

May 2017

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Help Wanted!

Everyone is talking about the graying of our industry and the lack of qualified applicants for jobs, ranging from manufacturing personnel to engineers and even management. Who will take over when we retire? Do we simply find qualified individuals or create them? How do we retain them? Find out this month in *The PCB Magazine!*



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Conversation with Peter Bigelow



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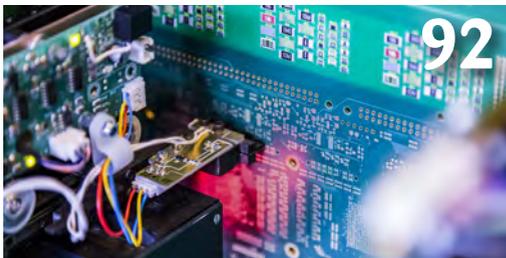


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Help Wanted—and How!

by Patty Goldman

I-CONNECT007

It seems that I am extra-sensitive to topics in the news that coincide with an upcoming magazine topic—I see headlines in newspapers, suddenly the subject comes up in conversations, in email, and even in other media. And I think, is it just me or is everyone talking about this at the same time?

This was ever more so for this issue we're calling Help Wanted! But in this case, it wasn't just because I was sensitized to the topic. Every-

one is talking about the graying of our industry and the lack of qualified applicants for jobs ranging from manufacturing personnel to engineers and even management. Who will take over when we retire? Who will run the PCB fabrication business in another five, 10, or 15 years? Are the millennials we keep hearing about going to pick up the slack or not? (You don't want to hear that again, do you?)

Way back in January you may recall the re-



sults of our 2017 [industry hiring survey](#), where more than half of respondents planned to bring on new employees this year, and half of those were talking the first six months. It appeared that most of the hires would be for technical, operations and sales personnel, which we felt pointed to an expansion in the industry. But the greatest challenge by far that respondents pointed to was a shortage of skilled or qualified applicants.

One thing we can learn from reading or watching news is that it's not just our segment of manufacturing that has this problem. It is pretty much the entire manufacturing industry that is struggling to find people to work in their factories and engineers to keep them running.

What to do about this phenomenon was the topic at the IPC APEX EXPO show in February. It seemed no matter what topic a conversation started with, it ended up with the concern on everyone's mind: how difficult it is to find good people. We put an ad in (wherever) and got no responses; process and quality engineers are nowhere to be found; we hire someone, they quit in short order.

In the March issue of [The PCB Design Magazine](#), Editor Andy Shaughnessy's [column](#) was a great call to action for us all. In a nutshell, we have a problem finding talent in our industry and it's time to stop complaining and go out and do something about it—and a good place to start is with your local high school or trade school. Andy put the onus on all of us to start getting young people interested in engineering and manufacturing even before they get to college and choose a major.

I talked with several people on this subject and a few of the conversations are included in this issue. Theirs were not lists of complaints or sighs of resignation, but rather they offered solutions that work for them. In addition, many of our columnists felt inspired to speak about related issues like leadership, employee recognition, with several offering concrete actions to help.

So, let me tell you about our lineup for May. We start out with a column by Steve Williams of The Right Approach—who started his career as a “board rat.” In his straightforward yet eloquent way, he presents the problem that our industry faces of attracting talent.

Next, we have conversations with the presidents of two PCB companies and a column by a third. The first is with Peter Bigelow, of IMI Inc., based in New England. He is followed by a talk with Dave Ryder of Prototron, with two locations in the Western United States. Columnist Sam Sangani of PNC Inc. (East Coast) follows with yet another viewpoint. These three fabricators are dealing with the same problem, but with somewhat differing perspectives and methods to go about solving it.

Right after this is a very interesting conversation with Doug Pauls of Rockwell-Collins. My original intention was to talk with him about his recent election to the Raymond A. Pritchard Hall of Fame, but our conversation barely got there and we talked at length about their roadshow to high schools, which has shown results.

Since part of what attracts people to a company is the leadership within, we have Dave Dibble of Dibble Leaders, and Dan Beaulieu, DB Consulting, discussing leadership, systems thinking and how the old top-down style of management does not work.

Launch Communications' Barry Lee Cohen devoted his column to the subject of employee recognition. He stresses the importance of a consistent, planned program and the necessity of full participation by management. He notes that the way you recognize achievement is just as important as doing it.

In the continuing quest to learn how more companies are finding and keeping good people, I spent time with the Aimee Miller and Rebecca Brennan, in the HR department of sister companies Compunetix and Compunetics. Their hiring standards are high, with most positions requiring at least an associate's degree, but their benefits are excellent and employees have advancement opportunities so that longevity of employees is not just because they are graying.

Columnist Keith Sellers discusses employment problems—and solutions—from both sides of the fence, recalling his own job search out of college. He offers advice for both the employer and the prospective employee.

And, as luck would have it, I met a young gentleman while cruising one of the local SMTA Expos. Amitron's Matt Hammesfahr is a (drum

roll) millennial who started in our industry a few years ago and is fast becoming a top salesperson for his company. How does he do it and what does he have to say? Go ahead; read it.

Wrapping up the monthly topic part of the magazine is a conversation with IPC's Dave Bergman and Kris Roberson. They lay out IPC's training-to-standards programs, talk about the new EDGE online training, and make a request to PCB fabricators: Tell us what you need.

True to form, we have a couple of technical items for you. Mike Carano, RBP Chemical Technology, presents a troubleshooting guide on hole-wall desmear complete with photos of defects and a list of probable causes.

Regular columnist Todd Kolmodin, Gardien Services USA, outdoes himself with a very detailed technical column on flying probe testing versus the IPC test method. You may not realize that this is not as simple as it sounds. I guarantee you will learn plenty from this article.

Last, but certainly not least, IPC's John Mitchell pulls us in another direction as he discusses international trade and the ever-growing globalization of supply chains. As always, his column is thoughtful and thought-provoking, as he makes the case for multilateral free trade agreements and offers a few words of caution to

our government regarding tariffs and other import barriers, especially with China.

Next month, we will switch gears entirely and turn our attention to the world of embedded technology—those inside our printed circuit boards. Learn about the challenges and solutions along with practical applications. Learn more and the increasing demand for embedded passive and active components to save board real estate and improve yields.

What? You don't know when the magazine is available? Time to [subscribe](#) so it will be delivered to your inbox the moment it's published and you will be up on the latest. **PCB**



Patricia Goldman is a 30+ year veteran of the PCB industry, with experience in a variety of areas, including R&D of imaging technologies, wet process engineering, and sales and marketing of PWB chemistry. Active with IPC since 1981, Goldman has chaired numerous committees and served as TAEC chairman, and is also the co-author of numerous technical papers. To contact Goldman, [click here](#).

It's Only Common Sense: Putting Your Team Together

What do the Boston Red Sox, the New England Patriots, and the Chicago Cubs all have in common? Besides all being winners (and my three favorite teams), they have won by building teams synergistically. By that I mean they build teams by putting the team in front of individual players, which makes the team much stronger.

When Theo Epstein, president of baseball operations for the Cubs, sought and won pitching ace John Lester for a cool \$155 million, he also sought his battery mate, aging catcher Dave Ross, with a sub-200 batting average, for a measly \$5 million. He knew from watching them in Boston that they were a perfect pitcher-catcher duo and that Lester always



did better when Ross was catching him. You might even say he "completed him," (sorry).

The New England Patriots have one star and he wears number 12, and even he is a kind of anti-star. Tom Brady has had dozens of receivers over the years while breaking every passing record in existence, and he did it with a bunch of non-stars (except for bad boy Randy Moss, who was much better behaved as a Patriot than ever before).

Why are these teams so successful? If you want one more example of how putting a team together, instead of hiring a bunch of great players works, then check out the movie *Moneyball*.

To read the full column, [click here](#).

HELP WANTED!

*Attracting New
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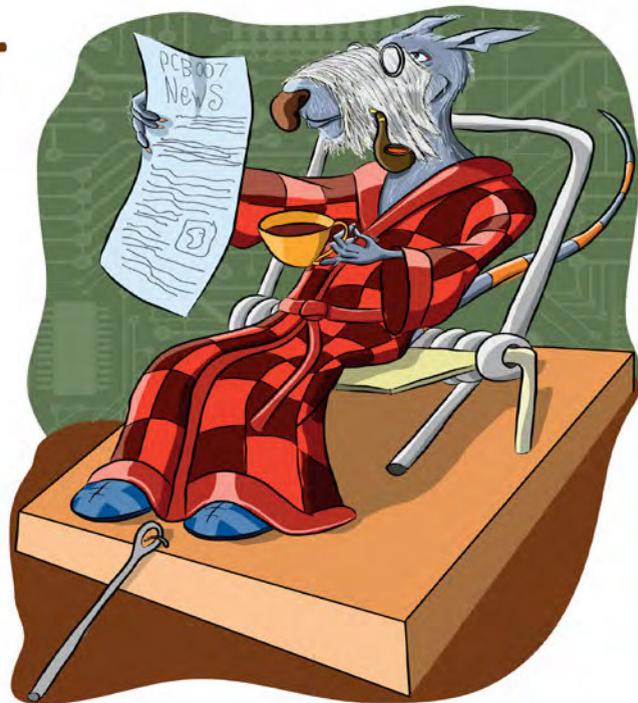
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Finding the Next Generation of "Board Rats"

by Steve Williams

THE RIGHT APPROACH CONSULTING



Introduction

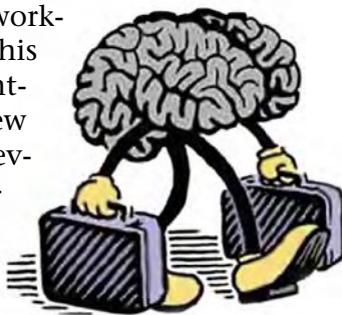
Owners of printed circuit board shops across the country are united in their top concern for their businesses: finding new talent. While this problem crosses all industries, what is unique is the complexity and learning curve of our business.

What is a board rat?

We old-timers affectionately refer to ourselves as board rats; we are lifers in the industry who truly share a passion for building printed circuit boards. For most of us, this was one of our first full-time jobs, starting out sweeping floors, shearing laminate (yes, manually), sanding panels, and doing all the grunt work that "back in the day" meant we were paying our dues. We grew up with the business, could never imagine doing anything else, and advanced through the ranks by good old-fashioned hard work. Many went on to become industry leaders, which includes developing new technology, running plants or owning a shop.

Brain Drain

There is no question that America has an aging workforce, and once again this is neither unique to printed circuits, nor a new phenomenon. However, in my humble opinion, the talent issue facing PCB leaders today is the most challenging I



have seen over my 40-year career. The aforementioned passion is the most troubling part of developing the next generation of PCB craftsmen. In fact, I had this very discussion recently with Mark, an old friend who owns a board shop.

As we spent some time catching up and talking about business, I asked Mark what kept him up at night. He said, "Steve, that's easy—people. I've got several key employees who have been with me since I started the company who are planning to retire in the next couple of years. I just don't know how I am going to replace that talent." Mark went on to lament that the younger people he brings in just do not "love boards like we do." He told me about a recent hire who showed exceptional promise, was absorbing everything like a sponge, and who everyone had very high hopes for. After months of training, she just did not show up for work one day, and Mark never heard from her again. Unfortunately, this is not a one-off.

Dwindling Talent Pool

One of the root causes of this lack of talent is the sheer decimation of the U.S. printed circuit industry. In the mid-1980s, there were more than 1,500 printed circuit board manufacturers in North America. As of this publication, there are only 253 North American PCB

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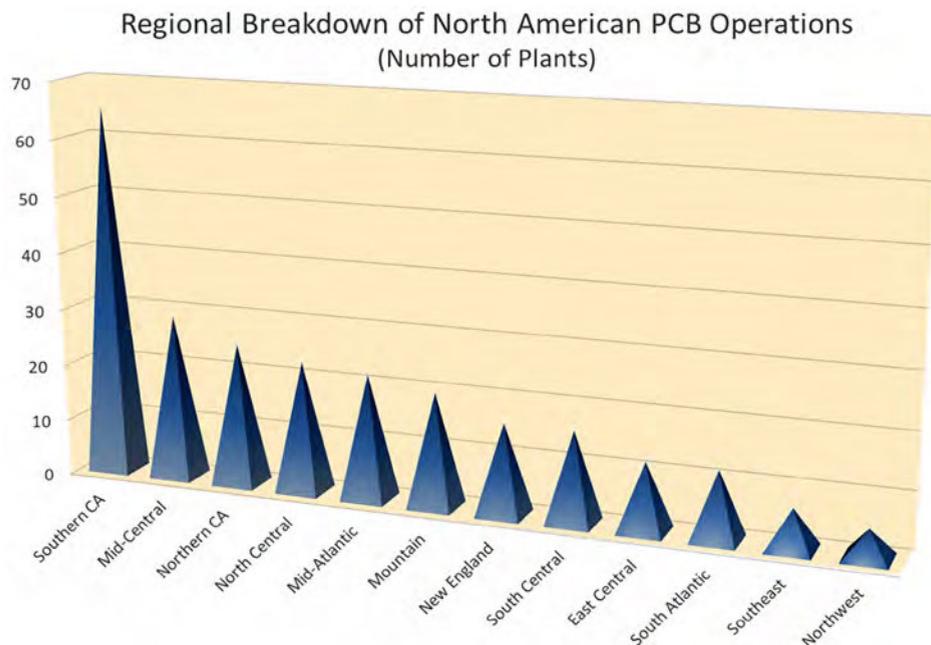


Figure 1: California remains home to the single largest concentration of U.S. PCB fabricators.

facilities (Source: FabFile Online, 2017). Subtract the organizations with multiple facilities plus the companies with primary operations in other countries but may have a plant or two in the U.S., and the real number is closer to 200. I have been tracking this trend for 20 years and predicting the future state-of-the-industry during my lectures. This year at IPC APEX EXPO, my projections for the number of “real” North American operations was 165 operations in 2020 and 100 in 2025. I have been fairly accurate over the years, and if these numbers hold up, it will be staggering. Breaking it down regionally is particularly instructive as it relates to this issue (Figure 1).

Depending on where your shop is located, Figure 1 highlights the dwindling talent pool from which to pull from. Another recent discussion with my friend Dave reinforced this truth. Dave is also a printed circuit board shop owner with multiple facilities. One of his shops is in an area that used to be a mecca of PCB manufacturing, but now finds himself one of the last men standing due to acquisitions, consolidations and closures. Finding local experienced PCB employees is next to impossible and he now competes with tech companies offering office jobs and

plush environments. His biggest problem used to be losing a skilled worker to the local competition for \$0.50 more an hour, a problem he would love to have back!

College is a path, not a right!

A changing society is as much to blame as anyone for the lack of bench strength in our U.S. manufacturing companies. Any young person will probably tell you that college is not a privilege; it is a right. (If you really want to blow your mind, ask them who they think should pay for it.) Not to

paint all young people with an overly broad brush, as there are plenty of hard-working kids with their heads on straight, but compared to past generations, they are a bit of an entitled bunch. Remember the aforementioned hard work, dues paying and understanding that you have to earn what you want? Not so much with today’s youth. Right out of college they expect a cushy desk job with an office and a high salary because they paid their dues just by going to college.

