

PROTO LABS

JOURNAL

Issue 2 • 2014



REDEFINING ROSIE THE RIVETER

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Women in manufacturing,
then and now

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Retro bikes, mechanized
exoskeletons and cats
chasing lasers!

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Machine shop owner turned
Proto Labs CSE



“ Dang, you guys are fast. Took me longer to bore more coworkers at the water cooler than for you to get me a quote.”

– Eli Lynn, Firstcut customer

“ Proto Labs is one of the easiest, fastest, friendliest companies I have worked with. I would definitely recommend them to others.”

– Paul Jakovac, Cooper-Standard Automotive

“ Any time I need the best quality parts with the proper fit, I use Fineline. Nobody else can touch their work when it comes to making parts such as ours.”

– John Wasko, Motorola, Inc.

“ I have been a machinist for over 30 years and I have machined molds, but now that I am involved in the designing process, your design tools and support was like having my own mold designing team to bring our product to market. I’m looking forward to many years working with Protomold.”

– Darrell Freeman, Blue-White Industries, Ltd.

We’d love to hear from you. Send your comments to news@protolabs.com.



It was pretty obvious during my first visit to Proto Labs’ headquarters in Minnesota that this was a company that had witnessed a tremendous amount of change over the past 15 years. Even more intriguing was the mindset of the company’s executive team and employees that this was just the start; the beginning of a new phase at Proto Labs that will undoubtedly be defined by rapid growth on many levels.

Before there was Proto Labs, there was The ProtoMold Company. It was a very small group of forward-thinking engineers led by its founder Larry Lukis, who wrote the complicated computing code to automate the injection-molding process. When it was apparent that product development engineers not only needed molded plastic parts really fast, but small quantities of plastic and metal

just as fast, if not faster, our Firstcut CNC Machining Service was created. The two services formed a harmonious tandem of manufacturing siblings under the matriarchal umbrella of Proto Labs.

Recently, we introduced a third service to the Proto Labs family, an addition that has, and will continue to grab the attention of engineers, designers, headline

writers and manufacturing companies like ourselves. We launched Fineline Additive Manufacturing to bring three new prototyping processes to our customers. Stereolithography, selective laser sintering and direct metal laser sintering — which are often a significant part of the 3D printing conversation — build parts from the bottom up, letting product designers and engineers prototype with concept models and parts for form and fit testing, before moving to Firstcut or Protomold. We’ve always preached speed and scale at Proto Labs; we now add scope to the mix.

Fineline builds parts layer by layer into a reliable final product. That’s what we’re trying to do here at Proto Labs. We’re adding service layers like Fineline; we’re adding process layers like metal injection molding and liquid silicone rubber molding;

we’re adding material layers like PEEK and PEI; we’re adding these layers to bring you the best possible experience with a breadth of prototyping and production options. It’s this progress that we hope will allow your projects to progress.

Employees are the backbone at Proto Labs, which leads me to our cover story on women in manufacturing. We have many talented women working in all facets of our company, from mold techs to engineers to software developers. We have women running presses and machines on the production floor; we have women making major decisions in boardroom meetings.

Now, the manufacturing industry dips below the total national average of female employment by about 20 percent. And although Proto Labs employs a slightly higher than average ratio, frankly, we’ve experienced similar challenges in recruiting women into an industry that has historically been skewed more towards a male demographic. In this regard, we will continue to voice the potential of what a career in manufacturing holds for women, using platforms like our Journal to do so.

Progress means forward movement and that’s what we intend to do through innovation in our services and investment in the people who drive those services.

Victoria Holt,
President and CEO

Icon Electric-Flyer



Icon is a high-end, custom automaker that recreates and rebuilds vintage vehicles like the WWII-era Willys jeep, early-'50s Chrysler Wagon, late-'60s Ford Bronco and others. Steering down the same retro path as the company's four-wheeled classics, Icon has released a new electric bicycle inspired by board track racers found during the first few decades of the 20th Century. The monochromatic E-Flyer has a hydroformed aluminum frame, Brooks Leather saddle and two driving modes (street and race) that can achieve speeds of 20 mph and 36 mph, respectively. Its asking price, however, is decidedly not vintage.

