

The Proto Labs Journal

2008 ISSUE 4

EDUCATION How we learn today

Choosing a career as an engineer in today's business environment means a commitment to lifelong learning.

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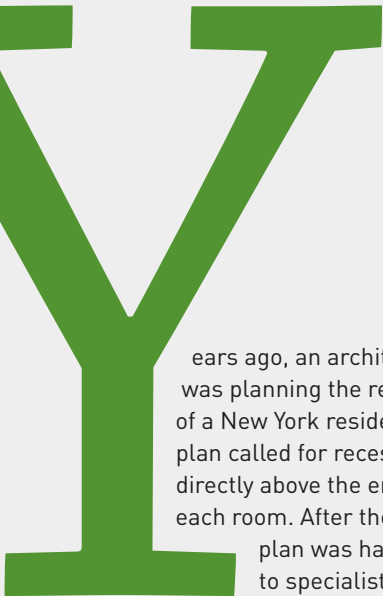
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THE VALUE OF KNOWLEDGE



Years ago, an architectural firm was planning the renovation of a New York residence. The plan called for recessed lighting directly above the entry to each room. After the initial plan was handed off to specialists within the firm for fleshing out, the lighting specialist decided that dropped globe lights would cast a warmer, more welcoming glow and changed the specification accordingly. Meanwhile an interior design specialist decided that the majesty of full-height doors would best suit the large rooms. Unfortunately, no one talked to anyone else about these changes, the workmen shook their heads and followed the plan, and each sumptuous globe lamp was

smashed to pieces by the first person who opened the floor-to-ceiling door.

At first glance, the solution to a problem like this is communication, but in today's fast-paced business environment where speed-to-market is critical, mere communication may not be enough. The product development process typically involves more specialties than ever, and the individuals involved tend to be more specialized. In an increasingly complex environment it pays to know something about the work of those outside your own area of expertise.

Clearly, the purpose of such cross-discipline knowledge is not to be able to do the other individual's work. It's not even to know the answers to questions that may come up. Realistically, it's simply to know what questions to ask (or even when to ask questions rather than merely assume).

For example, a designer developing the plastic shell for an electronic device might be looking at size, shape, strength, button locations, and color in creating a model and selecting a resin. Add some knowledge of electronics, however, and he might contact the electrical engineer to ask whether any of the components of the device will generate significant amounts of heat, a factor that could affect both design and material choices.

In addition to cross-discipline knowledge, high-performance companies have learned to acquire and apply knowledge faster than

their competition by using an iterative development process utilizing multiple prototyping cycles. Smart development teams bring complex products to market fast by incorporating a series of "build-test-feedback-revise" steps into their project. They develop a first version of the product and test it with a customer seeking immediate and early feedback. They then use this real-world feedback to develop the next and more complete versions of the product, rapidly cycling through these iterative steps as many times as needed to perfect the finalized product. Utilizing this process, these fast-paced teams eliminate unnecessary and costly re-work and bring their product to market faster than the competition.

We are devoting this issue of *The Proto Labs Journal* to various aspects of knowledge, its acquisition, and its use in the design process. We've talked to engineers — both long practicing and newly minted — designers, and educators. And we've looked at resources for learning and ways they can be used to enhance the development process. As always, we hope you find the information here useful.

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LIFELONG learning

Things do not change, we change.
HENRY DAVID THOREAU

Engineers must ensure that their technical competencies continue to keep pace with technological change. Adopting the philosophy of a “lifelong learner” will go a long way to maintaining a successful career path.

Several generations ago, a newly-graduated engineer would emerge from college, carve out a niche in one well-defined area of expertise, and remain there for a lifetime. Today, product cycles are shorter and the need for innovation is greater. The pace of technological change has increased, and in response, today’s engineers find themselves switching jobs more often, even if it is within the same company.

Numerous studies have pointed out that the half-life of an engineer’s knowledge — the time it takes for knowledge to become obsolete — is getting shorter and shorter. Estimates range from two to five years, depending on the specific engineering discipline. The rapidly changing technology environment has placed new demands on engineers to acquire more skills and knowledge to function in their day-to-day lives.

Choosing a career as an engineer in today’s business environment means a commitment to lifelong learning.

In a recent Machine Design study (page 8) only 22% of the respondents said that they have access to adequate training for their position. Each project that an engineer works on expands his or her knowledge base, but on-the-job learning, or relying on your company to train you is no longer enough. The primary responsibility for professional development for engineers is now almost entirely in their own hands.