I don’t blame the kids; I blame the educational system that teaches them from a very early age that college is the only choice, and that they are entitled to it. Remember when college was just one of three potential paths that high school graduates could pursue? The other choices were the trades or to enter the general workforce, both providing just as many opportunities, if not more, than the college path. Contrary to what our children are being taught, college is not for everyone, and certainly not for every job. What we have now is an awful lot of college-educated 20–30-somethings asking, “Do you want fries with that?” or choosing to live in Mom and Dad’s basement because getting their hands dirty in a factory job is beneath them. I remember guidance counselors

who actually helped students determine what to do with their life, not just what to do in college.

Second, I also place blame with the parents! We have been seeing the “participation trophy” generation entering the workforce for a while now, and the results are not pretty. Parents who push kids into college to earn a degree that there is little market for are part of the problem. Encouraging their kids to stay at home far longer than ever before are enabling the entitlement syndrome that has created the situation we are in relating to the next generation of manufacturing craftsmen and women. Taking five, six, or even seven years to graduate with a four-year degree is now the norm.

I could write an entire book on how the participation trophy philosophy is leaving our kids ill-prepared for not only work, but life. Sorry kids, but life is not fair, never has been, and never will be. Our children have lost the ability to handle failure and learn from their mistakes—invaluable life lessons. A recent Fox poll of current university students really highlights this point. When asked “What age do you consider yourself an ‘adult’?” The overwhelming response was 30! Wow. When we original board rats were growing up, the answer was 18, and we couldn’t wait to get out on our own.

Not Just Our Industry’s Problem

A good friend of mine, Tom, is president of a sheet metal fabrication company. He tells me that the hardest position to fill is for welders. Welding is a physically demanding, dirty job that requires lots of specialized training and certification. He has to fight with local competition for the finite number of good welders because no one is coming out of high school getting into apprenticeships. Same story for machinists, electricians, plumbers and machine operators.

So, what do we do?

Fortunately, not all young people embrace this mindset, but we must change how, and where, we look for this talent. You can learn an awful lot about people through social media before you hire them. If you really listen, the folks that

presentable
 Skilled
 respectful
 Flexible
 IDEAL
 EMPLOYEE
 compassionate
 hard-working
 Adaptive
 motivated

may not be the right candidate for you from a work ethic standpoint will usually let you know that through their social media accounts.

Shining examples do exist, if you look hard enough. Speaking as a totally biased proud dad, I do have some personal experience in this arena. My daughter was a four-year elite athlete and finished college in four years with honors, got a great job and bought a house at age 25. My son spent four years in the U.S. Coast Guard and is now about to become a police officer. Both would be considered millennials and both are not shy about calling out slackers, no matter what generation.

Another shining example is Davina McDonnell, director of marketing at Saline Lectronics Inc. Davina is publishing a great series of articles with I-Connect007 titled “Millennials in Manufacturing” that is spotlighting the amazing work being done by millennials at her company. So... there is hope!

It’s up to us to cultivate the next generation of board rats. Get involved with your local school districts and campaign for change. Let them know about the jobs that are available in the real world, and the skill set needed from their students to do those jobs. Be vocal about the fact that college is not the only choice, that the trades and skilled general factory work are just as honorable as college. Offer internships for high school graduates and work with local technical colleges and universities to do the same. I had a great interview with IPC President Dr. John Mitchell a few months ago, and John discussed some exciting new programs they are launching to train people in the skill set needed to work in the PCB manufacturing industry.

As usual, it’s up to us to ensure the sustainability of our industry. **PCB**



Steve Williams is the president of The Right Approach Consulting LLC. To read past columns, or to contact Williams, [click here](#).

“Help WANTED”

WITH IMI'S PETER BIGELOW

by **Patty Goldman**

I-CONNECT007

In preparation for this month's topic, especially what companies in our industry are currently experiencing when it comes to finding and hiring the right people, I sought out Peter Bigelow, president and CEO of circuit board fabricator IMI Inc. We spoke in February at IPC APEX EXPO.

Patty Goldman: *Peter, let's talk a little bit about what it's like to find and hire people nowadays. We've devoted this entire issue to the "Help Wanted" theme. It all plays in: training, education, and finding qualified people. So, what's happening?*

Peter Bigelow: There are several aspects to it. The first is that I can't believe we're alone in having a reasonably seasoned, shall we say, staff. People we've had for years. They know what they're doing. We've forgotten what we've taught them to be able to get them where they are, because much of it is tribal knowledge having been in the industry for years, been in our company for years, and migrated from one plat-

form of equipment or technology to another. In some cases, taken old technology and reapplied to new. Part of the problem is that you're dealing with an unknown. We've got people, but we don't even know what they know. All we know is that they're doing their job.

Then you have the second part, where some of those people want to retire or are coming to the age for retirement. You have to say, "OK, I need to bring in new people. Where do I find new people?" We're up in the Boston area. We allegedly have a great work force. We have a very low unemployment rate, but it's difficult to get people who want to be in manufacturing. It's difficult to get people who want to be in manufacturing that is not biotech, cleanroom type of stuff. We've got plating lines, and we've got drill rooms. Yes, we've got a cleanroom, but you know everyone doesn't work in that cleanroom. So that's a tough work environment to sell when you're interviewing people.

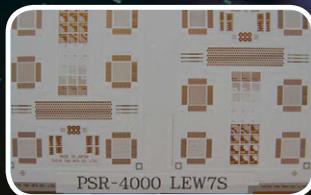
Then you have what I call the millennial issue, which is that their lifestyle is very different. We expect people to show up at a certain time and work a certain number of hours. At IMI, we've gone through several people who

A BRIGHT FUTURE FOR LEDS

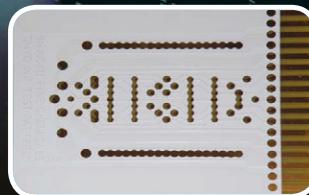


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Peter Bigelow

say they want more hours, they want to have that kind of structure, and when they get into it, they find it really difficult. "Do I really have to be at work at 7:00 or 8:00 in the morning? I can't take an extra half hour for lunch because I want to do something?" It's a culture shock. It's not just a culture shock for management, it's for the coworkers. Then they're saying, "Well how come they get to?" and "Why can't I?" You get into those kinds of issues.

Then you get into the skill issue where you have people coming in that you must teach. In some cases, it's the basics: "Can you read a drawing? Can you read a process sheet? Can you follow the process sheet? Will you follow the process sheet consistently?" They take shortcuts, they get creative, and you have to teach them that this is not the place to get creative. It's a place to follow the process and raise your hand when you have a question. So when you put all those together, then yes, it's awfully difficult to get good employees.

At IMI, we've gone through the evolution of placing ads; that doesn't work. You have some

people who are walk-ins, or word of mouth. That helps some. Then, where do you go next? You go to the vo-tech schools. At the vo-tech schools, everybody seems to want, again, not to be in our type of industry, or they don't have the right skills. They're more machinist skills than say, electronics skills.

We're beginning to talk a little bit with the universities to see if we can maybe bring in a summer employee. We don't have a formal co-op program in place, but we'd like to see if we can develop anyone who might be interested in manufacturing. It's a real problem.

Goldman: *It's an ongoing issue, and probably not getting any better.*

Bigelow: We also have training issues with existing employees where different types of skill-sets in technology are necessary. We've got a lot of people who know their job really well, but the increased level of verification/validation that our customers expect is forcing them to learn how to manipulate Excel spreadsheets and Word documents.

Goldman: *Not always things they want to learn, I would guess.*

Bigelow: Exactly. They have a tough time realizing that, and realize they already are using those skills, in many cases, at home. Instead of doing a letter to a friend or relative, they're now doing it to a customer. They need to use our format so it's consistent, and upload a picture into a PowerPoint so you can get it to a customer so they can see what's going on. You've got those skillsets, and that's the problem when you have a seasoned group. Now you've got new technology where they may or may not be as comfortable going in that direction. All the way around, it's a problem. It's been there; it continues. Where does that bring us?

What we are doing is realizing that we must start embracing change in how to train, how to hire, and how to get people on board. We don't need tons, but we need some good people. We need to look at different types of training options. We do IPC-600 training. That type of stuff we were doing internally and that works well.

We're also looking at going to a web-based training company like Resource Engineering who do SPC and process-related training via the web.

Goldman: *Do they have good programs that will help your people?*

Bigelow: They have a manufacturing focus. Some of their courses are not perfect for our industry, but things like failure analysis, SPC, and getting people to be thinking about how to analyze problems are. We're looking at using that kind of training. The nice part is that it's online, it's not a classroom environment, so it's self-paced. We also see by self-paced training if somebody is really getting engaged or if they are not. If you have to keep pointing the pitchfork to say, "We need you to log on and keep going," that tells you something.

Goldman: *IPC has recently come out with their EDGE program. As I'm sure you know, everything on there is for assembly. So I have been complaining about that. John Mitchell told me, "What do you guys want? Find out what should be on there for printed circuit boards." Do you have any thoughts on that?*

Bigelow: I do and I don't. The EDGE program is great. It's the kind of thing that I've been an advocate of IPC doing. IPC is standards. A lot of the time it's a matter of, how do you then teach people how to follow the standards or apply those standards to their day-to-day job? And some of that requires some skillset. I don't have a concise answer for what's necessary, because I really need to sit back and see what they're doing with the assembly side. Then I could say, "OK, that's assembly; how do you relate that kind of training over to fabrication?"

A lot of things that we deal with you can teach. You can show someone and then get them IPC-600 certified, but then you have to show them in your plant where are the key areas that you can go and where you can get messed up. In any decision tree, there are certain key places where you better understand that area, because that's going to make you successful or not successful. Part of that is, again, can be basic stuff like reading the print.

It can also be more advanced like, what data is important? How does the data relate to other data?

I would have to take a little different slice at it and say that based on IPC standards—because I do think it should tie into the standards, so someone is getting trained—there should be touch points saying, "This is covered in this standard, and this is covered in that standard." So you understand how the pieces come together, and you understand how important those standards are. It may not be one that you touch every day; it may not be the number one that you use, but they all do interlock. The surface finish is really important. So is lamination and so forth.

Goldman: *It's all critical.*

Bigelow: All critical, and they all tie together. If you screw up in one place, you may not see the symptom until you get further down the line. I do think that there is a need for fabrication-

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“ If you screw up in one place, you may not see the symptom until you get further down the line. I do think that there is a need for fabrication-centric training. ”

.....

centric training. My guess is it would have to be broken into a couple of categories. One would be for high-volume automated processing, versus batch processing. Every plant has some of both. It's key that you do cover those two.

Goldman: *At one time, there was a series of circuit board training videos done by IPC.*

Bigelow: Yes, we still have some—in a VCR format!

Goldman: Do you find them useful at all?

Bigelow: For new employees, they often are good to show that we're not alone in how we do things. The basic processes have not really changed. Many things have changed in those processes, but you're still following a process link through. When you hire someone to be a plater, you still want them to see the entire manufacturing process. You might not be able to take the time to walk them through your plant and watch a job go through, but you can pull a video out, even if it's a very introductory video. But you still need to have a more in-depth training.

Goldman: A video on etching shows you how to run the etcher, or shows you that this is etching, but it doesn't really show you how to control the etcher parameters for a particular job.

Bigelow: Correct, and everyone controls things differently. Everyone needs to control things. It's important to know that you need to do that. Now, you've got to go back into your own company's recipe book and say, "Follow our procedures." Because every company does it a little bit differently, and every job is a little bit different, but it's a good overview of the industry and how things go together.

We also have had many conversations about what happens to product once it leaves our building as we're not an assembler—especially when dealing with thermal shocks. A circuit board is going to go through a lot of thermal shocks between the time it comes into our facility as a piece of bare laminate and the time we fabricate it. We throw it through our thermal shocks, then it goes out the door to a UPS truck, into a warehouse, into the assembly plant, and then they operate on it, and in many cases, much more severe thermal shocks, such as putting it through their wave solder four or five times, because of the nature of what is going on.

Goldman: People might have more of an appreciation of what they're doing if they know where it's going.



Bigelow: Absolutely. They also need to know that it's going to go through some rough processes. If things aren't right, it's not going to get better, folks (laughs).

Goldman: You're not insisting on this training just to make life difficult for them. You've got some real reasons behind it. Any other thoughts on this subject of employees, hiring and training, and the difficulties? How about finding process engineers? Same deal?

Bigelow: Same deal. Every process engineer wants to work for the biggest company they can, and have a staff job rather than be active on the shop floor.

Goldman: They all want to be managers, right?

Bigelow: This industry is an on-the-shop-floor manufacturing type of industry. We're a hands-on industry. I do think, and I've had a lot of conversations with my management team, with other companies, that this industry is getting long in the tooth. We all have the same issue where every company has a great team of people that has tremendous tribal knowledge from years of experience. They're all at the stage, or reaching the stage, where they want to look at retirement. The industry is going to have an unprecedented number of hiring needs going forward, probably around the same numbers as in the '70s, when the industry was really in a growth mode.

We all need to get good people. We need to have people who can learn, and can understand the complexity of a circuit board. One of the

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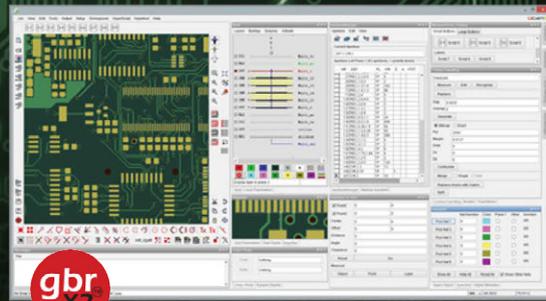
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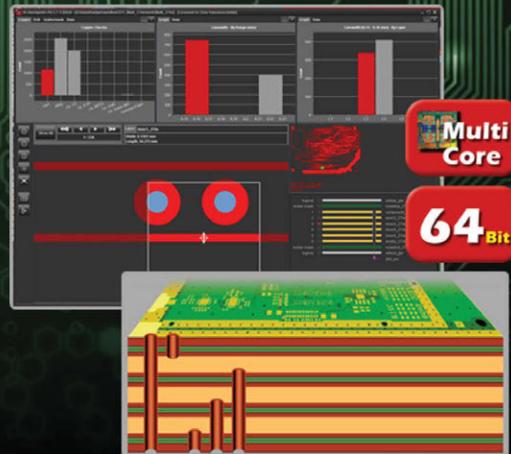
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things I love about this industry is that it looks so simple, but it is not.

Goldman: *It is not. Of course, you've got that moving target as things become more complicated and more complex.*

Bigelow: Everything tightens up, and so you now have to be making 3-mil line and space, which is kind of a standard in the industry, where it was seven or eight mils 10–15 years ago. That keeps changing, and yet you're using, in many cases, the same equipment. You have to adapt that. If you're replacing with newer equipment, which does things "automagically," it creates an opportunity for, "What else can you do with it?" which is a new process. It's a very dynamic environment.

