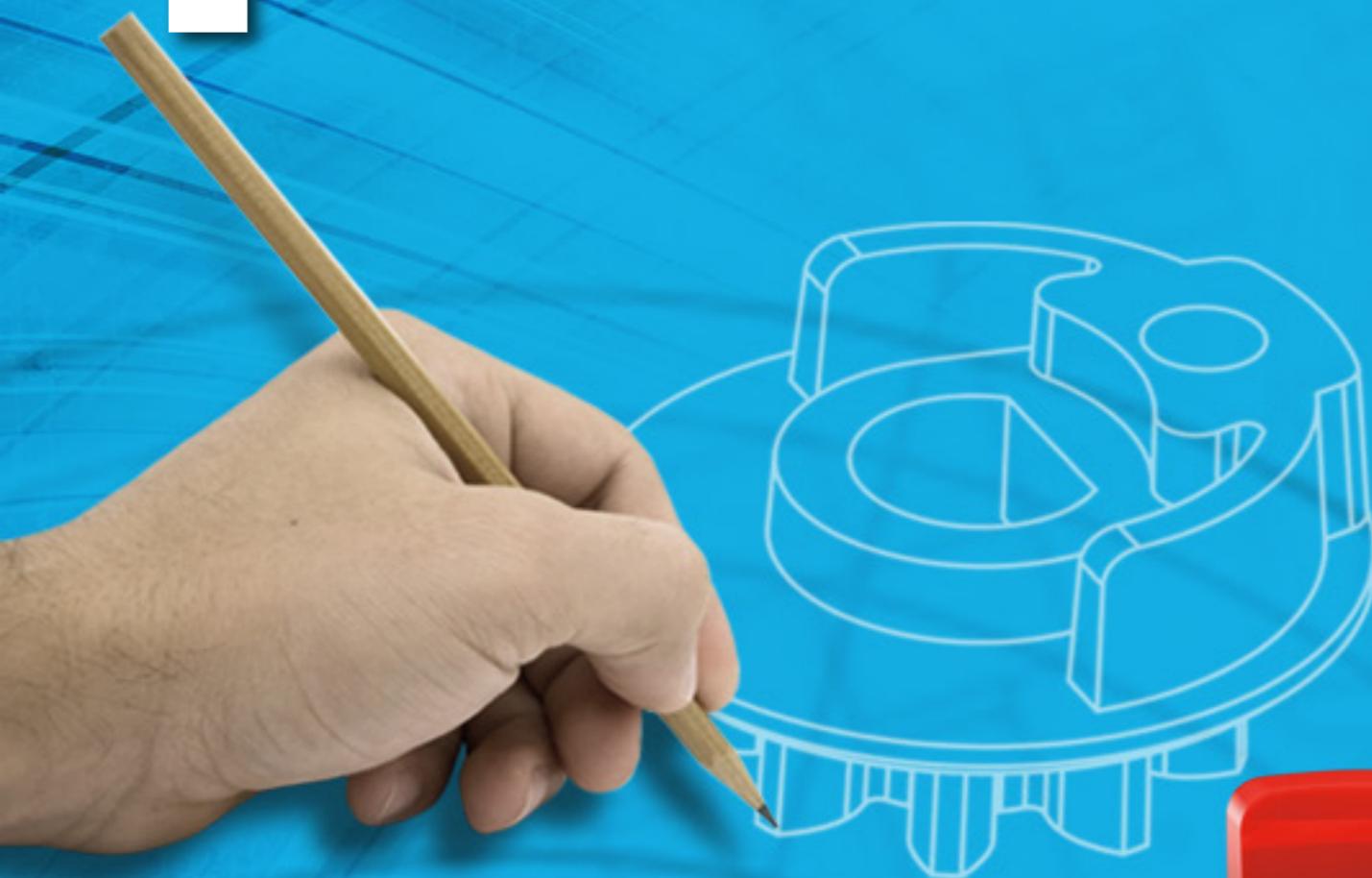


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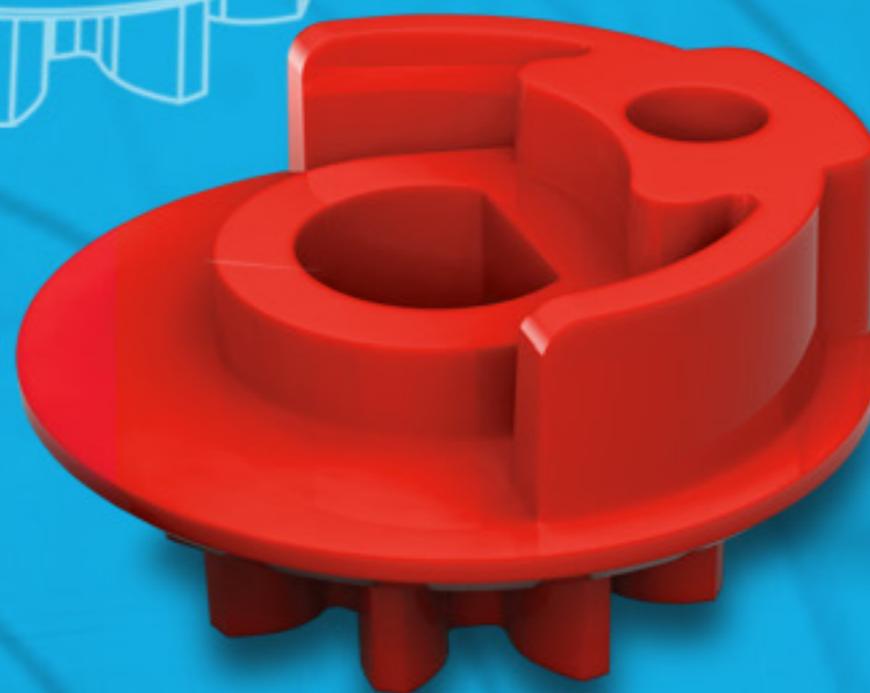


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or not **2D?**
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HOW ARE WE DOING?

“Proto Labs is the first vendor I think of to use based on speed and quality.”

— John Michalko, Philips Color Kinetics

“Everything about the prototyping process with Proto Labs was great. The quoting process was fast and easy and the parts arrived 4 days before you promised them. Our company will definitely be using Protomold in the future for our prototyping needs!”

— Blake Anderson, Polaris Industries

“Proto Labs is setting the standard for prototyping. Your Firstcut service is as fast as having the machine tools in-house, maybe even faster because I did not have to detail any prints for my parts. The website is fantastic and customer service was great.”

— Sean Johnsen, LI-COR Biosciences

“I’ve had a great experience with Protomold and Firstcut. I will continue to use and promote them with my customers.”

— Chirag Patel, TXS Industrial Design

“The speed of manufacturing and delivery, along with cost, makes Proto Labs an excellent resource for engineering and development.”

—Carolynn K, Aerospace Engineer

“Thanks for your fast service, it truly is remarkable!”

— Nick Levin, University of Minnesota Formula SAE

We would love to hear from you!
Send your comments to us at news@protolabs.com.

Here at Proto Labs, virtually every aspect of our business involves change. The parts we make either improve existing products or are components of entirely new ones. The processes we use to make those parts evolve as we enhance the software that makes it all possible. Some of our changes have been incremental, such as expanding the size and complexity of the parts we can support or adding materials from which they can be made. Others, like the introduction of fully automated direct machining at Firstcut, have been completely new. Like our customers, we grow and change in response to the needs of a market of global product developers that continuously seeks new and improved services and then rewards those who provide them quickly and capably. And while most of the technologies we use enable us to do what we do better and faster, in this issue of the Journal we look back—and forward—at the technology that made what we do possible in the first place: 3D CAD.