Retail price: \$4,995.

www.iconelectricbike.com

Cue Health Tracker



We live in an on-demand culture that wants its news, TV shows, movies, meals, even prototypes, instantaneously. The makers of the Cue home health tracker want to add medical results to the equation. It's a simple white cube that lets you test your molecular data in five areas: Vitamin D, inflammation, testosterone, fertility and the flu. Collect a small sample with its wand, place it in one of the five colored cartridges and get test results on a smartphone app (of course) within minutes. The doc in a box will then tell you whether you should improve diet, change workout routines, or go see a human physician before you get everyone sick.

Retail price: \$199.

www.cue.me

Kittyo



It's enough to turn the grumpiest of cats into a frolicking furball. Kittyo is a device that allows pet owners to play with their bored cats when they're not at home. (Some would argue that the owners themselves may be a bit bored. Wait, it has a laser? Never mind.) You can use your smartphone to shoot a beam around the room, which always has a hilarious outcome, and see and talk to your cat through a video camera and speaker. You can also dispense treats to well-behaved felines.

Retail price: \$149.

www.kittyo.com

Advanced Firefighting Apparatus



Resembling a robotic suit that would make Tony Stark envious, the A.F.A. exoskeleton concept was designed for heroes battling a daily menace on Earth. The mechanized exoskeleton – that in theory will outfit firefighters – was the brainchild of Australian graduate student Ken Chen. His design is still in its prototype phase, but that hasn't stopped us from gushing over its impressive list of potential superpowers: 200 lbs. of lifting power, impulse water gun system, mainframe computer, Jaws of Life and foldable axe tools as well as sensor units that help the exoskeleton transfer weight load off of the firefighter. And it's all powered by a lithium-polymer battery. (Sorry, arc reactor not included.)

www.theloop.com.au/kenchen420/project/166140

REDEFINING ROSIE THE RIVETER



Norman Rockwell's 1943 Saturday Evening Post Cover.

The evolution of women's roles in manufacturing from wartime workers to modern manufacturing leaders.

Manufacturing is a different industry than it was in the 1940s, advanced by technology that allows companies to produce things faster, better and more efficiently than ever before. A byproduct of that are new roles focused more on computing code than wrenches and rivets — roles that are being filled by women. But even though we live in a culturally evolved society, modern manufacturing still wrestles with misconceptions of masculinity at times. Where have we been, where are we now and what can we do in the future to ensure that women have an equitable stake in manufacturing?

Wartime women join home front workforce

On December 7, 1941, the United States Pacific Fleet stationed in Hawaii's Pearl Harbor was attacked by Japanese forces, abruptly pushing the U.S. into World War II. Germany and the U.S. declared war upon each other four days later, and by the middle of 1942, the American military was actively involved in both the European and Pacific theaters of the Second World War.

Men and women were being shipped to serve overseas while factories were

being transformed stateside to supply the U.S. with ammunition, weaponry, fortified vehicles, modified aircraft and other military equipment needed to fight in the largest human conflict in history. As factories across the country geared up for war, there were manufacturing jobs that needed to be filled — from the West Coast shipyards in California to Midwestern auto plants in Michigan to East Coast aeronautic manufacturers in Connecticut.

The increased demand for manufacturing workers along with the large percentage of enlisted male soldiers meant that women were being encouraged to join a traditionally male-dominated industrial workforce. Women answered the call in emphatic fashion. During a six-year span from 1940 to 1945, female employment in the U.S. grew more than 6 points to 34 percent, according to the National Bureau of Economic Research, bolstered by dramatic increases within the aviation and munitions industries.

"Employment really accelerated and shifted to higher risk, higher skilled machinist labor during WWII, and that's the general image of the woman worker during the 1940s — she's welding,

she's riveting, she's doing men's work," explains Brian Horrigan, exhibit curator at the Minnesota Historical Society. "However, it should also be remembered that women went into work doing conventional women's work; there was an enormous demand for secretarial and clerical positions... it was just that women in manufacturing at the time was so unconventional, it gave people a sense of newness, of patriotism."