Goldman: *On the issue of training, there was a community college, Saddlebrook I think, that had PCB type classes.*

Bigelow: I'm not familiar with that. But again, 20 years ago, when I was in Connecticut we put together an educational collaborative. That educational collaborative was with a combination of companies that were assembly companies, OEMs, and we were fabricators. We had a couple of machining companies there as well. We worked with a local community college, we took IPC courses, and we took whatever the machining association courses were. We took things like English as a second language, blueprints for idiots, and things like that.

We would hold classes with instructors, and we would do it at one of the collaborative member companies. Each company could send one or two people, so you didn't have to clear off your shop floor to get certified in various areas. We did that, and the community college was getting rather excited about this being a possible curriculum base. Unfortunately, at that point in time, it wasn't a large enough need for that community college to continue. There were other needs that they had. As our industry is so geographically spread out, today it would be very difficult to do such a thing.

Goldman: *So many shops have closed too. Now it gets even more difficult, because there isn't that*

little community of printed circuit board facilities within a reasonable radius.

Bigelow: Unless you can get someone like the University of Phoenix to do something, where it's an online course, and then you might have an option, because it's no longer contingent upon being within a local area of the employer.

Goldman: *Yes, then you don't have to worry about the geographical area. That's an interesting thought. That's something the IPC could perhaps spearhead.*

Bigelow: Absolutely. Once you have the learning base, and you have it digitized, that's how you could distribute it.

Goldman: *Whenever that person wants to take a particular class, there it is. It's not like everybody meets at a certain time, necessarily.*

Bigelow: None of us want to be like a Foxconn, where if your employees aren't working, they have to be studying. But the other side of hiring people is making them realize that, "I don't care what job you take, whether you're a banker, whether you're in construction, or whether you are in electronic manufacturing. You need to be on your own, spending some time to better educate, better train yourself." That's very important.

Goldman: *You don't move up automatically. Always be bettering yourself. Make yourself as valuable as possible to the company that you work for.*

Bigelow: It's a big issue, and it's an issue which we're going to have to deal with and will be hearing a lot more about in the next few years. It's one that is a common challenge for everyone in the industry. All through the supply chain we have that same issue.

Goldman: *Thanks so much, Peter. I really appreciate talking with you on this.*

Bigelow: Thank you, Patty. PCB

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DAVE RYDER

on Prototron Circuits' Strategy for Hiring in Today's Marketplace

by Patty Goldman
I-CONNECT007

I spoke with Prototron Circuits President Dave Ryder at IPC APEX EXPO, and he explained one practice that Prototron has been using in their hiring practices of late: temp agencies. Dave explains how and why it works for Prototron, and has some ideas about the bigger picture of hiring and jobs in the U.S. market.

Patty Goldman: *Dave, we're covering the topic of hiring and training for an upcoming "Help Wanted" issue of our magazine. In that regard, what's happening at Prototron?*

Dave Ryder: With regard to finding help and hiring and that sort of thing, we used to have people come in and fill out applications. That was a regular course of business. We'd have people would come in daily. We haven't had that happen in several years, now. People don't use the conventional methods for looking for jobs anymore. One of the things that we found that works for us is going through temp agencies and telling them exactly what we're looking for.

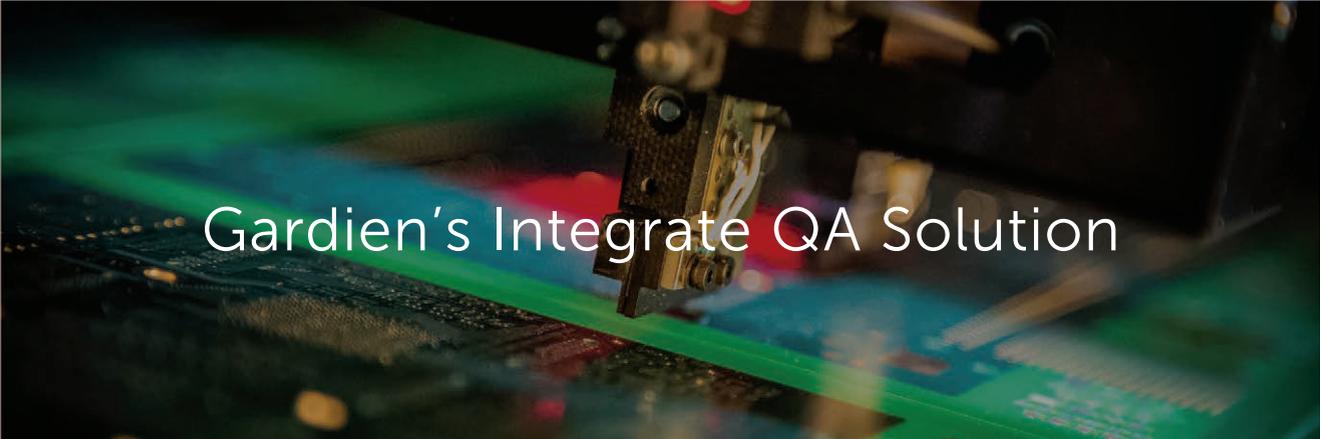
They're more like placement agencies now, but they'll do both.

Goldman: *But you get to trial somebody.*

Ryder: That's exactly right. If you decide you don't like them or it didn't work out, you make one phone call and the next day you get someone else that fits your criteria. Particularly in our Tucson facility, that has worked pretty well. The Redmond area is a lot more competitive than the Arizona market in that regard. We're competing with all the big companies, the flashy places that have big, sexy products and that sort of thing. It's tough to compete, especially when rents for apartments are \$3,000–3,500 a month. You've got to make some serious money to make sure you can afford that lifestyle.

Goldman: *You can't always offer that or you're not looking for somebody at that kind of level, I'd imagine.*

Ryder: Of course, we have offshore pressure. Customers are always asking, "Can't you cut the price?" It makes it quite challenging. We have

A close-up photograph of a PCB manufacturing process, showing a green circuit board being worked on by a machine with a metal tool. The background is dark and out of focus.

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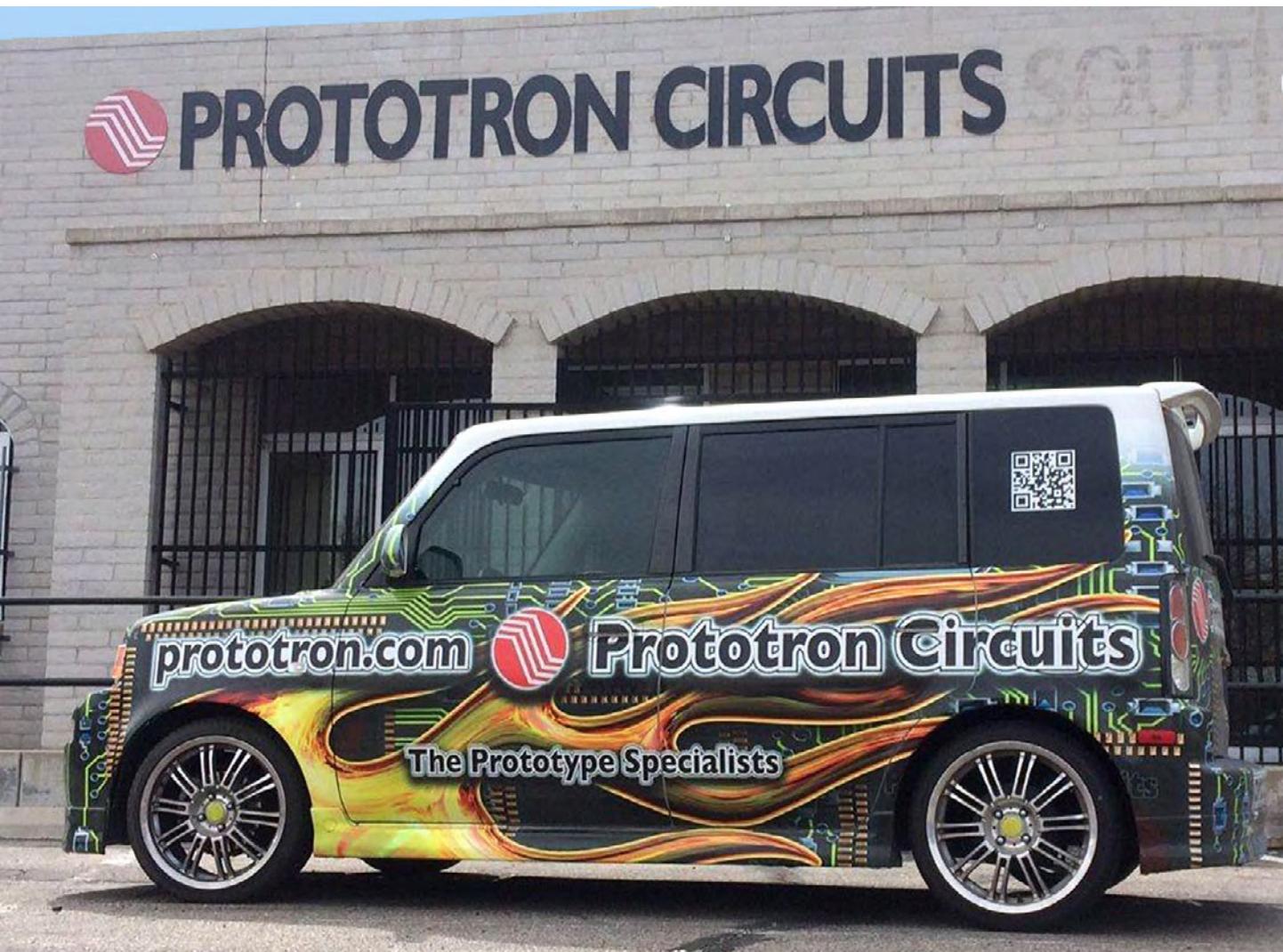
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rules and regulations and all these things we have to follow; offshore, they don't have quite as stringent a situation.

Goldman: You mentioned earlier that you had a couple of almost perpetual openings that you were having trouble filling.

Ryder: That's very true, Patty. We've had a real challenge with process engineers and quality positions/quality managers. Those have been tough to find, and when you do find somebody that fits the bill, you do have to take good care of them. Otherwise, somebody will be out courting them and they'll be gone.

Goldman: How about line operators? How's that been?

Ryder: In the Redmond shop we still have challenges with that, as well. People, again, want to go work for the big company.

Goldman: Or they can't afford to live there?

Ryder: They can't. In the city of Redmond there's an interesting thing that occurs. The population doubles during the daytime and then it gets cut in half after about 6–7pm. So, depending on which way you're driving, you're in for a long wait. It's sad that many people can't afford to live reasonably close to where they work. That's just the case. If you were fortunate enough to have purchased a home in the Redmond area, say, 20 years ago or so, you're in good shape; otherwise, good luck with that. Retail is a significant issue in the Redmond/Seattle

area for that matter, and then they just passed a \$15 minimum wage in the Seattle area, and so what's happening is all the fast food places are cutting labor. Now you're waiting longer and paying more for worse service.

Goldman: *Does that affect you?*

Ryder: It really hasn't, because quite frankly, we've never paid minimum wage. With our Redmond facility, we have a lot of people that have been there 15, 20, and 25 years, so they're at a higher level on the pay scale already. The new minimum wages aren't really impacting that, but to even try to find somebody at minimum wage wouldn't even occur. But I know in other markets around the country there are pockets where that does work.

Goldman: *Where it's probably less expensive to live.*

Ryder: I would also equate that with a level of technology that might be in a certain area. If minimum wage is seven or eight dollars an hour, there's no high-tech business going on there.

Goldman: *For the people coming in, how much training do you have to do? Are they experienced?*

Ryder: Pretty much if it's somebody that's never seen a circuit board, you're training them from the ground up. For a long time, we had the luxury of hiring people that worked in other PCB shops. Now we're the only board shop in the Seattle market, so there isn't any place for us to go to find other talent. We never had to train because they came trained. Now it's a whole different deal, and that's been a bit of a leap for us. We've had to figure out training programs and how to go forward in that direction.

Goldman: *You've developed your own training programs?*

Ryder: Absolutely. To be honest, we're constantly working at that, because we don't have it refined at this point. You get somebody that looks like they're going to be a keeper and the next

thing you know, they're gone and you wasted a year. It's the same things. They find a job closer to home that pays the same and I've got nothing to offer them to keep them.

Goldman: *One of the things that some would say is, "Okay, automation is the way to go, then." Are you thinking about that at all?*

Ryder: Oh, absolutely. Certainly, that's a good direction to go, but if we're in the low-volume high-mix side of things automation isn't really the best answer for us.

Goldman: *It's not as simple as it sounds.*

Ryder: It is not. I have heard that there's a company on the East Coast that's automated, but I don't know of a lot of others out there like that. I certainly see that as the direction it needs to go for our industry to stay competitive.

Goldman: *Perhaps you're talking about Whelen Engineering, which is a captive facility, so it's a little bit different.*

Ryder: Yes, I am.

Goldman: *I believe they are building single-sided and double-sided boards so far with multilayer planned. I do know that they welcome anybody to come in and look at their facility.*

Ryder: I'd like to go there and take a look for myself, to see how they're doing it. We might be able to help each other somehow. You never know. We've made unique relationships with people we never thought we'd have a relationship with over the years. Never say never.

Goldman: *Anything else you would like to add in the line of training and hiring and finding people with experience?*

Ryder: Well, I don't see anything coming to make this easier anytime soon. I keep hearing about some president guy that thinks he's going to bring jobs back to this country. I think those jobs that would come back would be automated positions if they ever do come back.



Dave Ryder

Goldman: *It's easy to make statements. Much easier said than done.*

Ryder: I would absolutely agree.

Goldman: *I think all of us in manufacturing have taken that with a grain of salt.*

Ryder: You have to, because I don't think he really understands, which is too bad.

Goldman: *But at the same time, we have to say, "Well, what can we do?"*

Ryder: That's true. I would look to the IPC to be working on that side of things.

Goldman: *That's interesting because IPC has education as one of its four aspirational goals. The program is called IPC EDGE and there are training webinars available to members. I've been commenting to John Mitchell because all the courses listed are related to assembly. He gave me a mandate, "Find out what the board shops need. What can we put in there for the board shops?" I'll make that a challenge to you. If they were to put in train-*

ing programs for printed circuit board facilities, what would you want to see?

Ryder: First, I absolutely support that idea. You could do basically all the functions that way. That would improve the person's chance of making more money and making it a real career versus a job. It's just like getting certified to be a designer or an assembler or a solderer, whatever it may be, we don't have any of that going on for the fabrication side. There are no programs that I'm aware of.

I would say about 20+ years ago, we used to bring a group of people down, typically supervisors from our Redmond facility to take some of the classes at the IPC show. This was back in the days probably around the time it was in Long Beach for a year or two, and then, all the sudden, those classes went away for the fabrication side. They just didn't exist anymore. I'm sure it was poor attendance or lack of interest or whatever, but that was the only thing that was out there for us.

Goldman: *I know that many years ago, IPC had a line of training videos on PCB manufacturing.*

Ryder: I worked for a company that purchased a whole bunch of those videos. They were terrible.

Goldman: *They were probably outdated, right?*

Ryder: That was the case. I believe it was looking at how to feed boards into an etcher and then take them off the other end. That was about the depth. It didn't talk about break points, pH, the temperature issues, etc. It didn't address any of the real science that's going on inside that machine. It's just how you feed a conveyor and take it out the other end.