How do today’s high-performing engineers constantly renew their knowledge base? Here are just a few ideas:

- Read books and journals, both in your field of expertise and in tangential areas as well
- Go to professional meetings and listen to the presentations
- Join an Association or Trade Group within your area of expertise — and **go to the meetings!**
- Talk to other people at work, not just engineers, but marketing, sales and customers
- Join a mentorship program — seek out leaders in your field
- Explore distance-learning opportunities and online classes
- Join a Linked-in group, reach out to peers on Facebook
- Sign up for an RSS feed from a technical blog
- Sign up for *The Proto Labs Journal*

From fresh out of school to fresh from a 40-year reunion, our customers are all over the map.

Depending on “vintage,” designers & engineers may have had very different schooling and experience since graduation. But old or new they face the same challenges, and each brings valuable experience to the job.

Dave Nyseth and Steven Hauschulz are engineers at Proto Labs with very different backgrounds. Steven came to Proto Labs directly from college, while Dave held a variety of positions over a period of decades before joining the company. Their careers also show some remarkable similarities.



OLD SCHOOL

Dave Nyseth 1977 graduate, University of Minnesota

I’ve always been interested in design. I took design and drafting classes in junior high school and architectural drafting in high school. I studied architectural engineering at UW Stout and worked in jobs drawing in ink on mylar and pencil on vellum; it was a pretty painstaking process.

I started my own company and bought my first CAD system in 1986. Except for some training in SolidWorks™ and ProEngineer™ along with some business courses, most of what I’ve learned since 1977 has been on-the-job.

Before the Internet we searched out experts in areas we were interested in. We went to associates or contacted companies that made the kind of products we wanted to know about. With the Internet, access is a lot faster, but you still learn a lot by doing.

One of the biggest changes since I was in school has been CAD, which takes the drudgery out of design. It frees me to focus on goals and to pick up the skills I need to keep up in a business that changes a lot faster than it did when I started.



NEW SCHOOL

Steven Hauschulz 2007 graduate, University of Wisconsin Stout

I spent time in high school and college working exclusively in 2D CAD, which gives you a good grasp of fundamentals, before moving on to 3D. Studying engineering at UW Stout, I did internships in rapid prototyping before coming to Proto Labs.

Obviously most of my learning has taken place in school, where education in engineering gives you ways of looking at things and understanding how they work. 3D CAD software lets you model individual components, join them together, and see how they fit and work together. FEA packages (finite element analysis) help verify calculations and identify areas of stress, but without school I wouldn’t have understood what FEA results really mean.

Design is creating new things, which means new challenges. I get information from the Internet and from resources like trade journals, ASME publications, and industry reference books at the public library. My formal education gave me methods for finding solutions that I will always use, but I keep learning from experience — my own and that of other people.

Hands-on learning

Inventables provides client companies with collections of innovative items designed to inspire new thinking about the development of their own products.

There are other ways to learn than at school or from books. Sometimes, just being exposed to new things can set off entire trains of thought and lead to solutions you never dreamed of. That's how we learned when we were kids, and it's an approach that can still be fruitful for product developers.

The online world provides more pure information than anyone could ever want, but in the process, has to some extent supplanted "hands-on" learning. CEO Zach Kaplan of Chicago-based Inventables LLC., believes in experiential learning, and his company is in the business of providing developers with unique products and materials that they can use to address design challenges.

Inventables provides client companies with collections of innovative items designed to inspire new thinking about the development of their own products. Among the hundreds of unique

items being showcased by Inventables are heat-sensitive color-changing plastic, powder coating on plastic, a tilt-sensing chip the size of a pencil eraser, magnetic paint, and a force-sensing bolt that tells you when it's tight.

"I'm surprised sometimes when clients ask whether it's OK to handle the samples," says Kaplan. "The whole idea is to handle them, play with them, even break them. We're happy to replace samples and want users to explore new materials, brainstorm, and come up with something they didn't think was possible."

At Inventables, collecting in new technologies is an assembly-line process. The company sends "Tech Hunters" out across Europe, Asia, and North America looking for ideas, and researchers filter the finds to identify the most relevant and innovative. Vendor advocates then step in to arrange supplies of the chosen items, and an editorial team writes articles describing them for the company's large and growing database.

On the client side, Inventables works mostly in consumer-oriented industries, providing a variety of services aimed at differentiating products.

