8

The Making of a New Balance Shoe

Christine Epplett

Photo taken by Rebecca Pierik

Key Concepts
from Previous Chapters

- 4 CAD
- 6 Assembly Line
- 6 Batch Production
- 7 Systems

Some of you might not realize that designing and developing an athletic shoe is an engineering task. Those of you who play sports, however, know that shoes aren't just a fashion statement. Shoes can make or break your performance on the field or on the court. Shoes that don't fit well or are poorly designed can even lead to injury.

My name is Christine Epplett, and I've always been interested in sports and fitness. Growing up, I ran track and cross country and played basketball in high school. In college, I was a member of the track team and played all kinds of intramural sports. I majored in business and found a job in health care administration after I graduated.

But wearing a suit to work every day just wasn't my style. I missed being around athletes. That's why I went back to school to study biomechanics in graduate school.

Biomechanical engineers design products, taking into account the physical forces that act on the body. I develop running shoes for New Balance Athletic Shoe, Inc., a large shoe manufacturing company with factories in the United States and around the world. I absolutely love my job. It's exciting to go to a road race, a park, or the grocery store and see people wearing the shoes that I spend months designing. It's also satisfying to feel like I'm helping athletes improve their performance while reducing the risk of injury. And you know what? The dress code at New Balance is "business casual," which means I get to wear running shoes to work every day.

At New Balance, much like at IDEO, we work in teams. These teams are composed of market researchers, designers, biomechanical engineers (like me), and process engineers who specialize in knowing the ins and outs of making shoes.

The research and development cycle (R&D) starts when our marketing department identifies a need. They use market research analysis to understand what new shoe designs the public wants and will buy. Recently, our marketing team identified a target consumer who is younger and more fashion conscious. These young customers want good-looking shoes that don't skimp on performance or comfort. Marketers also suggest a price point. That is to say, they tell us what a customer is willing to pay. This price will influence the quality of the materials and the manufacturing processes we use.

Photo taken by Rebecca Pierik

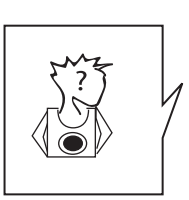
The "classic" look has been popular for years. We're updating the look with bold colors that will appeal to younger consumers.

As soon as the design team members understand the target audience, the price point, and the required features, they begin developing a style for the shoe. In this picture, we have what's called a "classic" design, which has been popular for a few seasons now. Our designers are working to update this look in different colors—perhaps greens, soft blues, and pinks—to appeal to a younger consumer.

After our designers come up with something visually appealing, biomechanical engineers make sure this beautiful design will actually fit the human foot—and fit it well! Manufacturing engineers then decide whether the shoe can be manufactured in one of our plants. I need to know all the details, such as what kinds of materials our manufacturing machines can process efficiently, what kinds of stitches our associates are trained to use, and how many individual pieces must be cut to make each shoe. Next time you look at a pair of sneakers, try to see where the separate pieces of fabric have been stitched together. Most athletic shoes require between twenty and thirty pieces of fabric. Sounds like a lot, doesn't it?

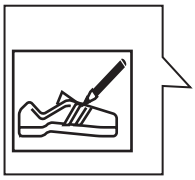
Other members of our team use Computer-Aided Design (CAD) software to develop the ***blueprint*** of the shoe. We can use CAD to assemble the entire shoe on the computer, creating detailed two- and three-dimensional drawings more easily than we could with traditional drafting. Some CAD systems can even simulate the manufacturing processes to ensure that our factory's machines and processes can actually make the shoe. Even better, CAD allows engineers to test products before we make a prototype. By applying "virtual stress" to a shoe design, we can get a sense of how well a shoe will withstand day-to-day pounding.

The New Balance Team

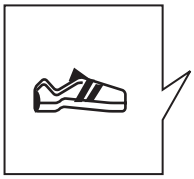


Marketers

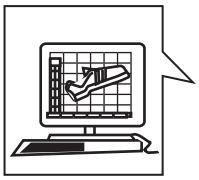
Identify the target customer.



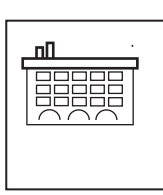
Designers
Create an attractive design with the customer in mind.