When CAD first appeared (in just two dimensions) it automated drafting but did not fundamentally change the process or its output. A 2D CAD drawing might take less time to produce than a hand-drawn plan, but turning the CAD model into parts or molds required the same sort of

human intervention needed with pencil drawings. 2D CAD automated one step in a complex process while still leaving multiple potential entry points for error. 3D CAD, on the other hand, enabled the potential of a seamless process. The 3D CAD model was more than a mere projection. It was a virtual part that could be rotated in space and allowed to interact with other parts. With the addition of material data, a part could be tested using finite element analysis (FEA). And with suitable software it could be turned into toolpaths to drive the production of physical parts, all with little or no human intervention or risk of introduced error.

At Proto Labs, 3D CAD is the foundation of virtually everything we do. Our proprietary software turns data from customers’ 3D CAD models into automated quotes with design feedback

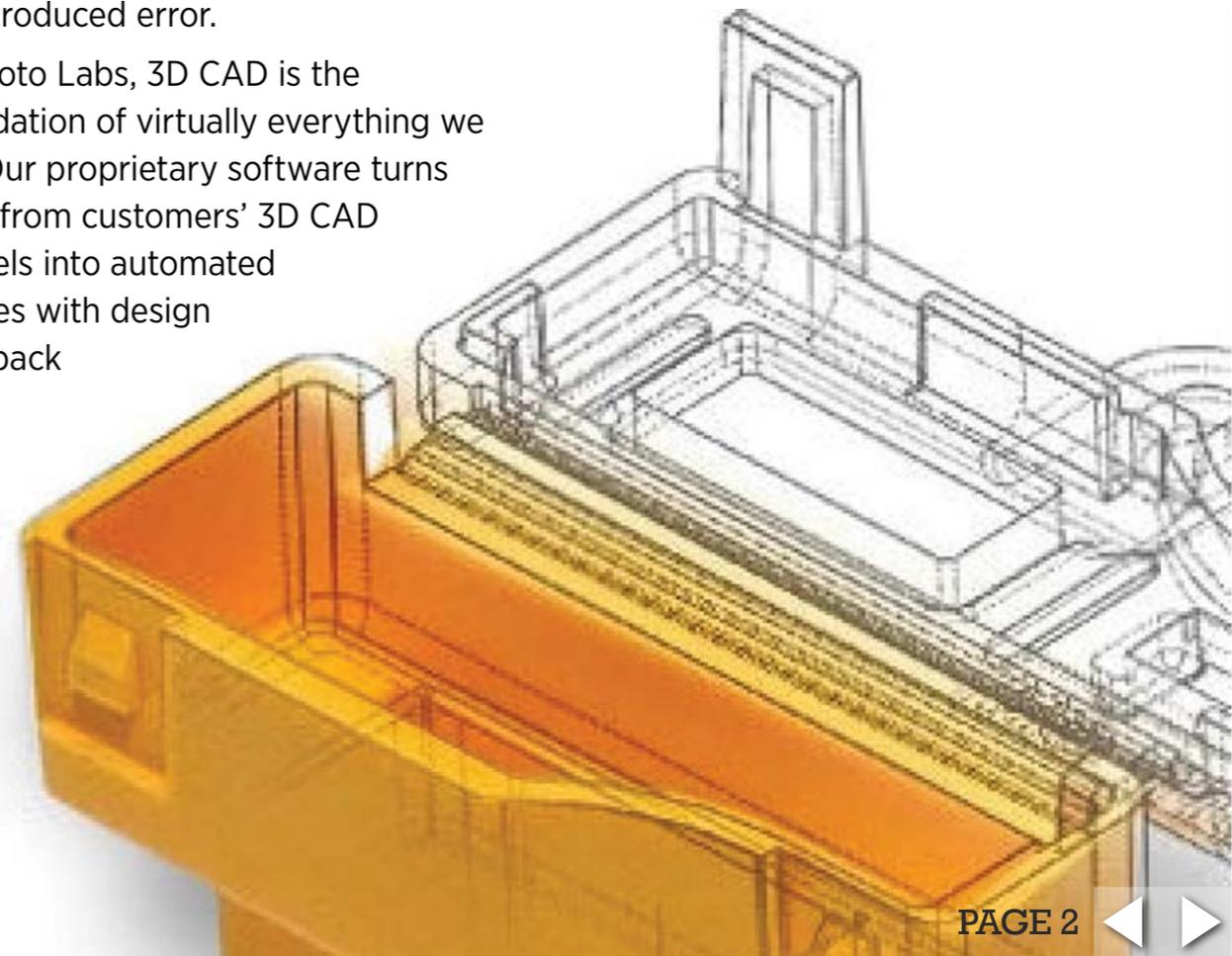
→ WHAT’S UP?