Goldman: *You want your operators to know a little bit more.*

Ryder: Oh, they have to. Otherwise, you'd be producing scrap all day long and not even know it. There has to be serious training in there.

Goldman: *An interesting part of this, then, is what do you want your operators to know? You want*

them to know not just how to be the automatic feed and unload. You need them to control their section of the shop.

Ryder: In low-volume, high-mix, they need to be a little experienced with everything in their department, if not have complete knowledge of everything in their department. In some of the bigger shops over the years that I've seen, the person running the plating line isn't even able to make the adjustment on the amperage. A supervisor has to come and do that.

Goldman: *But you expect your operators to be able to do that. And to stop something if it's not working right.*

Ryder: Right. You must empower your employees. Micromanaging is a terrible way to run a business. With that many steps in the process

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“You must empower your employees. Micromanaging is a terrible way to run a business. With that many steps in the process you'd go crazy.”

.....

you'd go crazy. It's hard to find somebody that really has all that knowledge unless they've been doing it for a long time. You know, the other thing that is happening is a lot of people that have been very knowledgeable in this industry are gone.

Goldman: *Everybody talks about the graying of our industry.*

Ryder: It's very true. At our Redmond facility, we probably have 10 people in their 60s.

Goldman: *And you're sitting there thinking, "I'm going to have to replace these guys." It would be nice to have some shadows there behind them.*

Ryder: It would. It's pretty rare when we see somebody's son or daughter say, "I want to follow mom or dad," in this industry. I think their parents are telling them, "Don't."

Goldman: *Or they make their own decision to go into computers or finance.*

Ryder: A different area of technology, yeah. It is something that all of us have seen with the number of shops that are left versus what there once was. Then you look at the numbers that the IPC provides and the dollars spent on circuit boards in this country is higher than it's ever been, just not domestically. I see the CMs going great guns. It's not because there's no boards being ordered. They're just not being ordered here.

There's been a little more leveling of the pricing over the last year or two. I've heard that there's a 30% difference in general on items from China versus what you would pay domestically. I don't know if that's really accurate, but at 30% we are starting to see people tell us they're losing interest with offshore. The thing that usually bites them is when they have a challenge or a problem come up. Communication is a challenge, and I don't mean just the verbal. It's the timing.

Goldman: *Communication and turnaround, I would think. Getting product quickly.*

Ryder: Fixed, repaired, replaced or whatever.

Goldman: *Or even just prototypes. You want them fast and you can't get them fast offshore.*

Ryder: We've heard three to five days is doable and then it's two days to ship. Now you're cutting into what you could get domestically at that rate. Personally, I don't know. I've never bought boards. I'm going to probably keep it that way (laughs). I know where to get them.

Goldman: *Well Dave, thanks so much for talking with me.*

Ryder: You're certainly welcome. **PCB**

Supply Lines Highlights



[Laser Pointers: Stepping Up to Laser Processing for Flex, Part 5— Process Development](#)

In Part 5 of this six-part series on effectively supplementing your flex production capabilities with laser processing, we'll discuss how to develop a process library and learn several best practices, tips and tricks for typical flexible circuit laser processes.

[Mutraxx Makes Green Operations Economically Viable](#)

During IPC APEX EXPO, I sat down for an interview with Jeroen de Groot, CEO of Mutraxx. He detailed the company's plans to install new equipment at a facility in Romania, and he explains why having a green manufacturing operation is not enough—it must also be economically feasible.

[EPTE Newsletter: FineTech Japan 2017](#)

Tracing the roots of the show, FINETECH JAPAN began as an exhibition for new material technologies 26 years ago. The convention expanded year over year to include other segments affiliated with the electronics industry and have had the following events added: Fiber Optics Expo, International Laser & Photonics Expo, Film Tech Japan, Plastic Japan, Metal Japan and Ceramics Japan.

[Eagle Electronics Invests in Quality and Reliability with ATG A7a Flying Probe Tester](#)

Eagle Electronics has recently placed an order for a new ATG A7A automatic flying probe tester. The new tester will allow Eagle to test 100% of their boards via flying probe.

[Mike Carano on the First PCB Executive Forum Held at IPC APEX EXPO 2017](#)

When John Mitchell came on board as president of IPC, he decided to tap the members of the Raymond E. Pritchard Hall of Fame for sugges-

tions and advice. He established the IPC Ambassador Council and tasked them to create special programs for IPC conferences. It is this group of people who put together the recent PCB Executive Forum that was presented at IPC APEX EXPO 2017.

[Stevenage Circuits Approves Use of Electra Polymers Direct Image Soldermask](#)

Stevenage Circuits has selected Electra Polymers EMP110 direct image spray soldermask for use on the AHK double-sided solder mask spray system in conjunction with their Limata, Orbotech Nuvogo and Orbotech Paragon direct imaging systems.

[Cibel Chooses Frontline PCB Solutions' InCAM as Its Leading CAM Solution](#)

Orbotech has announced that Cibel has chosen InCAM as its preproduction CAM solution to replace its Genesis2000 CAM operation. Developed by Frontline PCB Solutions, InCAM is a comprehensive CAM system that performs fast, high-precision CAM tooling, via powerful design-for-manufacturing tools.

[Zero Defects International Introduces Taiyo PCB Inspection System](#)

Zero Defects International [ZDI] has been appointed by Taiyo Industrial Company, Japan, to manage the North American introduction of its automated printed circuit board final inspection systems.

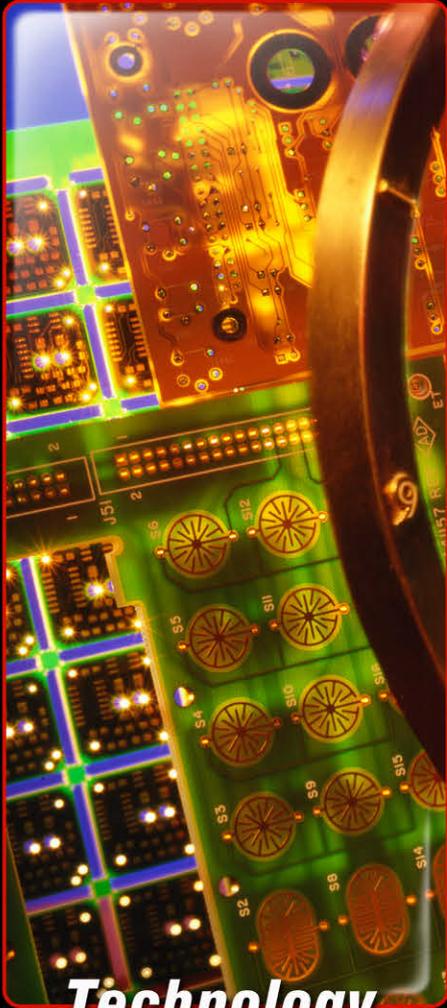
[SAE Circuits Express Installs New NTO Lead Free Hot Air Level Machine](#)

SAE Circuits Express has installed a new NTO 2424-LF lead-free hot air solder leveling machine.

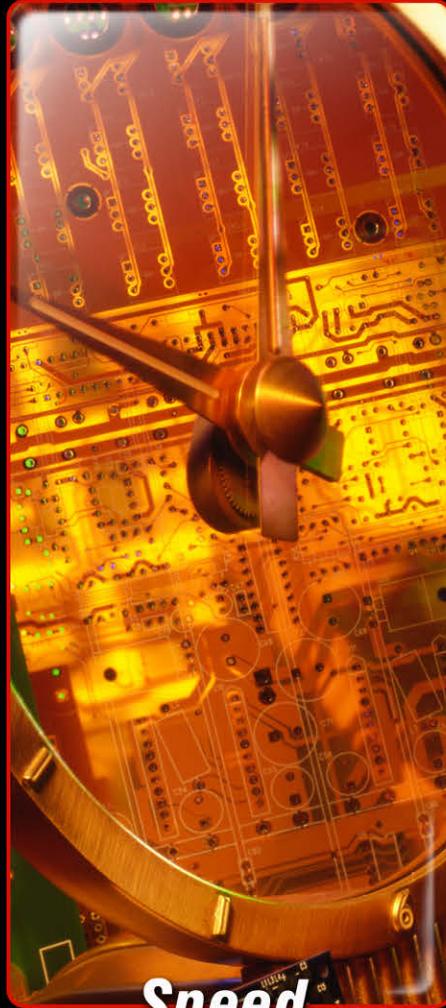
[Ventec International Appoints Kyle Pattie as Account Manager, Eastern USA](#)

Ventec International Group has appointed Kyle Pattie account manager for the US Eastern region, selling and supporting all product lines to help the company further develop its presence in the region.

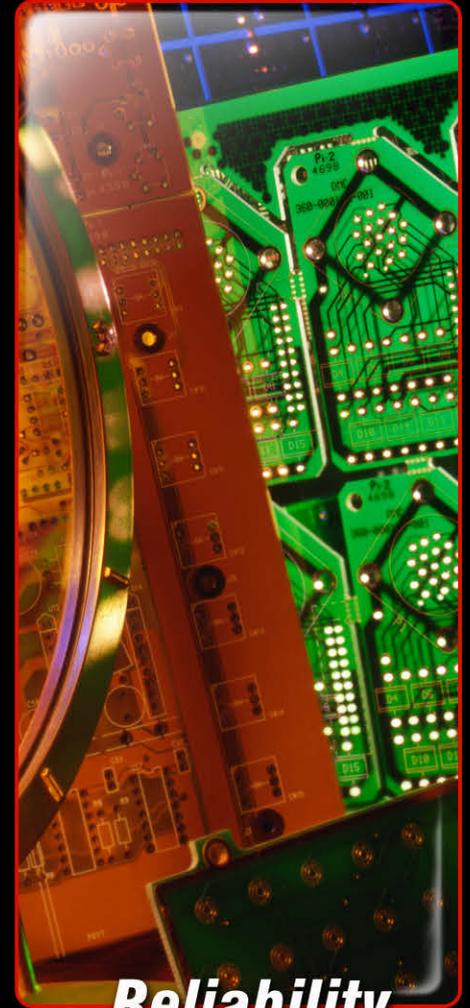
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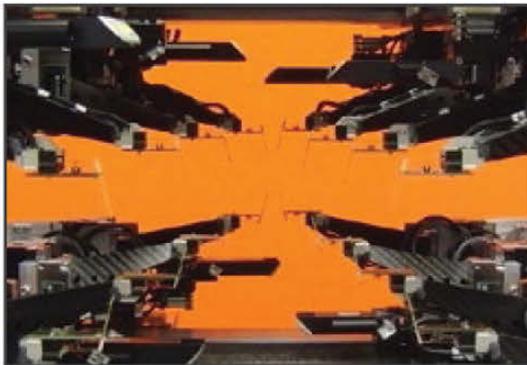
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America's youth in engineering and manufacturing is waning. In order to sustain our industry for the foreseeable future—especially domestically—this interest needs to be reinvigorated.

Once you get them in the door, how do you keep young talent in-house? Countless possibilities present themselves once he or she is a member of the workforce. Could they be poached by a competitor? Could they become disenchanted with the profession? Can you justify keeping them around? This is the harder challenge. When adolescents think about manufacturing, one thing stands out above all: manual labor. There is a certain stigma attached to it which newer generations find increasingly difficult to digest. It's as if physical work is a status symbol—or lack thereof. There are two things that can alleviate this misconception: showing them that there's nothing wrong with hard work and showing them that hard work doesn't necessarily mean breaking your back.

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As an employer, the need for innovative, young minds is evident everywhere you look. From process engineers to streamline your processes to motivated salespeople who can attract business to your company in a way you never might have thought possible, the ideas are there. They're just not being given room to grow. To do this, we need to partake in and commit to grassroots outreach including school field trips, participating in college career fairs, and welcome newcomers into our industry.

For a sector that prides itself on being full of Joe Six-Packs, many of us have a very “you can't sit with us” demeanor. We turn our noses up at an amateurish question or mentally disqualify somebody without taking the time to learn about them or what they know. New

ideas from new employees are dismissed because of resistance to change on the part of leadership. How, then, should we be allowed to complain that we don't have a sufficient influx of talent?

Another misconception that often goes unaddressed is the level of education required. Students and graduates often assume they need a master's degree or higher to be gainfully employed in our industry. Fortunately, many of us would agree that the best way to learn is on the job. There's no better teacher. Unfortunately, though, we don't do a great job of conveying that to the workforce. This industry doesn't align with current trends. To counter that, it's necessary to change and adapt to the times. The reluctance to change, though, is obvious and detrimental. This is a direct byproduct of an aging workforce. “If it ain't broke, don't fix it” never considered the fact that you still need to do some sort of upkeep on whatever “it” is.

Recruiting bright, young talent requires being able to speak their language. Bending employees to your will wasn't always effective and now it's become a hindrance to business. Whereas the business concept of “make a lot of money” is embedded in all people very early on in life from a purely survival standpoint, science happens in the background of our lives. It's not always as tangible and therefore, takes us longer to grasp. If the economic health of a nation is partly predicated upon the goods it produces, it's fair to say that complex manufacturing plays an important role. Therefore, not only does inspiring students to learn engineering and other sciences help our industry, it helps everyone. **PCB**

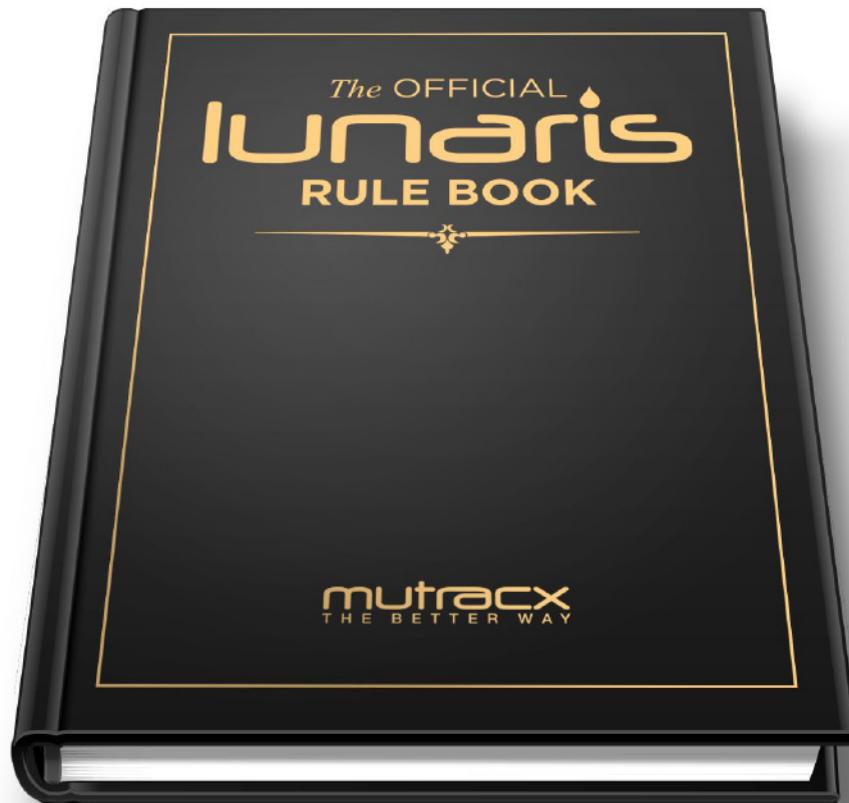
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Sam Sangani is president and CEO of PNC Inc.