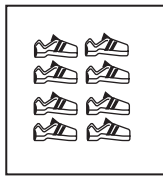
Biomechanical Engineers
Determine if the shoe design will fit a human foot.



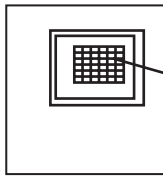
CAD Team Members
Use computer software to further test the blueprint of the shoe.



Manufacturing Associates
The people who will produce the shoes, create and test a prototype.



Manufacturing Engineers
Determine how the shoe can best be manufactured in large quantities



Process Engineers
Are responsible for creating manufacturing systems and training the employees.

Quality Control Personnel
Test shoes before and after they go to the market place.

After we've selected a design that meets all of our criteria and constraints, we create a list of specifications. The "specs," as we call them, detail exactly what materials are in the shoe and how the shoe must be made—from the color of the thread to the rubber in the sole. ***Manufacturing associates,*** skilled staff who actually produce the shoes, then use these specs to hand-stitch a prototype. One of my colleagues makes basketball shoe prototypes in his shoe size so he can wear them around, play basketball in them, and make sure they feel as good as they look. I do the same thing sometimes. We also ask athletes or sports enthusiasts to test our prototypes. They give us an unbiased opinion about comfort, performance, and style.

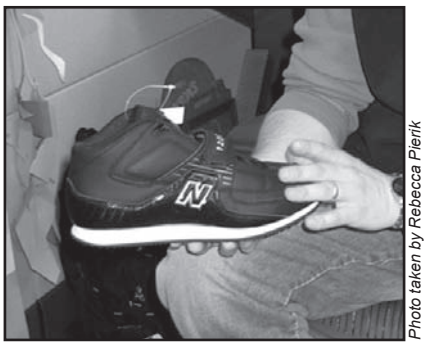


Photo taken by Rebecca Pierik

A prototype basketball shoe

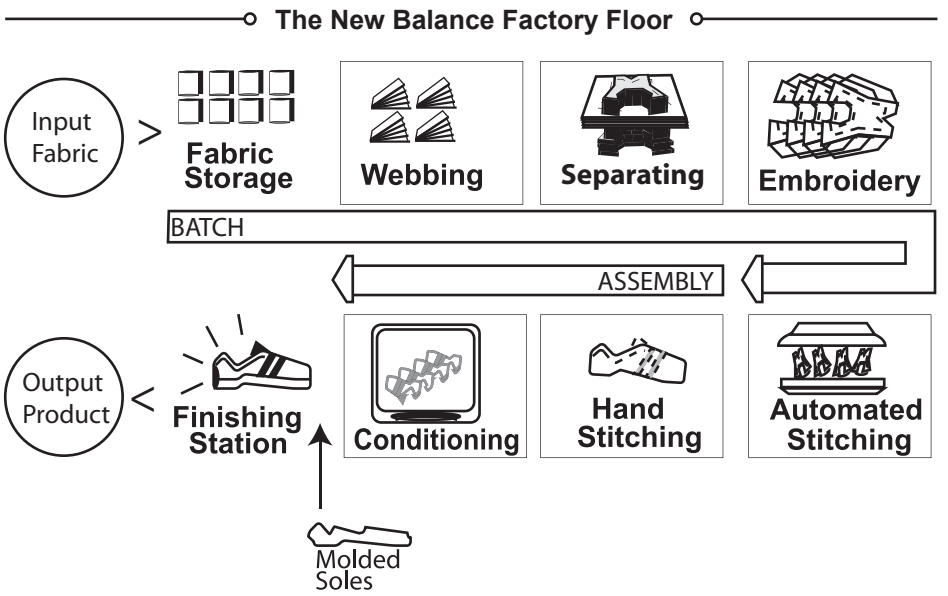
Prototypes often need to be modified. In this prototype, the "N" is off-center. We can't have that! Also, the ankle fits a little too snugly. These are common prototypes issues. We'll revise our specifications to resolve these two issues and, hopefully, in the next round the prototype will meet our requirements.