That idea of industrial patriotism was personified through a fictional character dubbed Rosie the Riveter — first referenced in a 1942 song about a female assembly worker, then in J. Howard Miller's "We Can Do It!" propaganda poster for the U.S. government and Norman Rockwell's famous illustration on the cover of *The Saturday Evening Post* in 1943. There have been various claims of real-life factory workers who inspired Rosie, but she is most widely associated with Geraldine Hoff Doyle, a young machine operator in a 1940s Michigan metal factory. The bandana-clad, muscle-flexing Rosie eventually grew into an American cultural icon symbolizing female empowerment in the 21st Century.

But was it purely a sense of patriotic duty that compelled women to take factory jobs? Not exactly. Women wanted to and did directly contribute significantly to the war effort, but there were other benefits to manufacturing work. "They were young, they were free, they made their own spending money, and they had independence," says Horrigan. "One of the things that women really remembered was the camaraderie. They remembered very fondly these groups of women who worked and bonded together. It was an emotionally important part of their lives."

The war ended in Europe in May of 1945 with the surrender of German forces, followed by the defeat of Japan in the Pacific four months later. The U.S. was returning soldiers home having won the war, but at the cost of more than 400,000 service members. As soldiers arrived back on American shores and to their everyday jobs, some women remained in an industrial work setting, but many

working in manufacturing left. Some women wanted to give up their positions to war-weary men who needed jobs, some wanted to leave to start families, while others simply lost their jobs, which justly caused a bit of resentment. By 1946, the baby boom was already underway while factories began reverting back to their original production states, which included the disproportionate male-to-female pre-war ratio.

Moving manufacturing forward

In certain ways, the modern face of manufacturing looks much different now than it did 75 years ago. In other ways, it's still a work in progress. Like many industries, manufacturing is being increasingly driven by technology. At Proto Labs, an advanced network of computers translates 3D CAD models into instructions for injection-molding presses, CNC machines and additive equipment. In a matter of days, tools are milled and parts molded; prototypes are machined; concept models are built. Plastic, metal and rubber parts are regularly shipped to the same land (automotive), air (aviation) and sea (maritime) industries that were critical to the WWII manufacturing effort.

Technological progression has led to a completely new job set within manufacturing companies. Whereas women in wartime factories were characterized by a blue-collar, wrench-turning image, women today are design engineers, software developers and corporate leaders of multi-million dollar companies in addition to traditional

machine and press operators. This diversification in roles shines through in national organizations like Ohio-based Women in Manufacturing (WiM).

WiM — run by the Precision Metalforming Association — hosted its inaugural conference in Cleveland in 2011 to bring women together to network, educate and share best practices. “To our wonderful surprise, we had more than 130 women participate from all over the country in all different levels of manufacturing. Many were from the C-suite [executive level] and owners and presidents, but also many in middle management and production,” explains Allison Grealis, WiM Director. “What we found at that first conference was that there was definitely a huge need for this. Women weren't necessarily receiving the support they needed along the way as they advanced and navigated their careers in manufacturing.”

Four years later, WiM has more than 400 members who have access to the organization's directory, development programs, conferences, online communities and other resources to aid in the advancement of women in manufacturing. They also have collegiate outreach programs to help usher in the next generation of women interesting in manufacturing.

But the fact remains that even though women make up approximately half (49.4 percent, to be exact) of the total workforce in the United States, they only comprise 27.1 percent of the manufacturing industry, according to

the U.S. Bureau of Labor Statistics' April 2014 report on employment. How can we bring that number to a more balanced level? Changing manufacturing perceptions might hold the key.

“It's our assessment, and it's just one opinion, but we think that women don't see themselves in manufacturing; they don't see it as a women's profession. Unfortunately, a lot of it is just a perception issue,” says Grealis. “There's also a national discussion that too few women, and men alike, are getting involved in STEM (science, technology, engineering, mathematics)-related careers, and we now see nationally that it is of great importance.”

By educating women through an open dialog happening online and face-to-face, WiM hopes to shift the existing stereotype of what it means to work in modern manufacturing. “Our goal is to get to a more equitable representation of women and men in manufacturing. We hope to increase that number from a near 30 percent representation to 50 percent, and we want that representation at all levels,” says Grealis. In the words of Rosie, we give that a solid: “We Can Do It!”

Sources: nber.org, history.com, nps.org, U.S. Bureau of Labor Statistics, savethebomberplant.org

Female factory workers at Willow Run work on the wing of a B-24 bomber.

