niche markets. I developed a printer for medical imaging, such as ultrasound, that doctors can use to see if embryos are developing into healthy babies.

Mass market refers to all consumers in general.	
Niche market describes a specific group of target consumers.	

I didn't realize it at the time, but during the design process, I always had to keep the look and feel of a product in mind. One time, I was experimenting with creating tiny circuits to run the automatic focusing and electronic timers on our instant cameras. Making these minuscule circuits was a challenge. The electronics had to fit into a very small space. Why? Most people want a camera that fits into their pocket or purse and looks sporty and refined, not one that's clunky and cumbersome.

Making Objects with Attitude

A few years ago, a friend of mine who also worked at Polaroid told me about a job opening at IDEO. IDEO is famous for *innovation*, which means coming up with new products based on technologies that already exist. At IDEO I would have the chance to work on all kinds of innovations, from redesigning toothbrushes to improving entire railroad cars. I applied for the job and got it.

Working at IDEO, I really started to understand that a product's look and feel is as important to consumers as how well it works. Good designers understand how humans will interact with a product and that we have an emotional reaction to any object, whether it's a cell phone, a car, shoes, or art. We buy products that we feel match our personalities. Look at a cell phone. The newest ones look sleek and fit comfortably in your hand. The designers who created the phone understood that the size, shape, and color of the phone all express something that we, as consumers, can relate to. Some products have attitude, others give off a more conservative air. Still others strike us as practical or romantic. I find it amazing that we think objects can say so much about who we are. But we do. It's our nature.

In one case, a company came to IDEO with a new testing instrument they had invented. Workers used this machine to make sure parts were the right size and shape. While it worked really well, the company wanted us to improve its look and feel. Now, you might be tempted to think that people who buy factory equipment wouldn't care about a machine's look and feel, but they do! You can see in the pictures to the right the difference in the machine before and after IDEO redesigned it.

Innovation



involves making improvements to existing technologies, products, or methods of doing something.

Invention



is the process of creating new technologies that never existed before.



Courtesy of Medtronics



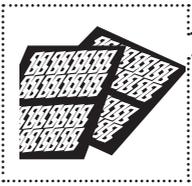
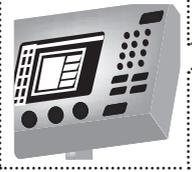
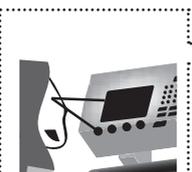
Courtesy of Medtronics

A testing instrument before (top) and after (bottom) IDEO redesigned it. Which one looks more appealing to you?

So, how can you design products that function well and have the “right” look and feel? One thing is certain: you can’t do it alone. In fact, you need a whole team of people with different backgrounds who can bring their individual expertise to the task. At IDEO our teams are made up of different kinds of engineers, industrial designers, experts in design research, and specialists in user behavior.

The engineer’s role is to understand enough about the natural world and science to make a design function well. **Industrial designers** focus on how an object looks and feels. **Human factors specialists** use the science of **ergonomics**—the study of how people interact with machines and systems in designed environments—to improve product design. They watch how products are really used and interview users and operators to understand their needs.

The team we assembled to redesign the test equipment closely followed this arrangement. Our team included these people:

	 <p>Electrical engineers redesigned the electronics and reduced its size to fit into the newly designed case.</p>
	 <p>Software engineers reprogrammed the computer so that the graphical display on the screen would be easy to see and use.</p>
	 <p>Mechanical engineers figured out how to manufacture the various parts.</p>
	 <p>Industrial designers created the size, shape, color, and texture of the case.</p>
	 <p>Human factors specialists observed how the instrument was used, then determined where the buttons should be and how large to make the display.</p>

All of our work here is done in teams. In fact, we consider teamwork so valuable at IDEO that everyone who works in our office interviews applicants. I probably had interviews with thirty people before I was finally hired. Now I understand why. At IDEO you aren't hired just to do a job; you're expected to become a member of a team. Of course, teamwork can be difficult, because team members don't always agree. But we work together to resolve disagreements so we can define the problem and generate various solutions. Each team member can contribute ideas at every stage, and everyone knows how his or her particular expertise fits into the whole.

Our company is well known for redesigning a toothbrush for children. You might think that a child's toothbrush should have a small handle to fit a tiny hand. However, human factors specialists watched children brushing their teeth and noticed that children could get a better grip with a larger toothbrush handle. So the specialists consulted the industrial designers who figured out the shape and color of the product. Engineers on the team ensured that the materials held up under repeated use. The result was a brightly colored toothbrush with a large, soft, easy-grip handle. Another example of teamwork!

Everything by Design

Recently, the company that operates the Acela Express high-speed train that runs between Boston and Washington, D.C., asked several firms to submit a bid to design the interior of the train. A *bid* is a price a company offers to a client for the work that needs to be done. I imagine that other firms submitted designs and estimated the costs for seats, windows, aisles, and such. But IDEO submitted a bid to design not only the interior of the train, but also the entire rider experience. We wanted to sculpt every step riders take, from the time they purchase tickets to the moment they depart the train at their destination. This approach required designing the entire rider experience, including the traffic flow at the ticket counter, the taste of the food, the feel of the seats, and all the other elements a rider sees and feels. I like to think we won the contract because we had a unique way of defining the problem.

Design is all around us. Just look at the doors and windows in the room where you are right now. Someone designed those. All man-made items are the result of someone's design. Even the experience of a school day, from the first bell to the time you leave at the end of the day, was designed and probably could be improved. Imagine if every public space were designed to give you the best possible experience. What would a hospital look like? How could you improve movie theaters? There are countless opportunities to improve our lives through good design. We take the path to innovation by questioning things as they are and thinking about how they might be improved.





What's the Story?

1. According to Bob, how are artists and engineers similar? How are they different?
2. What does the term “innovation” mean? Give three examples of products that are innovations.
3. Give three examples of products developed for niche markets and three examples of products developed for the mass market.
4. What methods do engineers and designers at IDEO use to ensure their designs will have the right “look and feel”?
5. Why is it critical to have a diverse group of people on a design team?



Connecting the Dots

6. How do the engineers who are improving technologies that already exist use the design process differently from engineers who are developing entirely new technologies? What individual steps might be different?
7. Engineers apply math and science while developing new solutions. In redesigning a toothbrush handle, how might IDEO engineers have applied math and science?



What Do You Think?

8. Give an example of a technology that you use every day and would like to change. How would you improve it? Would you market it to niche or mass markets?
9. Bob says that working on a team is not always easy. Have you ever had a difficult time working on a team? If so, what did you do, or what could you have done to correct the problem? If not, why do you think your teamwork experiences have been so successful?