"We work closely with each client company to determine how to populate their innovation center," says Kaplan. "We start with the executive team, looking at their business and P&L goals and talking strategy. Then we move on to work with their technical folks,



Powder coating on plastic

... talking about areas that drive toward the business goals. We take the information back, prepare their innovation center and list of hot projects. Our goal with the Innovation Center is to have 80 percent of the samples directly relevant to what a client is working on, and the other 20 percent "blue-sky." Our goal with the list of hot projects is to iteratively help them find solutions to their most important product development issues."

A recently-introduced product incorporating an idea from the Innovation Center is the Palm Treo cradle. Micro-suction tape on the bottom of the cradle adheres firmly to any smooth surface. Because it uses tiny suction cups instead of adhesive, it can be removed and placed somewhere else without leaving any kind of residue. "That's exactly the kind of outcome we're looking to facilitate for our clients and their customers," says Kaplan.

Additional information on Inventables can be found at www.inventables.com.



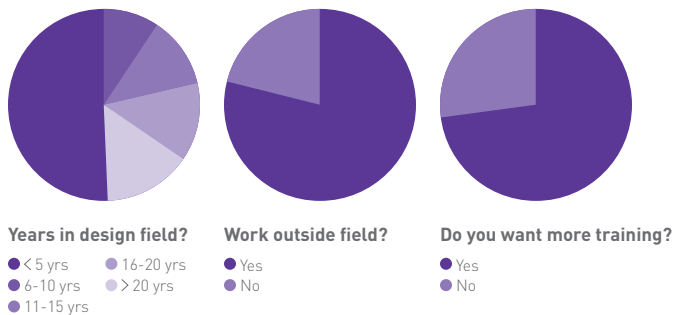
Innovation Center

TRAINING TODAY

Machine Design magazine recently completed a survey* of approximately 1,000 design engineers around the United States. Given the education theme of this issue of the Journal, we thought we'd include some of their results as well as a few of our own observations about the data.

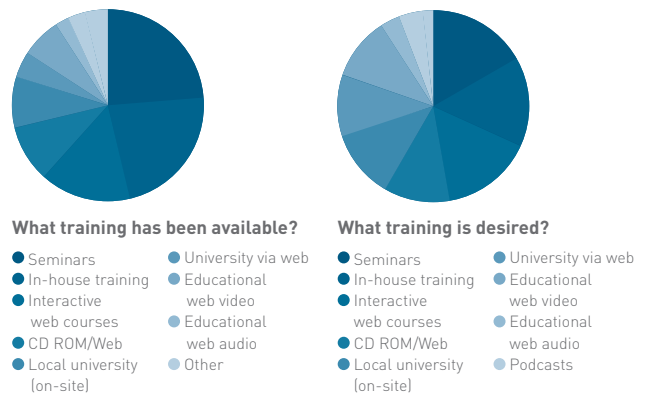
As you can see in the following charts, the survey respondents had a great deal of experience in their field. With over half of them having over 20 years of experience, they are often required to work outside of their degreed field, and they are in need of additional training to do it:

Observation: Design engineers are routinely expected to work outside of their degreed field, and this has been the case for a long time. It also explains why they are seeking training opportunities.



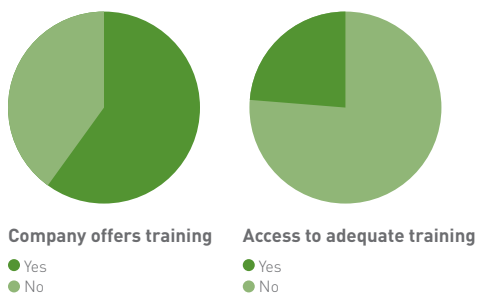
Another interesting comparison is between the types of training that design engineers have available to them, versus what they believe they need:

Observation: Traditional training methodologies such as seminars and in-house training seems to be both desirable and available. There appears to be an unmet demand for training via the web, such as university classes or streaming video.



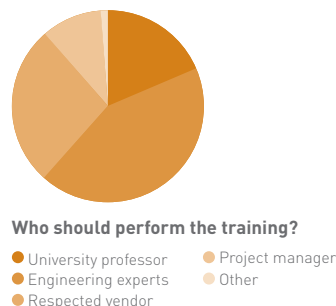
In terms of their training opportunities, the following charts summarize what the respondents had to say about whether or not their company offers training, and whether or not it is adequate:

Observation: The only thing more disappointing than seeing that only 40% of these companies provide training, is to see that only 22% of them do it in an adequate manner.