The Battle of Willow Run

The Willow Run Aircraft Factory employed many “real-life Rosies” who worked on B-24 Liberator bombers during World War II. Located in Michigan's Upsilon Township, the historic plant was sold to a developer in 2013 with a plan to convert the property into a facility for researching smart vehicles. A small portion of the plant (about 5 percent) was set aside, however, to allow organizers of the “Save the Bomber Plant Campaign” the time needed to raise \$8 million to “acquire, enclose, secure and power up” a section of Willow Run for The Yankee Air Museum — a museum that has lived in another section of the property for 33 years. On May 1, 2014, campaign organizers headed by the Michigan Aerospace Foundation announced that they secured more than \$7 million in funding, which was enough to begin work on a purchase agreement for the new home of the museum.



Welcome to the Machine Shop

Lisa Benson throws a wrench into conventional thinking.

Rocking a faint purple streak through her hair and piercing eyes that refuse to break contact, Lisa Benson's colorfully charismatic presence is immediate. A new addition to Proto Labs' team of Customer Service Engineers, Lisa spent her previous 20+ years disproving stereotypes as a female machine shop owner unafraid to show people that girls can play in the manufacturing sandbox just as well as the boys.

“I was always very confident in my machining knowledge, so no one could use that against me to make me stumble.”

Her career as a machinist began in 1991 when she left her job as a mortgage closer in a struggling real estate market. She went back to school to prepare for a new profession, but was soon called into the machine shop that her father opened two years earlier to help with production. Lisa would spend the next 23 years learning and running the business at JR Larson Machining — from ordering materials to programming the machines to milling parts. “At a fundamental level, a machinist needs to know how to problem solve. How am I going to hold this metal in the vice? How am I going to make this

work? What am I going to use to make this work?” she explains.

The shop initially housed two manual Bridgeport mills, which is what Lisa cut her teeth on, before adding three-axis CNC machines (much like Proto Labs) a few years later. Production fluctuated in volumes of one to 500, primarily milling parts from 6061 aluminum alloy, but also from a small percentage of plastics like Delrin®, Ultem® and nylon. Much of their early work was for devices used to check circuit boards against weather environments. They also produced industrial parts for machines that labeled various consumer products and developed a program that made ATV license plates.

The staff at JR Larson was both figuratively, and literally, small. Up to 15 or so temp workers would be brought in when workload dictated, but the shop was essentially a team of three — Lisa, her father and a role that was filled by a rotating cast of canine companions most recently held by her current pup, a Maltese Yorkie named Henry Bobber. Henry's predecessors included, in no particular order, an English Bulldog, Boxer, Yorkie and Shorkie (Shih Tzu Yorkie).



In 2010, Lisa officially purchased the company from her father. What was it like working at, and then owning, a machine shop? She describes the challenges of being a female in an industry that remains weighted towards men. Lisa would get openly criticized by some customers who specifically wanted her dad to set up and run their parts — especially during her first years as a machinist. “I encountered trust issues. I'd get tested with how much I knew, how fast I could do things,” she says. “But I was always very confident in my machining knowledge, so no one could use that against me to make me stumble.”

In the instance that a customer would request a man-made part, they would get directed back to the one who knew how to best mill that part — Lisa. “I've always said, don't ever assume who you're talking to on the phone or in person. You don't know. You could get the janitor, or you get the owner,” she says. “I can have long fingernails, and machine a part, too. I just can't wear high heels [laughing].”

Lisa turned the lights off at JR Larson Machining for the last time earlier this year, closing down the shop after two decades of production. The combination of a tough market and a desire to spend more time with her family led to the difficult decision.

“My time there was wonderful, and it was heartbreaking to close, especially after all of these years,” she says. “When you're ordering metal, cutting metal and running the machines yourself, and have no sales staff, it was too hard to fight the economy.”

In May 2014, Lisa started a new manufacturing adventure at Proto Labs. She's applying the hard-working ethic that was forged during 18-hour work days at the shop to her new position as a Customer Service Engineer. CSEs work with a customer's part geometry, material selection and other design considerations that can improve the manufacturability and production of their parts. As she transitions from paper blueprints and manual milling to 3D CAD models and automated toolpaths for molding, she's training herself to think in the negative by looking at molds that will make the parts, rather than the parts themselves.