including fill analyses from our ProtoFlow® simulation tool. 3D CAD also enables us to automatically generate the toolpaths to mill parts from plastic or metal at Firstcut and mold components at Protomold.

In the end, we are probably 3D CAD’s biggest fans, and we are excited about the additional ways the technology will enable us to serve product developers as we move ahead.



Brad Cleveland, CEO
brad.cleveland@protolabs.com



EcoXpower



It's not the first gadget out there to use the energy you generate pedaling a bike to produce electricity. But the EcoXPower is the first one to use pedal power to charge your smartphone or GPS and simultaneously provide electricity to your front and rear safety lights. The EcoXPower has two components—a handlebar-mounted water-resistant touch screen case for your mobile device, and a unit that attaches to your front wheel hub and uses a clutch to engage the wheel's moving spokes—converting kinetic energy into electricity. On the down side, some reviewers note that devices like this can make it harder to pedal, thus detracting from your cycling performance. So leave it home on your next Tour de France. This is literal empowerment, friends, and it's yours for 99 bucks.

www.ecoxgear.com/ecoxpower

The Nest™



Well finally! The wait has been long, and the knotted cords endlessly provoking, but at last it's here—an earbud storage system that prevents tangles, protects the equipment, and fits handily in your pocket or purse. The Nest™ Earbud Protector features a patent pending design that lets you wind up your earbud-style headphones in seconds and pull them back out instantly. No tangles, no damage, no muss, no fuss! The website shows it in a bright blue, with the caveat that “color may vary.” So you don't know what color your Nest might be, but who cares? It's yours for under 10 bucks, a small price to pay for lightening the aggravation load.

www.digitalinnovations.com

Logitech Washable Keyboard



When you think about it, computer keyboards can get pretty gross. The dust, the crumbs, the grease, the germs crawling around between the keys...Okay, okay. We try not to think about it. Because really, what can you do? Here's what: You wash it. Oh yes you can. The Logitech Washable Keyboard is submersible in up to 11 inches of water, and has drainage holes at the back for speedy drying. With laser-printed UV-coated keys, it stands up to frequent washings. Hand washings, please—the dishwasher would do it in. 12 hot keys let you launch popular applications like email, internet and volume control in one touch. Fast, easy, and mad, mad clean.

www.logitech.com/en-us/product/washable-keyboard-K310

EnChroma sunglasses



Struggling to decipher the maps on the Weather Channel? Wondering whether your meat is raw or cooked? Having no idea whether your outfit kills or clashes? When you're color blind you put up with a lot. But now, thanks to EnChroma sunglasses, you no longer have to settle for a chromatically compromised existence. As the EnChroma folks explain it, their lenses “feature an advanced optical coating that selectively filters wavelengths of light responsible for color confusion” resulting in “a breathtaking increase in the variety and purity of colors.” The sunglasses are available with different lens coatings, depending on your type of CVD (Color Vision Deficiency) in “frames with unisex appeal”, and if unisex appeal isn't your bag, you can order them in compatible third-party frames. By the way, if you've ever wondered whether you might be a little challenged in the color vision department, there's a test you can take on the EnChroma website. Fun, and enlightening. Greetings, fellow mild deutans!

www.enchroma.com

2D or not 2D?