Another insight we thought was worth passing along were the responses to a question about the nature of the person providing the training:

Observation: It won't surprise any engineers to see that the most credible source of information is other engineering experts. But, it was interesting to us to see vendors come in ahead of university professors.



Resources for online learning

For many of us, the Internet is 24-hour, self-guided graduate school. It places most, if not all, of the world's knowledge, a lot of opinion, and a certain amount of misinformation at your fingertips. With so much information at hand, the challenge can be digging through the volume to find what you need and get on with the job. We offer the following as starting points — a handful of sites that Proto Labs, and engineers and designers we've worked with, have found useful.

Machine Design is a respected source for design and engineering products, technology, and reference information including issue archives going back to 2004.
WWW.MACHINEDESIGN.COM

Technology resources, components, tools, and solutions for design engineers including archives going back to 1995.
WWW.DESIGNNEWS.COM

News, blogs, products, articles, and tips. Self-described as "written for engineers by engineers with an emphasis on applying the engineering fundamentals to real world machine design applications across industries ..."
WWW.DESIGNWORLDONLINE.COM

A Design World resource for mechanical CAD professionals, this site's mission is, in part, "to create a superior community of MCAD users that will help users unleash the power of 3D mechanical design ..."
WWW.MCADCENTRAL.COM

Another Design World resource, this is an online library of 3D models, blogs, freeware, tips, books, tutorials, and more.
WWW.3DCADTIPS.COM

A site addressing, in its own words, "The synergistic application of interdisciplinary engineering fields."
WWW.PROJECTMECHATRONICS.COM

Just weeks old as of this writing, this newly formed global networking community for engineers has already developed nine special interest groups. Seems like a great opportunity to get in on the ground floor of what could be a valuable engineer-to-engineer network.
WWW.ENGINEERINGEXCHANGE.COM

Oriented toward industrial design, this irreverent site provides links to leading edge design and seems likely to expand your thinking, if not your mind.
WWW.CORE77.COM

Connect Press "hosts communities in the fields of technology, energy and leisure time" and invites visitors to join communities like SolidWorks™ Community, Inventor Connections, and more, or start communities of their own.
WWW.CONNECTPRESS.COM

eFunda stands for engineering fundamentals and offers working professionals concise information to meet daily reference needs.
WWW.EFUNDA.COM

IDES describes itself as The Plastics Web® and offers information on all things plastic.
WWW.IDES.COM

This site provides data on materials in eight major categories, each containing multiple materials. Polymers, for example, contains 46,570 individual materials in dozens of subcategories.
WWW.MATWEB.COM

For information specific to Proto Labs services, we offer information on our web sites including:
WWW.PROTOMOLD.COM/DESIGNGUIDELINES.ASPX
WWW.PROTOMOLD.COM/MATERIALSELECTION.ASPX
WWW.PROTOMOLD.COM/DESIGNTIPS.ASPX
WWW.FIRSTCUT.COM/DESIGNGUIDELINES.ASPX

At Proto Labs, we're always trying to bring useful information to design engineers in any way we can, and we hope this has been a good example. As always, we welcome your input on engineering and design-related sites that might be of interest to our readers.

What's New



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WHAT'S NEW AT PROTO LABS?

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We couldn't have said it better ourselves. To view our certification, visit www.protomold.com/ISO.

Fast Parts, Fast Company

Speaking of October, that's when the Minneapolis/St. Paul *Business Journal* named Proto Labs to its 2008 Fast 50, a list of the fastest growing private companies in Minnesota. This annual competition is based on revenue growth over the most recent three year period, and the average growth rate of all 50 companies on the list is 122.7 percent. Proto Labs was number 22 out of 50. (The company's first appearance on the list came in 2004 at Number One.)

Cool Parts, Cool Calendar

Had your fill of cute puppies and postcard shots of scenic wonders? Next time you're trying to remember what day of the week it is, why not feast your eyes on a cornucopia of unique plastic parts. Designed by designers and engineered for engineers, the Proto Labs Cool Parts Calendar features the visions of product developers across the nation and around the world, brought to life in engineering-grade resin. The Proto Labs Cool Parts calendar features real parts from real Proto Labs customers along with design tips, monthly contests, and tradeshow dates, not to mention those elusive days of the week.



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The Protomold and FirstCut customer portals are now open 24/7 at <https://portal.protomold.com> and <https://portal.firstcut.com>. Sign in securely and check old orders, place new orders, view materials inventory, and manage other account-related matters at your convenience.