During the prototype stage, shoes are made in just one size. After we approve a prototype, we make the shoe in a variety of lengths and widths to check that the shoe pattern will fit a range of feet. After we determine that it will, our process engineers design patterns for every possible shoe size.

Finally, the design heads to the factory floor. The process engineers on our team have already prepped the manufacturing associates and set up the machines to make the shoe. Now we get to watch our best designs go into production. Soon, thousands of these shoes will be produced and shipped to a store near you.

Beyond the Idea Stage: Production

We produce more than 4,000 shoes a day at our factory. That's around 900,000 pairs of shoes a year. It's an amazing number when you consider that we only have 225 manufacturing associates on the factory floor. Our success lies in how we've organized the factory. Believe me, we must design our factory systems as carefully as we design our shoes. Here is a simplified layout.



We start by batch producing the shoe parts. In a batch production system, associates create bunches of parts that will be assembled into larger products in a continuous production system. Let's talk about the steps in the manufacturing process.

Separating

We start with large bolts of fabric. First, we cut the fabric into sheets, and then staple the sheets together, a process called webbing. We do this step so that the material can be processed in batches. Next we roll the batches of cut fabric into the die-cutting area. Here, associates use metal cutting dies, which work like cookie cutters, to cut materials into small pieces. The smaller the cutting dies are, the better we can line them up on the fabric without leaving big sections of uncut material.

To make a cut, an associate places a metal die along the fabric. Then a hydraulic press is used to apply pressure to the top of the die, which cuts through the webbed layers of fabric. Excess material is removed, leaving only the pieces that will go in to the shoes.

Webbing
is the process of stapling sheets of fabric together.

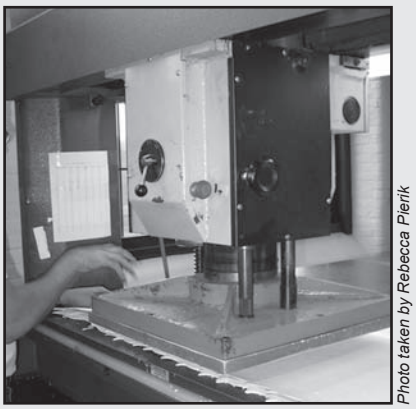


Photo taken by Rebecca Pierik

Separating
is the process of removing unwanted materials.

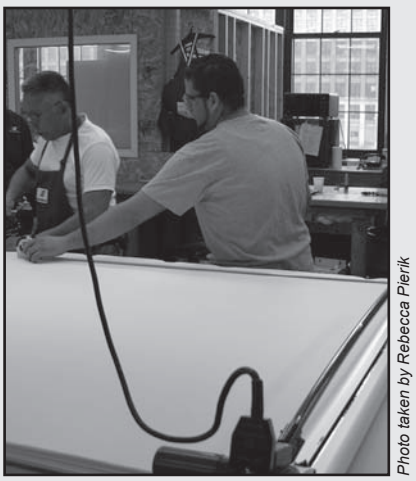


Photo taken by Rebecca Pierik

Forming
is the process of using force to shape a material.

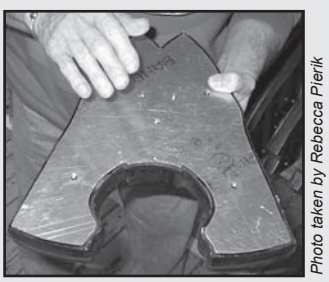


Photo taken by Rebecca Pierik

A cutting dye made by the forming process.

Those of us in the industry call this process ***separating.*** Separating simply means removing unwanted materials. If you've used scissors before, then you've had practice separating materials. Separating also refers to using heavier machinery to remove sections of a tougher material. If you've used a drill to make a hole in a piece of wood, then you've separated materials in this way. Chisels, lathes, and saws also separate materials.

Some shoe manufacturers cut all fabric pieces at a men's size 12 D. Then they remove the excess material and throw it away. Our company doesn't use this process. We use a whole collection of molds that range from women's size 5 to men's size 17. This approach takes a little more organization and time, but it saves material, and we feel it results in a better shoe fit. That's a trade-off we're happy to make.