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The Rockwell Collins Road Show visiting Toledo, Iowa's STC Middle School 7th and 8th Grade Math Class



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Rockwell Collins' Doug Pauls Discusses Volunteering, Mentoring and their Road Show

by **Patty Goldman**

I-CONNECT007

I was happy to see Rockwell Collins' Doug Pauls receive IPC's Raymond E. Pritchard Hall of Fame award at IPC APEX EXPO, well-deserved for him, and I wanted to chat with him about it. As with so many conversations at the conference this year, the talk quickly turned to inspiring interested young people in our "graying" industry. We also discussed the nature of volunteering and what we get out of it.

Patty Goldman: *Doug, congratulations on receiving IPC's highest award for volunteers. We are here at the first evening of the IPC show. I'm sure it was quite a day for you. Tell me a little bit about yourself and your background.*

Doug Pauls: I've been a materials scientist and engineer for about 32 years. I have a background in chemistry, physics, and electrical en-

gineering, but over the course of my career I've morphed into a materials scientist, a materials engineer. All that time has been spent in the electronics manufacturing industry.

The first nine years I was working for the Department of the Navy as a federal civil servant doing high-volume, low-mix manufacturing, spending time in their materials laboratory. After that, I spent eight years as technical director of Contamination Studies Laboratories in Kokomo, Indiana, doing process troubleshooting using chemical analysis, looking at what type of residues were on the circuit boards and what impacts they have. After that, I became a principal materials and process engineer at Rockwell Collins in Cedar Rapids, Iowa, where they make high-performance aviation electronics. So, that's kind of the professional background.

Goldman: *So you've been at Rockwell Collins now 16 years. What has your involvement with IPC consisted of, other than obviously quite a bit.*



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Pauls: Yes. Rockwell Collins has been a very good manufacturer and a very good employer for me, and they're a long-time IPC member, so they support everything that we've done. In fact, all of the employers I've been with have actively supported IPC. My association with IPC began in the fall of 1985. I came to my first meeting with Susan Mansilla, formerly of Robisan Labs and now retired, and Susan was also very active in IPC committees. If you know Susan, she's a ball of fire, and she is a force of nature when she gets going. She took me around, and said, "All right, for the stuff that you're doing in the materials lab, you need to be on the Solder Mask Committee, and you need to be on this one." And they introduced me to all the leaders of that and said, "Sign up for this."



Doug Pauls

Goldman: Got you going, didn't she?

Pauls: Oh yeah, and in those days the IPC meetings were Monday through Friday, as you recall. I learned about standard specifications, how the industry worked, and how everything was interconnected. It was a tremendous education.

Goldman: Tremendous learning experience and education.

Pauls: Yes, and then I found, in listening to the discussions about what the specification levels should be for a material or a process, I started to get an appreciation of the finer points behind what goes into a value that we all have to meet. As a young engineer, just out of school—of course nobody teaches you this stuff in college—it was a tremendous learning experience. I found that as I continued involvement with IPC over the years, I continued to learn more and more, because IPC and the people who come here are very good about sharing their knowledge and sharing their experiences, and it's a wonderful organization.

Goldman: Yes, I've found that it's not only at the meetings that they'll share, but once you've met that person, and you have a connection, anytime

you have a question or a problem or an issue, you can call that person and get help right over the phone or email these days. It's a very useful network.

Pauls: Oh, very useful and effective, and in fact, I think some of the more enjoyable parts are when you get to know all those people, and perhaps you go out for drinks afterwards, you get to hear a lot of the very interesting war stories. Some good lessons there.

Goldman: Besides a lot of laughs, you learn some good lessons. One of my theories is that people volunteer at IPC when they're with a particular company, but regardless of what company they're with, they're still a volunteer. You're sort of living proof of that, as am I, but I'm just curious about your thoughts on that.

Pauls: Well, I've been a part of a number of volunteer organizations. In addition to IPC, I'm a Boy Scout scoutmaster. You know, that's an all-volunteer thing. I teach confirmation at our local church, again, all-volunteer type of thing. I think people have a tendency to volunteer for things that are their passion, where they see, "I have a skillset that I can bring to this, I'm good at this, I enjoy what I'm doing." Almost any organization is going to be furthered by the efforts of dedicated volunteers who share their passion, and that's something I've tried to do here. I think back on all of the people who shared their knowledge and shared their information, their wisdom, with me in the early years. All of them had the "pay it forward" type of attitude for this, and so as I've learned a lot as a volunteer for the IPC, I've always tried then to give back—people were generous with me, so I should be generous as well.

Goldman: As you learned from people, then you taught other people. Yes, that's a good way to look at it.

Pauls: With IPC, like any organization, you get out of it what you put into it, and I think the more you put into it, the more dividends it pays.

Goldman: *Absolutely. You also mentioned you were doing demonstrations at local schools in your area?*

Pauls: Yes, Rockwell Collins is a very big supporter of the STEM initiatives. They are a very active supporter of the FIRST organization and FIRST LEGO League, Dean Kamen's organization. So a number of us are volunteers, and we have developed what we call the Rockwell Collins Road Show, and we will go out and do science and engineering demonstrations, and we've realized that to really get the attention of the children. You can't just make it a boring science lecture.

You've got to put a lot of "gee whiz" type of stuff that really gets them fired up and gets them excited, and so I've been doing that for 16 years. My colleague Dave Hillman, also an active IPC volunteer, has been doing it about 25 years, and we do 45 shows a year all throughout Iowa. It's showing some dividends too, because we have some engineers at Rockwell Collins who are engineers because they saw us in school, and what they saw from us inspired them to become an engineer.

Goldman: *It's nice that you have that feedback, and saw the loop completed.*

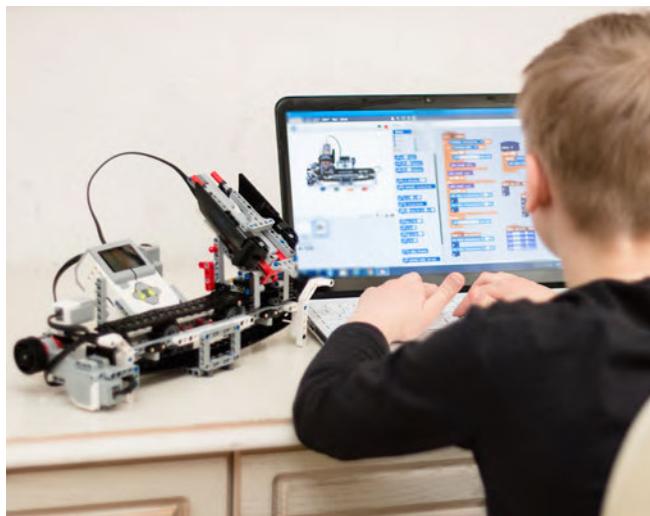
Pauls: It's very gratifying.

Goldman: *You also mentioned that you tell girls the same thing. Have you seen that side of it come through?*

Pauls: Yes. You know, in a lot of the urban schools, they've made great strides in making sure there's equal opportunity for both male and female, but you get out in some of the rural areas and there's still that concept of "well, science and engineering are for guys and not for girls." And we do what we can to battle that concept, because at Rockwell Collins, in fact all the companies that I've worked with, some of the most talented scientists and engineers have been the women scientists and engineers. So we try and get them interested whenever we can.

I also, as part of Rockwell Collins, participate in what we call job shadows. A job shadow

there is with individuals from local high schools, usually sophomore to senior level. If they're interested in a particular area, they can come into Rockwell Collins for a day, follow us around, we explain what we do, how we, as this particular type of engineer, fit into the big picture, and I've had a number of young ladies who said that they decided to become materials engineers based upon that day and the excitement and the passion that I shared about that type of science. It's tremendously satisfying.



Goldman: *I'll bet it is, because, it wouldn't have happened if you hadn't done that. It's kind of like "take your kid to work" day, but it's not just that day, and apparently, it's a lot more effective, so that's pretty neat. You mentioned the keynote speaker this morning, which again is along the same line, Mayim Bialik, from "The Big Bang Theory."*

Pauls: When she was talking about how a mentor got her going into the areas of science, something that she hadn't thought about before, I was sitting with a number of my colleagues from Rockwell Collins, all who were involved in the Road Show as well. That really resonated with all of us, in that we really need to get together with kids today, male and female, and share with them our passion for science, our passion for engineering, and give them a vision that it's not just nerds at a computer, but this is something that's an integral part of how planes fly, and how bridges are erected.

Goldman: *You build something.*

Pauls: We build things. We're part of the national infrastructure. When you drive through-out Iowa, and you see these massive wind farms with these 300-foot-tall wind turbines, and you talk about the materials science that goes into the composite blades that are there. How do you do the infrastructure to distribute that? How do you store that energy? How do you get it into the net, and how does that impact boys and girls locally?

Goldman: *Things they never thought about, for sure.*

Pauls: Yeah, they never thought about it. In an unrelated thing, we do one of our demonstrations where we have people think about ketchup bottles, or just packaging of materials. Why do you think this bottle of Clorox is shaped this way? You can see the lights going on. "Well, I just thought it was a bottle. You mean it's designed this way for a reason?"

Goldman: *I've always found packaging to be so interesting.*

Pauls: Oh yes, my wife will occasionally lose me in a grocery store, and she'll usually find me in one of the aisles just kind of looking over the differences in all the packaging. I'm fascinated by it.

Goldman: *I agree.*

Pauls: I get asked occasionally by some companies—the IPC staff refers a lot of people to me—why they should participate in the IPC. What am I going to get out of it? And I've found over the years that what I learn here allows me to solve many of the problems I come across in manufacturing. If you're in manufacturing, when your manufacturing line stops and goes down, you start to hemorrhage cash immediately.

Either my participation at IPC has allowed me to learn pretty quickly how to get to the root cause of the problem, or I've got a network of hundreds of technical contacts now that I can call. We'll brainstorm a few things. Somebody's got the answer, and the line gets back up.

Goldman: *And you aren't going to find it in a book.*

Pauls: Nope, and all you have to do is solve one manufacturing problem like that and you've just paid for your involvement in IPC.

Goldman: *For a long, long time. I'm always puzzled by the people in the companies that don't apparently see any value in IPC participation or membership.*

Pauls: Because they can't put it in a spreadsheet.

Goldman: *Like you said, all those intangibles, which after the fact, you could put in a spreadsheet. How long were you down or not down? How long could it have been down, but you weren't?*

Pauls: But if you take a look at the population of engineers and scientists in the U.S., we're aging. So we're taking a look at how we are going to get the next generation involved, and almost every company, if they're smart, is taking a look at what type of programs they can use to develop our young engineers. How can we bring them up the learning curve quickly? There are so many educational things available through the IPC. That is how I think we do it. When you allow your young engineers to go to something like this, where they can see so much in a short period of time, that kind of professional development can't be put in a spreadsheet. You can't quantify the dollars and cents.

Goldman: *It's the same with your road show, which apparently is paying big dividends. And yet, obviously, it took a few years, but again, you couldn't put that in a spreadsheet. I want to say, "Doug, make a kit so that other people can do road shows in their states."*

Pauls: Which we've done.

Goldman: *That's great, because it sounds like an effective way to get people interested. I remember when I was a kid, I wouldn't have known what a materials engineer was, or a chemical engineer, or any kind of engineer. Who did you see when you were kids? I saw my working parents, who were not in any professional capacity. I saw school teachers;*

half my graduating class wanted to be teachers, probably because that's all they saw.

Pauls: We didn't really have a scientific influence in my home. My mom was an English teacher, and my dad was a purchasing agent for the state of Wisconsin. He had been a carpenter and a bricklayer, and a stone mason before then. But when I grew up, my formative years were all during the Apollo program. So I took a look at all the Mercury and the Apollo missions, and that's when I wanted to be a scientist and an engineer. I wanted to be part of that push for the stars, and that's what inspired me. If you talk with most scientists and engineers, they saw something in their youth that fired their imagination and got them along that track, and that's what we're trying to do now.

Goldman: *You're trying to be that inspiration. That's great. You were elected to the IPC Hall of Fame; what does that mean to you?*

Pauls: I would have to say I'm still kind of stunned by it. I look at all the Hall of Famers, and of course you were in this position last year. I look at all those people, and these are all the ones I've looked at as industry giants throughout the years, people who I have respected and revered, and you are one of them. I'm wondering and still amazed that people would think that I would fit into that class. So it's a humbling experience, and I hope I'm always worthy of that honor.

Goldman: *Oh, they'll make sure that you are, Doug.*

Pauls: Yeah, I'm sure I'm not being put out to pasture just yet.

Goldman: *Oh, you're not being put out to pasture, not at all. Thanks so much for your time, Doug, and for your insights. I really appreciate it.*

Pauls: You're welcome, Patty. **PCB**

IPC's U.S. Skills Gap Study Reveals Qualifications in Short Supply

In response to mounting concern about the shortage of U.S. workers with skills needed by electronics manufacturers, IPC—Association Connecting Electronics Industries conducted a “fast-facts” study to learn more about the skills gap as it affects U.S. electronics assembly manufacturers. The results, published last week in Findings on the Skills Gap in U.S. Electronics Manufacturing, indicate that most companies are having a hard time recruiting qualified production workers, and they are having an even harder time finding qualified engineers and other technical professionals.

Among production jobs, general assembler and hand solderer positions are the most difficult to fill. On the professional side, quality control, process and entry-level electrical engineers have been hardest to find. Insufficient experience is the



most common reason that applicants do not qualify for most positions. For many engineering and other technical professional positions, however, the leading reason

jobs went unfilled was that there were no applicants at all.

Respondents cited many essential skills that are in short supply, but the most commonly cited are soldering for production jobs, and engineers with industry experience, especially in process, test and quality control.

The purpose of the study is to reveal specifics about the skills gap that can help IPC and other associations and organizations determine what actions they can take to help build the skill base of the U.S. labor force. A representative sample of 45 U.S. contract electronics manufacturers and OEMs contributed data.



David Dibble on the Hiring Process: Getting the Most from Systems Excellence

by **Dan Beaulieu**

If this is the first time you've heard the name David Dibble, or his company, Dibble Leaders, then you're in for a treat. David is one of our industry's foremost thought leaders when it comes to systems optimization and leadership development. He has worked with many companies, both in our industry and in the medical field. From starting his own PCB company and growing it into a successful firm, David has a record of success. I thought it would be interesting to have a talk with David and learn more about him and his company and more importantly, to hear how he can help companies in all industries be better, particularly the PCB industry.

Dan: *David, it's great to finally have a chance to talk with you; thanks for doing this. For starters, please tell us a little bit about yourself. What is your background?*

David: My pleasure, Dan. Out of college I started a PCB company with \$5,000, in an old warehouse. Over time we built the company to

about \$10 million in sales, doing mostly mil-spec and technically challenging commercial work. In the process, I became an expert in systems/process optimization and was one of the pioneers in the quality movement in the early 1980s. Since 1990 I've been consulting and training, helping leaders solve problems and improve their businesses. My work with companies is usually twofold: We take a systems-based approach to improving the parts of the business that will deliver the greatest ROI while assisting the CEO to expand his or her skill sets—a better leader.