With years of manufacturing experience and a strong voice, Lisa's refreshing perspective is a welcome addition. “Yes, I can sew really well, but I can also turn a wrench or climb onto a pallet to reach the top of a Bridgeport mill. I was taught that it was ok to get dirty, so get over here, let's go.”

Propelling Into the Silent World

BlueRobotics is about to make waves with its inventive underwater thruster.

We live on a planet that is more than two-thirds covered in water, yet only a drop

of it has been explored. With the Thruster-100 marine propulsion system, the two-man team at BlueRobotics is hoping their idea will provide the accessibility needed to advance aquatic exploration to new levels.

Rustom Jehangir and Joe Spadola are the mechanical engineers behind California-based BlueRobotics. Over the past nine months, the company has developed a design for an affordable and reliable thruster that affixes to marine vehicles used in many applications. From collecting ocean temperatures and monitoring current readings to filming exotic sea creatures and searching for lost shipwrecks, the adventurous spirit of a certain red-capped explorer named Cousteau is evident in the ambition of BlueRobotics.

The idea for the thruster began when Jehangir and Spadola were looking for an interesting engineering project to work on. “We thought it’d be cool to take a surfboard and put solar panels, propellers, a small computer and GPS on it and send it from Los Angeles to Hawaii,” explains Jehangir. The path of the autonomous solar boat involves a two-and-a-half-month trek across the Pacific – one that requires a motor and propeller unit that can power it throughout the lengthy duration while surviving the corrosive nature of saltwater.

They started researching the hardware needed, but every existing propulsion system was way beyond their budget with an average motor and propeller cost that exceeded the rest of the components combined. As they dug deeper, a trend emerged. “There’s a developing online community of people who are doing marine robotics projects for fun and ecological reasons. And they’re all having the same problem,” explains Jehangir. “They don’t have an affordable underwater thruster.”

Their initial two prototypes resembled existing thrusters. They purchased a brushless motor, enclosed it in a sealed tube and built a magnetic coupling to drive the propeller.

The coupling allowed the motor to be completely sealed from the surrounding seawater. The first iteration used an axial magnetic couple, which was replaced in the second prototype iteration with a radial magnetic couple that didn’t require a steel thrust bearing that would corrode and require lubrication. Parts were manually lathed out of ABS plastic and more complex parts were 3D printed.

“Our prototypes worked, but our part count was high with all of the extra pieces and magnetic couplings. The thruster was big and long because it had to fit all of the components in it and we realized that it was still going to have the same issues that other thrusters have like depth limitations and oil that could spill and leak,” says Spadola. “We ended up cutting the part count in half. What we came up with is a much more robust, much more capable design.”

BlueRobotics prototyped its revamped design with parts made from stereolithography (SL), then rigorously tested them in saltwater, followed by additional stress testing, all with successful results. Jehangir and Spadola shifted to Proto Labs’ CNC-machining service to thoroughly vet the functionality of the thruster’s plastic parts before moving to Protomold for low-volume production tooling.

The final thruster assembly has injection-molded parts from Protomold that include a plastic nose cone, motor base, propeller, and nozzle and tail cone as well as a mounting bracket. The motor is tightly integrated into the propeller and all of the parts are sealed using a protective coating; it’s one of the differentiating characteristics that gives the thruster its unique ability to resist saltwater corrosion and pressure at very deep ocean depths.

The Thruster-100 is designed for a broad user base that includes hobbyists, students, researchers, filmmakers and photographers, along with various commercial uses. Whether vehicles take the shape of handheld units for divers, surface vessels like canoes, or something yet to be invented, Jehangir sums up an important reason why they wanted to develop an affordable thruster: “It creates this

enabling technology that allows others to build what they want with it.” BlueRobotics is moving towards a summer 2014 release with an initial consumer cost of approximately \$100.



Cool Idea!™ AWARD

The Proto Labs Cool Idea! Award was created to help innovators turn great ideas into actual products. As a recent winner, BlueRobotics received an initial run of CNC-machined and injection-molded plastic parts manufactured by Proto Labs. “We were both pretty blown away by the quality of the Firstcut parts and they made quite a difference versus our old 3D-printed parts,” says Jehangir. “I’m proud to say that the Thruster-100 is now more efficient than nearly every thruster for which we have data.”