In the beginning there were draftsmen. They sat at oversize tables wielding pencils, compasses, rulers, and vellum to produce two-dimensional top views, side views, and all the other views on which production processes depended. If anyone wanted a three dimensional representation they modeled it in clay or built it out of balsa wood and cardboard. Then in the mid-1980s, with the introduction of 2D CAD, everything changed. Suddenly architects, engineers, and designers could create their own drawings, and the remaining draftsmen (and women) turned from pencil to computers, on which they produced models and drawings in a virtual world of X and Y coordinates. As on paper, the solid objects being represented existed in an imaginary cube within which they could be viewed (two-dimensionally) from multiple points of view. And even though the final product was more-or-less identical to hand-drawn, 2D CAD version had many advantages. It was fast, it was clean—

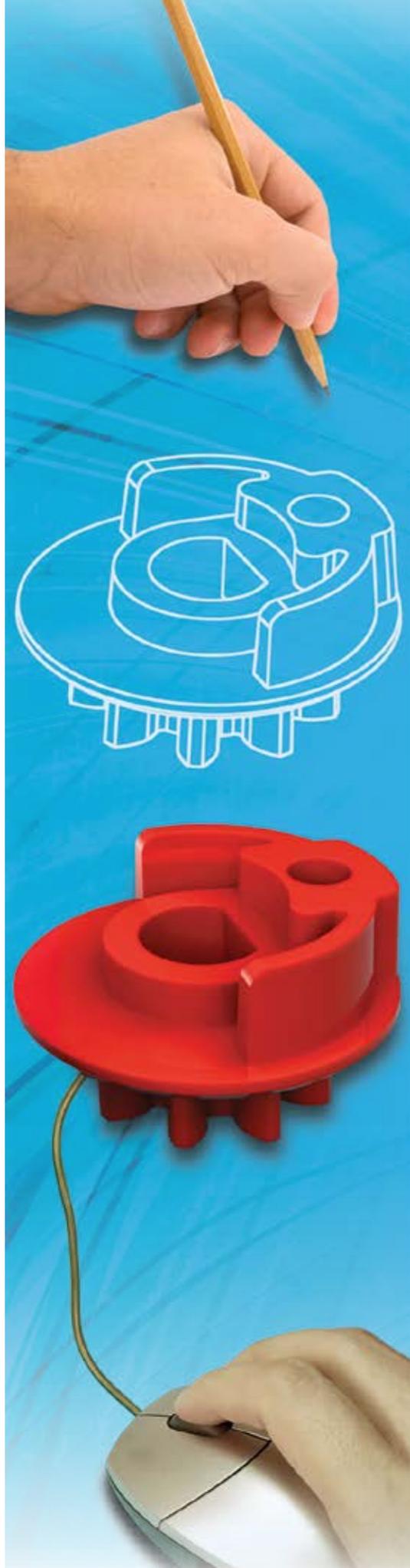
no messy erasures—and CAD could be easily duplicated and transmitted.

A decade or so later another revolution drove CAD, literally, into a new dimension. 3D modeling brought a host of new capabilities. As the technology developed, models could be rotated in space and shown from any point of view. Parts could be assembled in virtual space and checked for fit and motion. They even could be assigned material properties and, using finite element analysis (FEA), tested for weight, balance, strength, and durability.

3D modeling has been eagerly embraced by many in engineering and design, but despite its many capabilities, and for a variety of reasons, it still shares the field with 2D. Some applications work perfectly well in two dimensions and for these, the Z-axis is irrelevant. Utility companies doing infrastructure mapping, for example, can work comfortably in layers of 2D. On a smaller scale, circuit board design can be a simple two-

dimensional process (again in layers), quickly and completely accomplished without moving off the X-Y plane in any single representation. And even for those using 3D CAD, annotated 2D drawings derived from 3D models may still be useful.