Dan: *Fascinating, from PCBs to systems expert. How did you come to start Dibble Leaders?*

David: I saw basic flaws in both process improvement and leadership. Programs such as Six Sigma, Lean or Lean Sigma have, in most cases, underperformed and in some cases outright failed to produce on their promise. Sustainability has proved elusive. I also saw few leaders who were even close to being systems thinkers. Leaders, in general, were focused on the wrong things in attempting to solve problems or grow their busi-

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nesses. I created Dibble Leaders as a consulting and training company that addressed the two equally important halves of the integrated whole we call systems-based leadership—systems optimization and systems thinking in leadership.

Dan: *I like that. I agree that those systems, although useful, are not the complete solution. So, you saw a need and filled it. Were there many challenges in getting started?*

David: Oh my, yes! First, the tools used for systems optimization are often difficult to use for non-technical people. I'd watch frontline workers' eyes glaze over when teaching even elementary SPC [statistical process control] tools. I spent almost two years reworking these tools to make them easy to use for almost anyone—even those for whom English was a second language.

An even bigger challenge was finding leaders willing to grow beyond whatever thinking was creating the problems their company was facing. Einstein reminds us that we can't solve our problems with the same level of thinking used to create them. It's amazing how many leaders unconsciously keep doing the same things over and over while expecting a different result.

Dan: *I agree completely. The hardest thing for people to accept is change. I must give you kudos if you have been able to get people to change, especially in our business where there seems to be a culture that believes "If we do the same thing we did in 1987, it will eventually work in 2017." David, please tell us about the company.*

David: We do systems-based consulting and systems-based training. On the consulting side, we normally do an assessment to tell us where the company will get the greatest ROI in doing systems-optimization work. Then, with leadership, we put an implementation plan together and implement the plan. On the training side, we provide a wide range of systems-based trainings including but not limited to: large group strategic planning, systems-based leadership and management, systems optimization for the frontlines, rapid deployment systems, and tools and implementation. I also do keynote speaking, usually on systems-based leadership, including "The Four Agreements at Work," conscious leadership/systems thinking, the future of business, and similar topics.

Dan: *Yes, I saw that on your website. What exactly are the Four Agreements?*

David: The original Four Agreements were created by Miguel Ruiz and introduced to the public in his worldwide best seller, *The Four Agreements*. I studied with Miguel for eight years and learned how the Four Agreements might be introduced to the workplace. Companies that integrated these Four Agreements into their cultures created much value. The original Four Agreements are:

- Be Impeccable with Your Word
- Don't Take Anything Personally
- Don't Make Assumptions
- Always Do Your Best

However, I quickly found that the Four Agreements were not enough to sustainably improve results being produced in an organization. Systems optimization and other pieces had to be added. The needed pieces are encapsulated in my Four New Agreements for the Workplace:

- Find Your Purpose
- Be a Servant Leader
- Be a Systems Thinker
- Practice a Little Every Day



I believe these agreements are a roadmap for becoming both a great leader and creating a sustainably great business.

Dan: *That makes sense. I like that. I understand that your system can apply to any company or organization. Can you give us an example of a success story?*

David: I have many. However, the one that stands out for me is Gila Regional Medical Center, a \$30 million hospital. This was the first hospital I'd ever consulted for. In 2006, the company was very optimistically projected to earn approximately \$2 million. With the systems and strategy work we did, the hospital earned \$3.1 million. Very good results, yes? But that's not the real story.

During my 14 months at Gila Regional, I trained mid-manager Brian Cunningham in systems-based leadership and systems optimization. When I left, I suggested he begin training his peers. We learn the most when we teach. Over time, Brian became a VP at Gila.

The CEO I worked with left Gila Regional and was replaced by an autocratic CEO, who, despite supposedly being a Six Sigma advocate, turned out to be a micromanager. The new CEO began undoing everything we had done to improve the hospital. Predictably, Gila Regional began experiencing problems. In FY 2013, the hospital imploded, losing \$9 million. One month into FY 2014 the Board fired the CEO and the VPs he had brought with him to the job, leaving Brian as the only VP. The Board installed Brian as the interim CEO while a search for a permanent CEO was initiated.

Not knowing what else to do, Brian reintroduced the systems optimization we had created between 2005 and 2010, the year the new CEO was hired. In 11 months Brian was able to take Gila Regional from a \$9 million loss to a \$1.1 million profit—with no layoffs! This may be unprecedented in healthcare or possibly in any type of bricks and mortar business. Needless to say, the Board made Brian the permanent CEO. Here we see what is possible when we integrate robust systems optimization and systems thinking in leadership.



Dan: *Great story. OK, I get it now. So, tell me, what is the coordination of your services? By that I mean, how much time does it involve? Do you offer follow-up or tune-up options?*

David: Coordination depends upon the company and how fast leadership wants the implementation and ROI. Larger companies usually take longer than smaller companies and manufacturing businesses usually take longer than service businesses. A consultancy may be as short as 3–4 months or as long as a year or more. The gating issue we must address is the fact that we have a business to run at the same time we are doing the systems and leadership work. These two issues must be balanced. We offer support services and tune-ups for companies that want ongoing support.

Dan: *You say this work is now more important than ever before. Why is that?*

David: I'll start by saying the old leadership model domesticated into the heads of our leaders over millennia is simply obsolete. For the most part, we are still leading via the old military top-down model. The old model also fails to take into account the connectedness of all systems in the physical reality (the business). Nothing we do is done in isolation and there are unintended consequences of focusing only on increasing revenue and profits—which is the preliminary driver of the old model. Finally, the old model doesn't include systems thinking, leaving leaders to do ever more of what is no longer working.

Models such as Conscious Capitalism and Servant Leadership take us part of the way there. But again, systems thinking is missing in these models. Peter Senge, the brilliant MIT professor, says that systems thinking is, without a doubt, the most important skillset that a leader must possess. It appears and practical application confirms the Four New Agreements for Leaders is, indeed, a reliable roadmap to creating the systems-literate conscious leaders our businesses must have to be maximally successful.

Dan: *What do you think are the biggest challenges that companies face today?*

David: Leaders and managers stuck in old ways of thinking and systems/processes that have not changed fast enough to keep up with a rapidly changing business environment.

Dan: *How can you help these companies overcome these challenges?*

David: I can teach leaders, managers, and their people to be systems thinkers. I can show people how to use now simple tools to quickly and sustainably optimize their systems. Remember, a leader who is a systems thinker and implements a sustainable systems optimization strategy will produce ever-higher quality products and services at an even lower cost. That's the name of the business game today. Note that the old model cannot compete with the new lead-

ership model. Higher quality at less cost will always win over the long term.

Dan: *What do you see in the future? Where would you like your company to be in five years?*

David: If I could wave my magic wand, there would be thousands of people teaching these concepts and tools around the world and in every business school. I'm now finishing a manuscript that describes the systematic nature of not only the physical world (business), but also of the inner world we call thinking. It turns out principles used for systems optimization in the physical world are equally effective in the inner world.

Dan: *David, once again thanks for doing this. Before we wrap this up, do you have any last comments?*

David: I have been teaching this work for 27 years. It may sound optimistic, but I feel that this work may be an idea whose time has come. If so, we will see the emergence of better businesses and more conscious, systems-literate leaders who will take us to heights not experienced before. **PCB**

If you want to learn more about how you can be a better leader and make your company better, you can go to David's [website](#) and check it out for yourself; it could be the best thing you do this year.

The Conference Board LEI for the U.S. Rose in March

The Conference Board Leading Economic Index (LEI) for the U.S. increased 0.4% in March to 126.7 (2010 = 100), following a 0.5% increase in February, and a 0.6% increase in January.

"The March increase and upward trend in the U.S. LEI point to continued economic growth in 2017, with perhaps an acceleration later in the year if consumer spending and investment pick up," said Ataman Ozyildirim, director of Business



Cycles and Growth Research at The Conference Board. "The gains among

the leading indicators were very widespread, with new orders in manufacturing and the interest rate spread more than offsetting declines in the labor market components in March."

The Conference Board Coincident Economic Index (CEI) for the U.S. increased 0.2% in March to 114.9 (2010 = 100), following a 0.2% increase in February, and no change in January.



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Employee Recognition: More than Money

by Barry Lee Cohen

LAUNCH COMMUNICATIONS

Employee recognition extends beyond dollars and cents. Today's workplace requires more than gifting monetary rewards, gold watches, and restaurant cards. These isolated acts are important, yet need to be part of a comprehensive, results-driven program that is both meaningful and engaging for all team members. Supported by visual and digital communications that showcase each achievement, employee recognition programs are instrumental in helping to create and maintain a high-performance culture.

Defining Recognition

Recognition fuels employee motivation to increase productivity and teamwork. However, recognition can backfire if employees don't understand the "rules of the game." Even worse, it can be viewed as unfair if employees witness the same folks being regularly feted, while they never get toasted.

Therefore, it's essential that every employee understands exactly what performance areas are recognized. The recognition should be clearly defined and reflect a key performance objective of the company.

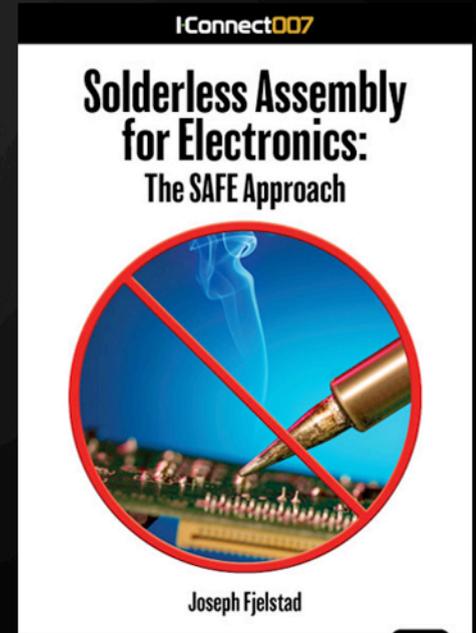
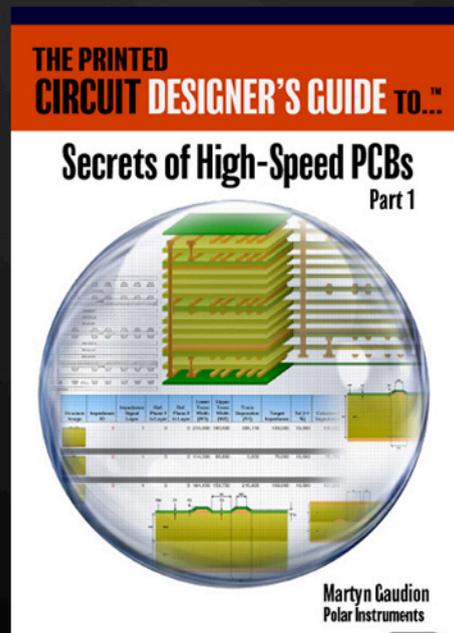
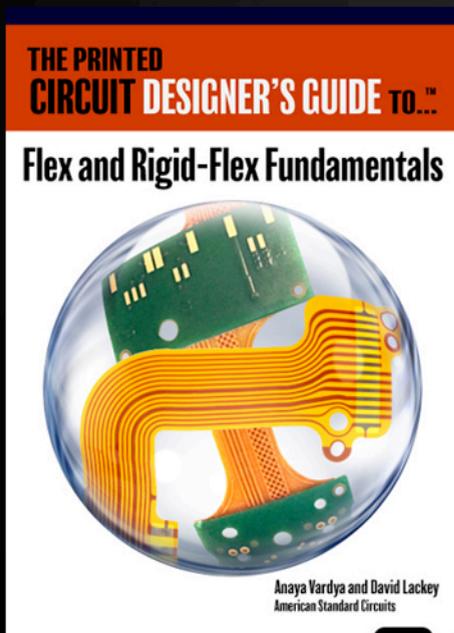
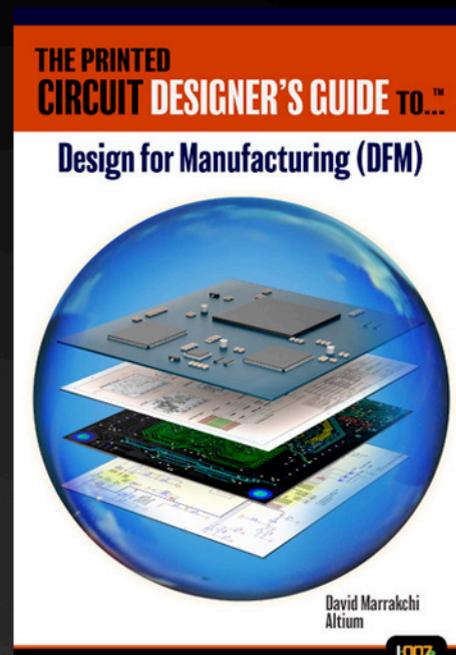
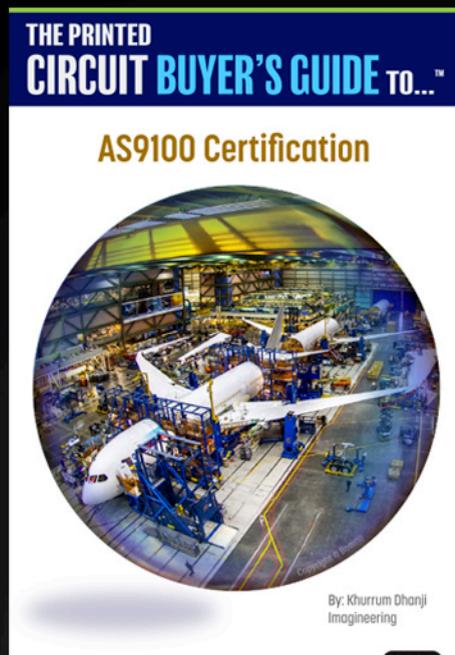
To illustrate, a top corporate priority for a manufacturer is workplace safety:

- The production team is recognized for no accidents in the last 90 days
- A production worker is recognized for completing a forklift driver safety course
- Corporate communications produces a video on workplace accident prevention

All of the above actions exemplify positive behaviors that contribute towards the performance objective of workplace safety. Tactics that range from achievement certificates, special parking space privileges and bonus incentives, to pizza parties and president's awards



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ceremonies could be deployed based on the type and level of performance achieved. All should be planned and executed consistently as to demonstrate the company's commitment to a high-performance culture.

Management Makes the Difference

The key ingredient to any employee recognition program is the staunch participation of management. When an organization's leadership lauds an employee's high performance, it boosts morale and teamwork, while fostering an atmosphere of trust and loyalty to the organization.

“The key ingredient to any employee recognition program is the staunch participation of management.”

According to a recent Gallup workplace survey^[1], 60% of employees responded that their most memorable recognition came from management, which includes 24% from a high-level leader or CEO. Another employee satisfaction survey^[2] asked what would make the employees feel as if the company cared about them. Fifty-five percent of the respondents said that praise and attention from their supervisor would make them feel as if the company cared about them and their well-being. As you would expect, money and benefits scored high; however, recognition from the supervisor ranked the highest of all choices provided.