We control every step of our separating process carefully. We offer our employees incentives to waste as little material as possible. We analyze every piece of cut fabric to ensure that most of the material we buy actually winds up in a shoe somewhere—maybe on your foot! And we resell any unused material to the factory from which we bought it. Those factories can recycle it into new fabric.

Forming

We don't actually make our cutting dies. A company in Portsmouth, New Hampshire, makes them from high-carbon steel strips using a process called ***forming.*** Forming means using force to shape a material. Our dies are made with a press, which forms the strips into the cookie cutter–like shapes.

Assembly

When all of the pieces are cut, they move on to the ***assembly*** stage of manufacturing. Our associates must sew most of the fabric pieces together using sewing machines. If you've ever used a sewing machine, then you know that this step takes a lot of time and labor. In an effort to boost efficiency, some of our associates use automated stitching machines to do some preliminary sewing.

These automated stitching machines work by casting a light that outlines the stitching pattern on the fabric pieces. The machine then takes a picture of the light and sends the images to a computer system. The system triggers another machine part to stitch along the path of light. These machines are extremely accurate and fast. They've helped us boost production a great deal.

After the machines complete the first stages of stitching, the rest of the stitching is done by hand. Skilled associates stitch fabrics with great precision. They don't use any guides to do this, just concentration and a steady hand.

Automated machines have led to the development of highly efficient manufacturing systems in recent years. In fact, some factories have grown so efficient that they don't use human laborers anymore. As a result, many people have lost their jobs to machines. Sure, these new technologies have led to greater profits for company owners. But at what cost to society? Many people now face unemployment and must get more training or education to find new work.

This is a trade-off that our owner, Jim Davis, is not willing to make. As a policy, Jim never lays off associates in exchange for making manufacturing processes more efficient. When we started using machines, associates were retrained to work in other parts of the factory. This approach costs the company money, but according to Jim, New Balance employees won't be as happy or as productive if they fear that their jobs may get cut the moment a new technology comes along. And no one will have an incentive to look for faster and better ways to make shoes if those improvements might jeopardize their jobs. Jim thinks that it's worthwhile to retrain associates or move them to other locations, and I think he's right. What do you think?

Molding and Casting

As soon as the body of the shoe is stitched together, it's time to attach the sole. We aren't able to make all of our soles, so we have to buy some from a manufacturer in Asia who produces them based on our specifications. The soles are made using a process called ***molding.*** A mold is created in the size and shape of the sole, often out of plaster, then a liquid sole material is poured into a prepared mold (not unlike an ice cube tray) and allowed to solidify. After the sole material hardens, the finished sole is removed from the mold.

Assembling
refers to the process of putting the parts of a product together.

Photo taken by Rebecca Pierik

Much of shoe assembly involves hand stitching.

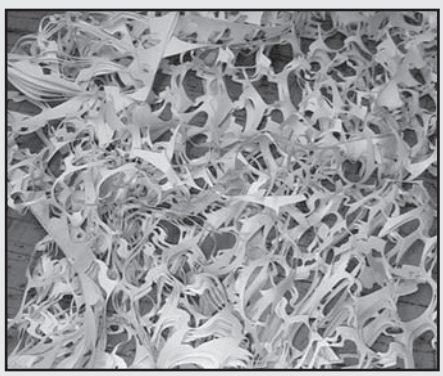


Photo taken by Rebecca Pierik

At New Balance, every piece of cut material is analyzed to ensure that we reduce fabric waste.

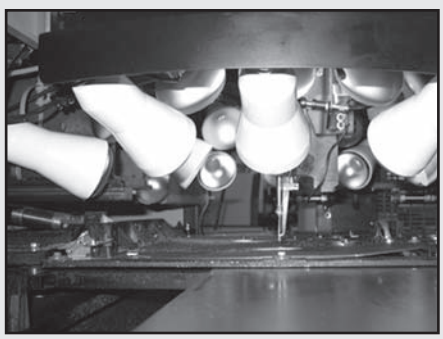


Photo taken by Rebecca Pierik

A machine automates the assembly process—but doesn't lead to job cuts at New Balance.