While a 3D model may contain all the geometric information needed to manufacture an “ideal” specimen, it may not include potentially critical information that cannot be represented geometrically like tolerances, packaging instructions, cosmetics, mil specs, etc. For that reason, 3D models may be accompanied by 2D drawings containing notes regarding these and similar items for use in manufacturing. In addition, 2D drawings may be used by buyers in developing specifications and by inspectors in quality control. But even when these 2D drawings are used, they are often derived from 3D CAD models, and where 3D hasn’t taken over areas of design it is working its way into prominence, and for good reason.



IN THEIR OWN WORDS

Proto Labs staff and customers have opinions (some quite strong) regarding 2D and 3D. Here's a sampling:

Rodd Joos, Technical Operation Manager, Proto Labs: "I think 2D is a long way from becoming obsolete. I think at first CAD data will supplement drawings and then eventually replace them. However, dimensioning rules and techniques like GD&T will remain. They will be embedded into the 3D model."

Kevin Crystal, Sr. Engineer, Proto Labs, retired: "In Proto Labs, the 2D drawing is ignored and the 3D model plus a few choices when the quote is finalized entirely define the design. On all my designs that I order outside, and I would guess many other companies, the 3D model defines the vast majority of the geometry and only critical dimensions and GD&T is on the drawing."

Carlos Carranza, Proto Labs customer: "I started drafting using a board in the late 80s, then started using CAD (AutoCAD) in 1990. In 2000 our company moved us to 3D CAD. Today we strictly use 3D for designing. I see 3D design eventually going to full 3D dimension on the computer (like hologram)."

Chris Crowley, Table Mountain Innovations: "I am truly SHOCKED when I find out a customer is still using 2D tools. Many Asian vendors can accept 3D files but then REDRAW the parts in a 2D tool and send the PDF back to me for approval. I never use 2D CAD anymore. Occasionally I will make a 2D print from a 3D file to use in my machine shop. I HOPE that 2D tools die a quick death, but they have been hanging around for a while. There is still a need for 2D PRINTS generated from a 3D file, mostly as placeholders in a document control system or as a reference for incoming inspections, etc."

Bill Raridan, Proto Labs customer: "[From 1970 to the present] I've used pencil on vellum, ink on vellum, AutoCAD, Pro/engineer, and Solidworks. 2D is lame, 3D is the only way to represent 3D objects. 3D drives quick turn prototyping, machining, 3D printing, AND it prevents human error in creating 2D inputs to the same folks."

3D has many notable virtues. As noted earlier it allows manipulation in space of a single component or of multiple components and can be used in finite element analysis to examine performance aspects of the design. Because it represents the real-world appearance of an object it is ideal for presentation to those unable to read drawings. And perhaps most important of all, 3D CAD models are becoming required input for an increasing number of production processes including Proto Labs' rapid injection molding and automated CNC machining as well as most additive prototyping processes.

Still, 2D has a long history and there are still those who choose to work primarily, or at least initially, in that format. Their arguments are that 2D is universally understood and that it is both faster and less expensive than 3D. Those statements are true, but may not be as valid as they sound. Universal understanding of 2D is rapidly becoming less significant in the face of 3D's growing acceptance. And while 2D truly can be faster and less expensive than 3D, the savings are illusory. As previously noted, many 2D drawings are created from 3D models, in which case the time and cost of 3D is already factored into the process. And for those who work directly in 2D, the 2D process itself may be fast and inexpensive, but the work and cost are actually being passed downstream to

whoever has to create the 3D model for use in manufacturing. And of course there is always a risk of error creeping in when converting a design from 2D to 3D, which is not true in going from 3D to 2D.