Top Performer Retention Impacts the Bottom Line

If you still believe that employee recognition is the “soft stuff” that allows you to easily pay periodic plaudits to the daily grind of your employees, think again. The only impact in pay will most likely be to your company's bottom line. Increased absenteeism and turnover, coupled with decreased productivity are too often casualties tied to passive or non-existent employee recognition.

The Bureau of National Affairs^[3] estimates U.S. businesses lose \$11 billion annually due to employee turnover. This turnover is felt most severely when it includes the departure of your company's top performers. Some leave because they do not feel valued or challenged. For others, minimal recognition is interpreted as limited growth potential. When top performers depart for greener pastures, they pack up their knowledge and training (which you had invested in) and often head for the competition.

Some of the world's leading brands utilize employee recognition programs as a strategic tool to retain and engage their best talent. These results-driven programs reduce turnover and provide an environment to cultivate creativity and innovation.

Steve Jobs left a roadmap for employee engagement at Apple that endures to this day. Under Jobs, Apple became a pioneer of 360-degree management^[4]. The concept includes emphasizing employee retention and building a sense of community, amongst other areas. Key to the concept is how communication is instrumental to nurturing dedicated and loyal employees.

Different Routes, Same Destination Everyone likes to be recognized. However, it's not a one-size-fits-all proposition. This is especially true of millennials. For this next generation of leaders, a monetary award is not the key motivator.

Being selected as part of a new project development team or being tapped for Six Sigma training trumps trophies and trinkets for millennials. These awards are often deemed more valuable as they provide technical knowledge and opportunities for career advancement. Additionally, millennials place a high value on being part of the conversation. So corporate communication programs that incorporate social media enable them to provide feedback and be recognized for their ideas and contributions. Beyond the generational divide, an employee's position in the company also influences the type and preference of communications. Sales and marketing colleagues may welcome being interviewed for a broadcast to be splashed on digital display boards throughout the company's campus. They may also be enthusiastic about giving an acceptance speech at an awards luncheon. Both are natural activities, given that these in-

terpersonal and verbal skills are showcased to customers on a daily basis.

However, not everyone wants the up-close and personal treatment. Some consider such activities the exclusive domain for sales and marketing types. Others may be camera-shy and feel uncomfortable under the spotlight. They may prefer to have someone speak on their behalf. Better yet, skip the ceremony, and write a personal note of thanks for a job well done.

No matter how well intentioned the recognition, there should be a degree of flexibility. No one should feel inadvertently pressured to participate in the same manner. Wherever possible, individualize the recognition so it is authentic to the employee.

Digital Employee Recognition Drives Communication

With so many communication alternatives, companies have a choice as to what works best for recognition. Digital employee recognition via electronic display boards, video walls and digital signage can complement traditional approaches such as safety posters, employee events calendars and newsletters.

Once considered the exclusive domain for promoting new products and services at customer trade shows and conferences, today's digital signage is strategically positioned throughout corporate campuses and often accessible via employees' laptops and mobile devices. Employee recognition can now be reviewed—and most importantly acknowledged and appreciated—in a dynamic format that enriches both images and text. From pre-taped to real-time broadcasts of award ceremonies, recognition

can be immediately communicated within moments of an event or concurrently with other announcements.

Creating a High-Performance Culture

Successful employee recognition bolsters the company's brand and reflects the vision of the organization to the marketplace—as well as to current and prospective employees. It sets the tone and expectations of how business is conducted both in and outside the company walls.

Corporations that commit to results-driven employee recognition programs are advancing a culture of trust and teamwork, while reinforcing positive behaviors and expectations of high-performance. **PCB**

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This article was originally published by [The Marlin Company](#), and republished here by special permission.



Barry Lee Cohen is president and managing director of Launch Communications. To read past columns or to contact Cohen, [click here](#).

It's Only Common Sense: Let's Talk Leadership



Do you ever wonder what kind of leader you are? Are your employees inspired by you or are you just the only game in town? Would they stay if a similar company opened nearby? How about if they could earn a dollar more an hour by moving across the street? Have you inspired them enough that they would follow you through hell, or have you beaten them up so badly that they would not follow you across the room to a free buffet?

To read the full column, [click here](#).

Electronics Industry News

Market Highlights



Worldwide Spending on Cognitive and Artificial Intelligence Systems to Hit \$12.5B in 2017

A new update to the Worldwide Semiannual Cognitive Artificial Intelligence Systems Spending Guide from International Data Corporation (IDC) forecasts worldwide revenues for cognitive and artificial intelligence (AI) systems will reach \$12.5 billion in 2017, an increase of 59.3% over 2016.

Inkjet Printable and Biocompatible Layered Electronics

Printed electronics can lead to both low-cost and flexible devices. Flexible electronics is of particular interest for wearable systems, such as health and fitness trackers, while the relative low-costs of printing are attractive for functional packaging for consumer products.

Innovations Enabled by Industrial IoT Accelerate the Shift to Manufacturing 4.0

Manufacturing across the globe is on the threshold of a revolution, with Industrial Internet of Things enabling manufacturers to influence the capacity of objects to communicate with and sense the world around them.

Streamlining Mass Production of Printable Electronics

Memory devices—as a subset of electronic functions that includes logic, sensors and displays—have undergone an exponential increase in integration and performance known as Moore's Law. In parallel, our daily lives increasingly involve an assortment of relatively low-performance electronic functions implemented in computer chips on credit cards, in-home appliances, and even smart tags on consumer products.

Semiconductor Industry Sets Out Research Needed to Advance Emerging Technologies

The report, titled Semiconductor Research Opportunities: An Industry Vision and Guide, also calls for robust government and industry investments in research to unlock new technologies beyond

conventional, silicon-based semiconductors and to advance next-generation semiconductor manufacturing methods.

Driverless Cars and Shared Mobility to Transform Traditional Vehicle Interiors

Fully driverless technology will spark a transformation of personal mobility, enabling consumers to abandon costly vehicle ownership and summon shared vehicles when needed.

Robotics Companies Off to Fast Start Since Trump's Inauguration

Since being inaugurated on January 20, 2017, President Donald Trump has pursued a policy of discouraging manufacturers from leaving the United States. As a result, more businesses, large and small, have turned towards robotics technologies to keep labor costs down.

Spotlight on Industry 4.0

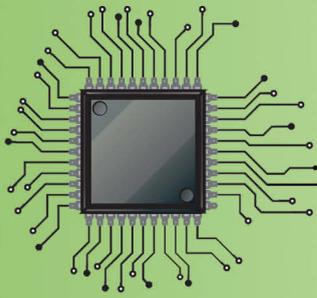
The way we approach employee training in the workplace must change as we see traditional industrial sites transformed into smart factories and technology taking over, according to RMIT Europe Innovation and Engagement Manager Boaz Kogon.

Flexible Electronic Devices With Roll-To-Roll Over-molding Technology

VTT Technical Research Centre of Finland has, for the first time, performed all manufacturing stages for a flexible in-moulded LED foil -in roll-to-roll process. The purpose of this demo is to prove the suitability of the technique for the highly cost-effective manufacture of products such as flexible LED displays containing printed electronics.

Global Smart Locks Market: Rising Trend of Smart Homes to Drive Growth

As per TMR, the worldwide market for smart locks was worth US\$226.7M in 2015. Researchers expect the opportunity in this market to increase at a CAGR of 18.30% during the period from 2016 to 2024 and reach US\$1.01B by the end of the forecast period.



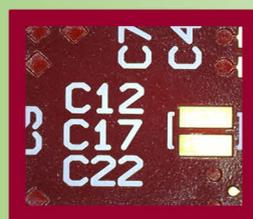
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HOW TO FIND —AND RETAIN— THE RIGHT PEOPLE FOR THE RIGHT JOBS



by Patty Goldman
I-CONNECT007

I sat down recently with Rebecca Brennan, director of human resources, and Aimee Miller, director of corporate communications for Compunetics and Compunetix. These sister companies in Monroeville, Pennsylvania are actually three companies: Compunetics is a PCB manufacturer; Compunetix does assembly; and conferencing service provider Chorus Call is considered the parent company. I already knew a little bit about their programs, having spent time at Compunetics in past years. My understanding was that people really seemed to stick around there, and since this month's issue is focused on digging into ways to attract and retain talent in our industry, I looked forward to learning more about their methods.

Patty Goldman: *Hi, Becky and Aimee. It is great to meet with you. I really want to learn more about your company's hiring and training practices and the Compunetix philosophy regarding retaining people.*

Aimee, perhaps you can start and provide a little background on both Compunetics and Compunetix and how they fit together with Chorus Call. Please share something with our readers about yourself, and your position.

Aimee Miller: I'd be glad to. We are 49+ years old, with our 50th anniversary coming up next February. In the early days of Compunetics, the original parent company, we relied heavily on government contracts including our first for the Navy's Anti-Submarine Warfare program. Years later, in 1990, Compunetix was established and we began to undertake commercial applications within the Communication Systems Division. Within Compunetix we also have a Federal Systems Division, Video Systems Division and, the Instrumentation Systems Division, which works closely with the Printed Circuit Boards Division of Compunetics.

We design and manufacture state-of-the-art collaboration applications. Over the years, before we acquired a large percentage of the market share, Dr. Giorgio Coraluppi, our president and founder, thought it would be a good idea to



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Aimee Miller

put into use the equipment we were making. To test the product, we set out to find customers.

We found potential customers and offered them a very personalized, high-touch service. Our services were well-received and we started charging for them. What grew from this was the notion of a small service provider, first called Concert Call then incorporated as Chorus Call. Rather than having a large service provider that farmed out the services, we started opening small offices around the world. We're literally in your backyard, speaking your language. In 2008, we acquired a fourth company, Sonexis, which is our foray into the enterprise market. We've covered the commercial aspect. We've got the federal, we've got enterprise, and we've got service.

Goldman: *Sonexis. Interesting. I've not heard of that one before.*

Miller: All have Dr. Coraluppi in common, but we are four separate companies, with Chorus Call as the parent company.

Goldman: *And they're all pretty independent of each other, correct?*

Miller: As independent as a company can be when it shares a common president. A lot of services are shared, IT and HR, for example.

Goldman: *Very interesting. That's a great company background. How about yourselves?*

Miller: I joined the company in 1995 in human resources. More recently I spent about three years marketing Concert-Oh, the foundation for something that we sell now in Chorus Call, called C-Meeting. And very recently, I stepped back in to help in human resources because we had a lot of open positions.

Becky Brennan: I joined the company in 1996 and was the first addition to the one-woman HR department. Aimee and I have worked together for 20 years in different capacities, although I haven't left HR. We've always been a small HR department and as Aimee said, in recent years, we've had a lot of open positions across all the companies. We have a full-time recruiter who works with us as well.

Goldman: *I take it there's been a lot of growth in the last 20 years. Obviously, as there are a lot of open positions.*

Miller: There were about 160 employees when I started and it had reached a point where I could either help find more people or help the people that we already had.

Goldman: *That's when you needed another person for sure.*

Brennan: I think that we had about 250 employees worldwide when I started, and now it's 700+. For the most part, Aimee is leading the recruiting effort with our recruiter and I'm handling everything else in HR.

Goldman: *Is the HR department involved in any training of new employees or ongoing training? Do you have any programs or is that handled by the individual company?*

Brennan: The technical training is generally handled within the functional area; it occurs on

the job, outside of our HR department. In HR, we administer new hire processes, like orientation—things like becoming familiar with the company and procedures. We also have a tuition reimbursement program that we encourage our employees to participate in. We have funds available if there's a program someone is interested in pursuing. We see people throughout the company pursuing anything from a certificate or an associate's degree up to a master's or PhD-level training. At any given time, we have 10 to 15 people pursuing a degree program.

Miller: Certainly, it is an attractive benefit.

Goldman: *Can they pursue any subject or must it be science-related?*

Brennan: We support almost any program, at varying levels. If I am in engineering, and I have a bachelor's, and I want to pursue my master's in electrical engineering or mechanical or whatever it might be, the company will generally support that 100%. If I want to become a teacher I still might get support, but it's not going to be the same level.

Goldman: *No, or if you want to go into history, I suppose.*

Brennan: Right. From the top down, we support education in all respects that we can. Education is frequently part of our strict requirements for hiring. It's very important to us that someone is coming to us with what we consider to be a necessary or appropriate educational background, but we also want to support it on the other side, if you want to pursue more and continue to grow as well.

Goldman: *That's good. I've heard that before that Dr. C is very big on education and quite supportive.*

I'd like to know how it has been lately. You have positions open now that you're hoping to fill. Are you finding people? We hear this a lot

in the industry, that it's very difficult to get people these days. Younger people don't look on manufacturing as something they're interested in, or else they just don't know about it. With printed circuit boards, everybody knows what they are these days, but most people don't know you can actually work in that field. I presume there is a local technical school here where people can learn CNC programming?

Miller: Yes, I believe there are a couple. There's also the Pittsburgh Institute of Aeronautics (PIA) which, interestingly enough, seems to turn out some people with appropriate skills.

Brennan: There is also the Pittsburgh Technical College.

Goldman: *Do you go to those technical institutes to recruit?*

Miller: We've tried a variety of strategies. In fact, very recently we have returned to some grass-roots efforts, even posting in grocery stores, putting signs on the bulletin boards. Just trying to capture the people that aren't necessarily on Monster and Indeed. Fortunately, our reputation for being an excellent place to work helps.

Goldman: *Right. And I know there's not a lot of advertising for jobs anymore in newspapers, and the younger folks don't read them anyhow.*

Miller: I can't tell you if we've found anybody using those methods, but it's another way to get the word out.

Goldman: *I suppose you must have a referral system with your own employees.*

Brennan: We do, and that's been fairly successful. We see a decent number of employee referrals. We have a referral program for every position we have open. There is a dollar amount attached that an employee could receive if they refer someone who is hired successfully. Six months down the road,



Dr. Giorgio Coraluppi

if both the referrer and the referee are still employed, then they get a referral bonus and we try to promote that. We have seen successful results from that program. Also, if we have open positions that seem to match up then we're in contact with those technical schools directly. Our recruiter is in contact with their placement officer or their adviser, so we're saying, "Do you have anyone?" and encouraging that.

Goldman: *Do you have any feeling for how familiar the technical schools and others are with this type of business, or with manufacturing? Do the kids know what's out there? They obviously know banking and finance and some other things. Then they see Microsoft and all those types of companies, but we often find that when it comes to the manufacturing, the nitty-gritty here, they really don't even know what it is. It seems so many people in our industry just kind of fell into circuit boards. I think it's changed a little bit but I don't know if it's changed enough.*

Miller: I don't know if they're searching necessarily for printed circuit boards, per se. But chemical processing is one way that people find their way to us. Another is CNC programming. We are an attractive operation for many interested in hands-on work in a high-tech environment.

Goldman: *I've been thinking about this a lot. How do kids know what kind of jobs are out there, what*

type of industries there are? They don't run door-to-door and they don't read the employment ads in the newspaper. They aren't going to learn it in school. All they see there are teachers.