Molding and casting
is the process by which a material is liquified, poured into a mold of a desired shape, allowed to solidify in that shape, then removed from the mold.

Conditioning
refers to any process that uses high temperatures, chemicals, or mechanical force to change the properties of a material.

Photo taken by Rebecca Pierik

A conditioning machine uses heat to make a strong bond between a shoe and its sole.

Finishing
is any final treatment done to the surface of a product to make it more attractive to a consumer.

You'll sometimes hear manufacturing engineers use the term "casting" to describe a similar process to molding. In ***casting,*** however, the liquid material is a liquid metal or a ceramic instead of a plastic. Most ceramic dishes are made by casting, as are metal utensils and tools.

Conditioning

We don't stitch our soles onto the shoes. They are glued on through an assembly process that uses chemical bonding adhesives. Stitches, on the other hand, are examples of mechanical fasteners—much like rivets, bolts, screws, nails, or staples.

Before applying the glue for the sole, the fabric must be treated to make it more pliable so that the adhesive sticks better. To do this, an associate places it in a machine that heats up the shoe and makes the fabric softer. In manufacturing lingo, we call this ***conditioning,*** which refers to any process that changes the properties of a material using heat, chemicals, or mechanical force. When you apply primer to a piece of wood before painting it, you're conditioning it, changing the wood's surface so that the paint goes on more smoothly. We heat condition our shoes so that the adhesive makes a stronger bond.

Finishing

As soon as the shoes have soles, they are ready to be cleaned and laced—all part of the process of finishing. ***Finishing*** means any final treatment done to the product surface to make the product more attractive to a consumer. Finishing also describes the process of varnishing or lacquering a wooden chair, or glazing a ceramic bowl. We don't paint our shoes, of course, but we do clean off any scuffs, as well as excess glue or thread that may have accumulated during the manufacturing process. Finally, the shoes are boxed and ready to go to our distribution center.

Quality Control

Before any batch of shoes can leave our factory, the shoes must pass stringent quality tests. Our quality control inspector, Ada Cardoza, is in charge of quality control on the factory floor. Ada roams the factory choosing three sample shoes at random from any finishing table. She measures the shoe's heel, the tongue, and the toe; she looks for any visible flaw in the material; she tugs at the sole and yanks on the laces. If she finds any defects in these random samples, the whole batch must be checked thoroughly. We use bar codes embedded in the fabric pieces to track exactly where the flaw originated in the manufacturing process. That way we can learn exactly what went wrong and correct the problem.

After a batch of shoes passes the quality control tests, it goes on to the distribution facility—a 259,000-square-foot warehouse that holds 2.4 million pairs of shoes at any given time. The distribution center receives shoes from the five New Balance factories in New England and combines them with inventory coming from several overseas factories. A constant flow of trucks picks up the shoes and delivers them to retail stores across the United States and Canada where you, the consumer, can buy them.

That's the story of how a new shoe goes from an idea in someone's mind to your foot. It's an incredibly complex route—and we're improving on it all the time. Ultimately, you, the consumer, get to judge how well our system works. The more "Ns" you see walking around your town, the better we're doing!

Photo taken by Rebecca Pierik

Ada Cardoza (right), who's in charge of quality control on the factory floor, and her colleague Leslie Castillo.

What's the Story?

1. Chris discussed seven manufacturing processes: separating, forming, assembling, molding and casting, conditioning, finishing, and quality control. What are these processes, and how is each process used in the New Balance factory?

2. What's a trade-off? What is one trade-off that the New Balance management makes?

Connecting the Dots

3. What processes in the New Balance factory involve batch production, and what processes involve assembly line–style production?

4. Robert Hartmann talked a lot about the importance of teamwork. Who are the members of the team involved in R&D at New Balance? Are they all engineers?

5. How do some engineers at New Balance test prototypes?

What Do You Think?

6. You've just been hired as a consultant to a factory that makes wooden birdhouses. List the seven manufacturing processes mentioned in the chapter, and write how each process might be used in the factory.

7. You've just been hired as a consultant to a second factory. This factory makes ceramic coffee mugs. List the seven manufacturing processes mentioned in the chapter, and write how each process might be used in this factory.