As 2D did for many years, 3D has had its own standard—ASME Y14.41-2003—for nearly a decade. This was created in recognition of the technology's growing use without any standard in place. So while 2D as a primary method for defining designs may have made sense when products were simpler, and prototyping was a final step before manufacturing, things have changed. Today's markets move faster than yesterday's, and anything that slows product development can be costly. Moving your design quickly into 3D eliminates steps, and augmenting the 3D CAD model with a 2D drawing can be accomplished far faster than moving from 2D to 3D. At the same time prototyping is moving to earlier phases of the development process, and most of today's prototyping processes work directly from 3D CAD models.

Bottom line: 3D CAD is here to stay. It has standards and is becoming the primary language of design. There are processes for which it is required, and avoiding it can slow the development process. Best of all, today's powerful 3D CAD packages make it easier than ever to produce sophisticated designs and beat the competition to market.





THE COMPANY THAT COOL BUILT

Larry Lukis, Proto Labs Founder and CTO

Back in 1999, when Proto Labs was a three-person outfit just opening its doors, we had no idea where the business would go—or whether it would go anywhere at all.

What we did know was we'd solved a problem that had kept who-knows-how-many great ideas from ever making it to market—namely that it took so long and cost so much to get working parts for new product designs. I know this from first-hand experience.

There's gotta be a faster way

When my former company started designing plastic printer components, I was floored to find out how time-consuming and expensive it was to get tooling for injection molded plastic parts. Driven by sheer frustration to

find another way, we came up with a process that automated the tooling process to make injection molding much faster and cheaper. That's how Protomold came into the world.

We realized pretty quickly that we were onto something. There were a lot of cool ideas out there that would not see the light of day because of the time and cost involved in prototyping, iterating and proving the design. Protomold could change that game.

Keeping pace with the coolness

What was really exciting about the business right from the start was that we were able to play a part in the development of so many cool products, and in turn, the projects designers brought to us pushed us

to up the ante on our own process. We added size and complexity to our molding capabilities, as soon as we could do it without affecting our turnaround times.

Cool was the fuel for the company's growth, and speed was the engine.

A few years up the road we introduced the Firstcut CNC machining service for very short runs and one-of-a-kind custom parts. Then in 2009 we began operating both the Protomold and Firstcut services under the name Proto Labs, Inc. And at that point things really took off, as we opened manufacturing facilities in the UK and Japan, serving the European and Asian markets. Proof that innovation does not stop during tough economic times, the projects kept coming, and the business thrived throughout the global recession.

Giving back

Then in 2011 we began wondering what we could do to nourish the culture of innovation that has been so good to our company. The result was the Cool Idea! program, which helps people with great ideas for products bring their designs to life with donated Protomold or Firstcut parts. We are excited to be kicking off this program for the 3rd year in a row. It has been incredibly exciting seeing so many ideas for cool products, and being able to make a difference in getting

deserving designs off the ground. But it's not all about altruism. Because let's face it, the Proto Labs crew just gets really geeked out over cool stuff.

Taking it public

That brings us to this past year. In order to support the level of expansion we needed to meet growing demand, Proto Labs went public in 2012. We felt good about what we had to offer, but it was uncharted territory for us. Okay, we were nervous. So we were really gratified to find investors who understood what we're all about and believed in our mission as high-speed low-volume manufacturers.

It was an incredible feeling to see right before our eyes that people are willing to put money on Proto Labs' ability to continue growing, improving, and doing what we do better than anyone else out there.

But more than that, it is great to know that others believe a business like ours, that both fuels and is fueled by innovation, is a smart investment. And that's the whole point. What makes our work so exciting is the opportunity to help bring cool ideas into the world—as fast as possible. So thank you for your business, your support, and your awesome ideas.

We've got the coolest customers in the world.

Firstcut Helps “Muscle Up” Moxy

In fall of 2010, Roger Schmitz and the development team at Fortiori Design first conceptualized the Moxy muscle oxygen sensor, a device that, unlike the traditional metabolic cart or blood lactate meter, could be used in training activities like running or cycling. Existing methods measure overall oxygenation; Schmitz wanted one that could isolate specific muscles, like those in a bicyclist’s leg. He knew that oxygenation could be assessed using near infrared spectroscopy (NIRS) to measure scattering of light in body tissue and believed that the proper algorithm could slash the cost of optics and allow creation of an affordable, wearable unit.