Since 2011, the Cool Idea! program has awarded 18 winners and more than \$600,000 in Proto Labs services. To celebrate some of our past recipients, we hosted a gallery event (coolideaaward.com) in New York that featured their finished products, followed by showcases at GE Garages and the IDSA Southern District Conference. Later this year, Cool Idea! will be in the Bay Area. If you have an idea that will blow us away, apply now at protolabs.com/cool-idea.

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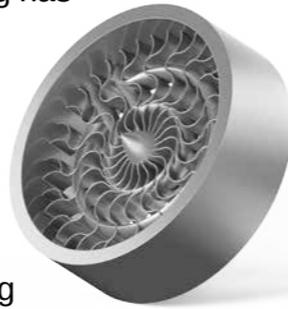
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Join the discussion!

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

FINELINE JOINS PROTO LABS

Additive manufacturing has arrived at Proto Labs. In April, we acquired FineLine Prototyping, Inc., a North Carolina-based company of 84 employees specializing in three rapid prototyping processes: stereolithography (SL), selective laser sintering (SLS) and direct metal laser sintering (DMLS). With the addition of a third flagship service at Proto Labs, product developers have a trio of distinct manufacturing processes to choose from — regardless of what prototyping stage they are in — all in one place.



Stereolithography uses precision lasers that draw on liquid resin to build parts layer by layer in normal, high and micro resolutions. SL has a wide selection of materials, can create the smallest of prototypes with even smaller features (minimum feature size in micro-resolution is 0.0016 in.) and works well for concept models and form and fit testing.

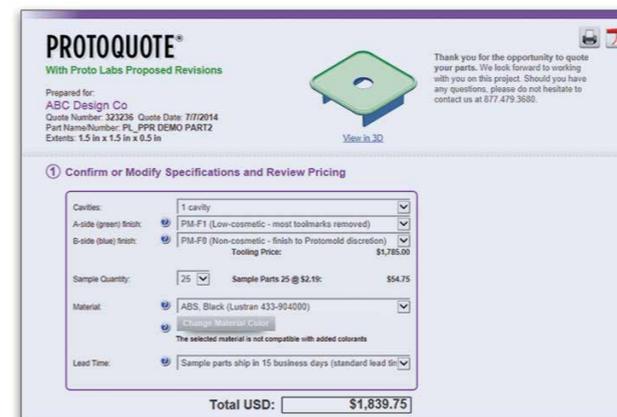
Selective laser sintering draws on a bed of thermoplastic powder to create a fully sintered Nylon-based part. SLS offers a large build volume, can produce part with highly complex geometries and creates tough, durable prototypes.

Direct metal laser sintering builds production-quality metal parts (stainless steel, titanium, aluminum, etc.) using a laser system that draws onto a surface of metal powder. DMLS parts can serve as functional metal prototypes with the potential to transition into metal injection molding.

We're now offering SL, SLS and DMLS to our customers. Just like with Protomold and Firstcut, if you're interested in having parts built through our Fineline service, you can upload a 3D CAD model (.stl file recommended) and receive a quote within hours. Typical turnaround times range from one to seven days for shipped parts. Visit our website to see if Fineline is a good fit for your project.

QUOTING ENHANCEMENT

Our automated injection molding quoting system, ProtoQuote[®], has received a tune-up that will make ordering parts faster and easier. In addition to the free manufacturability analysis that comes standard with each quote, if your design has moldability issues in areas like draft or wall thickness, you'll get a new model with proposed revisions to your geometry directly within your interactive quote. You can accept the new model, or modify your original. Most parts that contain new models with proposed revisions can be ordered right away. The enhancement to ProtoQuote translates to faster parts.



UPCOMING TRADE SHOWS

IDSA

August 13-16, 2014
Austin Hilton
Booth #211
Austin, TX

IMTS

September 8-13, 2014
McCormick Place
Booth #N6690
Chicago, IL

Design & Manufacturing Midwest

October 15-16, 2014
Schaumburg Convention Center
Booth #423
Schaumburg, IL

Inside 3D Printing

October 21-23, 2014
Santa Clara, CA