“Our first prototype sensor was connected by wire to a laptop running the algorithm,” says Schmitz. “We needed to shield the electronic components from EMI (electromagnetic interference), but an EMI-blocking coating was too expensive for a handful of prototypes, so we had Firstcut machine shells from aluminum, which blocks EMI. They also made our plastic optics holder.”

When Schmitz first uploaded a 3D CAD model to Firstcut’s online quoting engine, it identified several



design issues. Some holes were too deep, there was a minor aspect ratio problem, and some inside corners needed to be radiused.

“Quotes from other machine shops were more expensive and a lot slower,” says Schmitz. “We made the necessary changes and sent a revised model that Firstcut machined for us,” he says. “Our next version added a radio transmitter to send data from the sensor to a TI Chronos wristwatch for display, along with a microcontroller, eliminating the need for a laptop. This required revised shells, which Firstcut again machined from aluminum.

“Eliminating the laptop let us start real-world testing. We figured we’d need about 20 copies, but Firstcut’s fast turnaround let us start out with four and wait on the rest until we’d identified additional changes. Another nice thing about Firstcut is that they can handle draft, which most machine shops can’t. Draft isn’t necessary in machined parts, but it is for molded or die-cast parts, and we wanted our prototypes to be as close to production designs as possible.

“We’re in the final stages of development,” says Schmitz. “Moxy needs to be fully gasketed, both to



withstand sweat and to be used by swimmers. Future prototype versions of the shell will be injection molded plastic with EMI-blocking coating. The device will be drop-tested, vibration-tested, water-tested, and lifecycle-tested, and we’ll build and break between 50 and 70 units to make sure it’s bulletproof. We’ll use Protomold, which I’ve used before with great success, for molded plastic parts. The short lead times and transparent quoting at Proto Labs will help us easily meet our goal and bring a fully-tested product to market in summer of 2013.”



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pl Join the discussion!

Email article ideas, cool projects or great design stories to the editor at stacy.sullivan@protolabs.com.

A quick look at what's new from Proto Labs

WEBSITE ENHANCEMENTS UNDERWAY

Recently a number of improvements have been made to the protomold.com and firstcut.com websites that will make your account management and ordering experience as simple as possible. Many of the upgrades have taken place behind the scenes to make the process easier for customers, but there are a good number of changes that you'll see on your next visit. The most exciting and noticeable piece you'll see is the Protomold and Firstcut portals have been integrated into one and can be found under "My Account" on the main navigation bar. So now quotes, carts and orders can be viewed and managed as one.

Go check it out; we think you'll like what you see. Further enhancements will continue to roll out over the coming year, but rest assured we will keep you informed.

NEW METALS FOR MACHINED PARTS

We're excited to announce that we are now offering machined parts made in stainless steel (304/304L or 316/316L), steel (1018 or 4140), magnesium and copper. We are also making the necessary capital equipment investments to support the anticipated demand for these new metals, all of which is a part of our ongoing effort to expand our existing capabilities and bring new accelerated manufacturing processes to market.

HIGH TEMPERATURE RESINS

Customers can now have quick-turn injection molded parts made in a variety of high temperature resins including Ultem[®] (PEI) and PEEK. Parts made from these resins are often used in medical/healthcare and food contact applications.

Ultem[®] is a registered trademark of SABIC.

CATCH US AT THESE TRADESHOWS

Pacific Design & Mfg

Feb 12-14, 2013
Anaheim, CA

Strategies in Light

Feb 12-14, 2013
Santa Clara, CA

AeroDef Mfg / Composites Mfg (SME)

Mar 18-21, 2013
Long Beach, CA

BIOMEDevice New England

Apr 10-11, 2013
Boston, MA

SAE World Congress

Apr 16-18, 2013
Detroit, MI