Brennan: Well, a lot of the high schools do have vo-tech programs still, so there is some feeding through from those programs.

Goldman: *And you are in touch with those schools, I take it?*

Brennan: We still have a gap between us because we're requiring an associate's degree for most positions. We're not able to pick them up right out of high school in the vo-tech program.

Goldman: *But perhaps direct them that there are these kinds of career paths one can take, like engineering.*

Brennan: From time to time we have hired intern students at the high school level. There's Forbes Road Career and Technology Center right around the corner, and that's a vo-tech program. We have several current employees who started 10 or 15 years ago as interns and have moved up in the company since then. It does work. They're in the shop class or they're in a vo-tech program through high school, and from there decide if they want to pursue a degree, and then they go into an associates program.

Goldman: *Through an intern program, you can perhaps get those guys started down technical career paths. That's nice. You have open positions. What are you looking for in those positions?*

Miller: For the circuit boards division, we're looking for a chemical process technician. We're looking for an imaging technician. I think we have hired a drilling/routing person, who should be starting soon. Also inside sales.

Goldman: *What are your requirements for the technicians?*

Miller: We are looking for at least a two-year degree in a technical field.



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Becky Brennan

Brennan: An EET (electrical engineering technology) program is perfect.

Goldman: *You're not going to find something in imaging at a vo-tech school, are you?*

Miller: Well, no. But some of the arts work in imaging techniques. There have been some trained in the gas and oil industry and some of those chemical processes seem to translate, at least loosely, to what we do with circuit board chemistry.

Goldman: *They're chemical and manufacturing. People have become familiar with those areas and so this seems familiar to them. Sometimes I think manufacturing isn't familiar to people, and so they don't think about it. For insides sales, I see here you want a four-year degree for that. What kind of experience should they have?*

Brennan: We are comfortable with some customer service experience, people skills and a go-getter attitude.

Miller: Experience in order entry, telemarketing, customer service...

Brennan: Someone who has just finished their liberal arts degree, for example, and who had worked in fund-raising in college. That's someone who could be a good fit.

Goldman: *Someone with good communication skills, who could then learn the business.*

Brennan: Right. Whereas for production positions, we're looking for a couple of years of actual manufacturing experience.

Goldman: *How hard is it to find a person like that?*

Miller: We've made it a little bit more difficult because we're trying to fill second shift positions.

Goldman: *That would be more difficult. There's not much manufacturing around like there used to be. Finding somebody who has manufacturing experience has got to be tough.*

Miller: We either find people who have 15+ years working for somebody that might be a competing company, or people who have virtually none.

Goldman: *If you find someone with virtually no experience, is that a no-go or does it depend on the person?*

Miller: We're not looking for necessarily five years' worth of experience, but they must have something relevant. They must have those skills. Let's say somebody is doing this as a hobby for the last five years on the side. They've been doing drilling and routing for some project that they're working on their own. We like them.

Or, some inspection experience, for example, may translate well. It's not necessarily that they worked in circuit board manufacturing but they've done something along those lines. Maybe they've inspected parts in another industry. If they have a lot of experience inspecting parts, that could translate well.

Goldman: *I can visualize that when you start with somebody who has no manufacturing experience at all, the likelihood of them being able to grow into a position is a lot lower than finding somebody with experience.*

Miller: Certainly, in manufacturing, in years past, when we were looking for people in assembly, where there is more of an opportunity, we used to advertise for people who like to knit.

Anything that had dexterity and the attention to detail. The ability to sit and focus for hours on end is not so much what we're looking for right now in manufacturing.

That's in the instrumentation systems in the assembly here in this building that those types of positions do not require experience. They require more of a mindset for the repetitious task and the attention to detail, and the dexterity. You don't need to have bent wires before. You need to demonstrate that you have those kinds of skills.

Goldman: *And do you have them demonstrate that?*

Miller: Yes, they come in and they solder.

Brennan: Can you play the piano? That's great. That's a skill that can transfer, for example.

Goldman: *Very interesting!*

Brennan: For a higher-level position, something more complicated, we would like some experience in assembly, but not necessarily for the entry-level roles.

Goldman: *Those are interesting things to look for. I imagine it took some time to figure out those requirements and that's what really works best. How long has it been taking you to fill positions and how are you finding young people, like millennials?*

Miller: It's interesting, but recently, within the last two weeks, we've been having a lot of strong candidates and from a wide range of industries.

Goldman: *Any reason that you can think of, or maybe it's the Compunetix name?*

Miller: Absolutely, and our recruiter, Bill Gerhardt, has put in a lot of effort that's paying off.

Brennan: Sometimes it is seasonal; people are job searching a little bit more right now. Sometimes there's more turnover at this time of year. People are more willing to take a chance now than they were four months ago, right after the

holidays. I'm just referring to general job market activity.

Goldman: *The popular view is that, with millennials, the work ethic is not quite the same as what we've always known.*

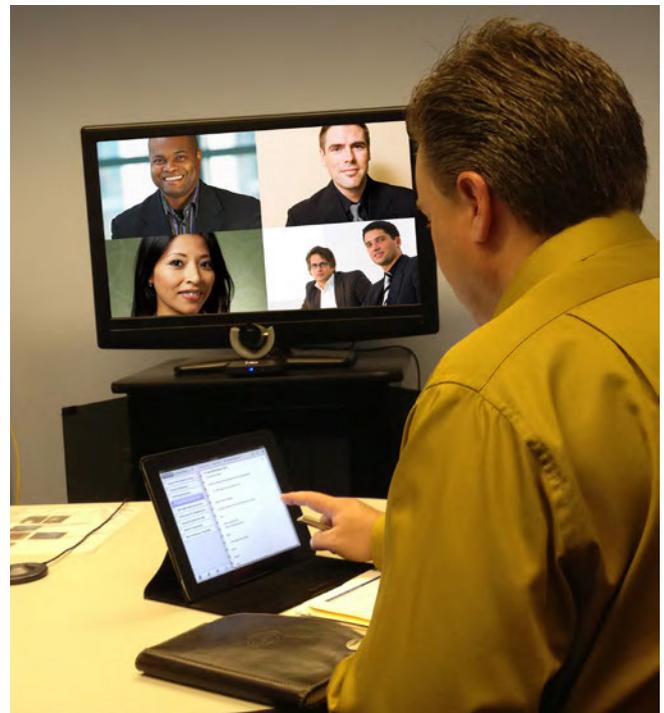
Miller: I feel like we've interviewed our fair share of people like that, but I think we've been fortunate or skilled at picking people that don't have that attitude. Even our interns; we've had some stellar interns in the engineering programs here.

Goldman: *Do you regularly have interns?*

Miller: We do. We have interns and co-op students, but primarily for the software development positions, not for manufacturing.

Goldman: *Why is that?*

Brennan: When we talked about the ones that we've hired that have been here 15 years, some of those were from manufacturing, but I think at the time, the tasks that were available for them were suitable for two months in the summer for a 16- or 17-year-old to do.



Video conference system.



Goldman: *You can't have them do a whole lot because of their age.*

Brennan: I think that what we're looking for isn't necessarily suitable for the training and the effort that would be required on our part. We're working on staffing to meet our customers' needs. Right now, I would say we're just not set up for that at Compunetics, whereas in Compunetix and the engineering divisions, the groups are larger. They have short-run projects that require a bright, trained engineering mind that's learned a particular thing in a recent class, like a new programming language for instance. They could come in for eight or 10 weeks, knock out a mobile app, for example, and then they've accomplished something complete in their internship. We're done with them and everybody's happy. Maybe we hire them when they graduate. It's not the same environment. I would say that's the reason that we haven't recently done interns in the manufacturing areas.

Goldman: *They would require more training, and if they're under 18, you can't put them on any equipment. They could probably work in the inspection area.*

Brennan: I'm not sure what they'd be allowed to do.

Goldman: *Then for your higher-level positions, are you mostly moving people along?*

Brennan: Yes, we do that a lot.

Goldman: *That's one way to retain people too. You would hope that they have been growing and of course, they want to keep moving up a little bit.*

Brennan: We do have very low turnover, 6–8%. It's low for manufacturing. It's low for the engineering side, the IT side. I think we do well

on our retention. We have a rich benefits package. We do promote from within whenever possible. People see that.

Goldman: *I'm sure that's encouraging to most people, whether or not they aspire to it. Plus, you have that great education benefit.*

Brennan: We have many employees who have started out in surface mount, for example, with an associate's degree, finished their bachelor's degree, later moved into an engineering role and eventually into a leadership role.

Goldman: *So, finding and hiring the right people, however long it takes. Then provide an outstanding benefits package that includes education expenses, and move people up whenever possible. It sounds like a great combination and apparently is proven to work.*

Thank you both so much for your time here. It has been a real pleasure meeting and getting to know you—and another facet of Compunetics/Compunetix. My regards to Dr. C.

Miller: Thank you.

Brennan: Thank you too. PCB

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Random Thoughts on Employment, from Both Sides of the Table...

by Keith M. Sellers

NTS-BALTIMORE

Many years ago, as I began my senior year of college, the reality of getting a job slapped me in the face! After three years of college studies, it dawned on me that without a job after graduation, all my hard work would have been for naught. Luckily, my university had a solid interview/job program that helped me and many of my fellow undergrads find gainful employment upon graduation the following spring. What became obvious to me at that time is something that I have tried to pass along to others as my career has progressed. That piece of wisdom is, simply put, your resume only gets you in the door. Where you go from there is completely up to you.

We've all heard the stories about college degrees, in which someone has a degree in one area of study but is then working in a completely different area of study. Who knows what the reason might be for that to have happened? The reasons are far and wide, some important and some not. But, as I mentioned, the degree (a

piece of your resume) simply opens up the opportunity for you to find your spot. Who cares if the spot is right in line with your area of study or not? Who cares if you've done a 180° turn and are headed in another direction? Ultimately, finding the right fit is paramount.

Thoughts for those looking for a job When you're out there trying to find your spot, be yourself. As someone who has been on both sides of this situation, being true to yourself is incredibly important, and it's the only way to ensure that both parties can be satisfied should you win the job. Build your resume with any possible experience that you can think of. You'd be surprised by what a prospective employer may consider valuable experience, or what you may be asked regarding a previous job that you thought had nothing to do with the position at hand. Also, only list experience on your resume that you can speak about if you're asked a question. For example, unless you can really talk about what a specific piece of instrumentation



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can do, and you only used it for one lab session your sophomore year, maybe you should think about leaving that off the resume. In the end, be confident about yourself and your experiences; after all, you're the expert on you.

Thoughts for Those Offering a Job

When you're trying to fill a vacancy within your organization, let the applicant talk, and as much as possible. Make the setting comfortable and allow the applicant to tell you about himself and his experiences. Ask the applicant about his interests and hobbies; you never know what atypical thing they might have done that could be beneficial to you or your team. Be sure to think about team chemistry and to think about what piece of the puzzle your applicant might fill, and to think outside the box when asking questions. Be prepared to conduct the interview, but don't feel the need to read from a script. After all, when it comes to interviewing, you don't know what you don't know about someone.

Once the uncomfortable interviewing process is complete, the real fun begins. All the companies that we work for are where they are in the world because of their people. So, don't forget that there's now real work to be done once you've decided to take a job or you've de-

ecided to offer an applicant a job! I have found one somewhat simple question that will help both sides of the employment equation better prepare themselves for the times ahead: "Where are you trying to go?" Of course, it's a figurative question so that the employee can express where he sees himself in the future, and the employer can understand the new hire's aspirations and be better prepared for what might come down the road.

Simply put, as the employee, how can you be led if you don't know where you want to go? And as the employer (and leader), how can you provide guidance and leadership if you don't know where the employee wants to go? It seems like a simple thing, but an employee/employer relationship in which both parties understand the goals of the other will be a strong one and a sustainable one, regardless of level within your organization. The more everyone is on the same page, the better it is for all involved. **PCB**



Keith M. Sellers is operations manager with NTS in Baltimore, Maryland. To read past columns or to contact Sellers, [click here](#).

CEO Confidence at Highest Levels since 2004

The Conference Board Measure of CEO Confidence, which had rebounded sharply in the fourth quarter of 2016, increased again in the first quarter of 2017. The measure now reads 68, up from 65 in the final quarter of 2016 (a reading of more than 50 points reflects more positive than negative responses).

"CEO confidence improved further in early 2017, propelling the measure to its highest reading in nearly 13 years," said Lynn Franco, director of Economic Indicators at The Conference Board. "CEOs were considerably more optimistic about short-term growth prospects in the U.S., and to



a lesser degree, about prospects in other mature and emerging markets. Hiring plans have picked up compared to last year, with nearly two-thirds of CEOs anticipating an increase in employment levels in their industry. However, 40% say finding qualified workers is a major obstacle to hiring."

CEOs' assessment of current economic conditions improved further, with 71% saying conditions were better compared to six months ago, up from 59% in the final quarter of 2016. Business leaders were also considerably more positive in their assessment of current conditions in their own industries.

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Matt Hammesfahr

by Patty Goldman
I-CONNECT007

At a recent SMTA Expo, I met with Matt Hammesfahr, a salesperson with Amitron. Matt is young, by our industry standards—in his mid-twenties. Just a few years out of college, Matt holds a business degree and is already a top salesman with the company. Here's one of those twenty-somethings we keep saying we want to attract to our industry. How did this happen? I had to get the story.

Patty Goldman: *Matt, you are 26 years old, you have a business degree, and you're in sales with Amitron—your first job out of college—and doing very well. How long you been with Amitron?*

Matt Hammesfahr: About three years now.

Goldman: *What brought you into this industry?*

Hammesfahr: I needed a job out of college. That is always good motivation. There seemed to be a lot of companies in the area and I always

A Conversation with an Industry Twenty-Something

wanted to be in sales so I called them, and they called me back.

Goldman: *So you reached out and then fell into circuit boards?*

Hammesfahr: Yes. It was tough starting out in this industry, because nobody really likes to switch their circuit board manufacturer, which I can understand now that I'm a part of it. There's a lot of work involved. I stuck with it, and after a good seven months or so I really started to catch on. It took a lot of hard work, though—calling and trying to get in front of customers.

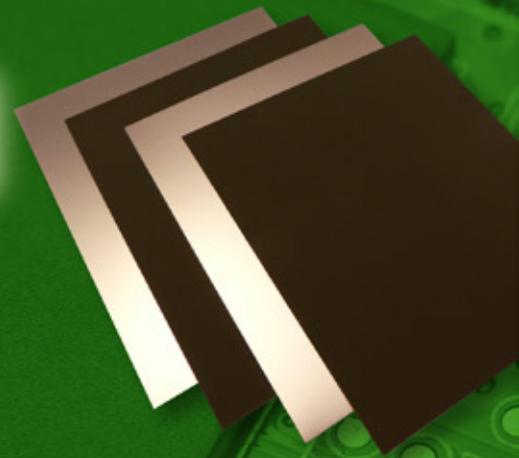
Goldman: *Have you learned much about the circuit board business in this time?*

Hammesfahr: Oh yes. I had a little bit of knowledge going into it. I knew how a circuit board was made, the printing and etching part. When I was going through the interview and they were pointing out processes, I knew what they were talking about and let them know that. When you go to an interview, you always want to have

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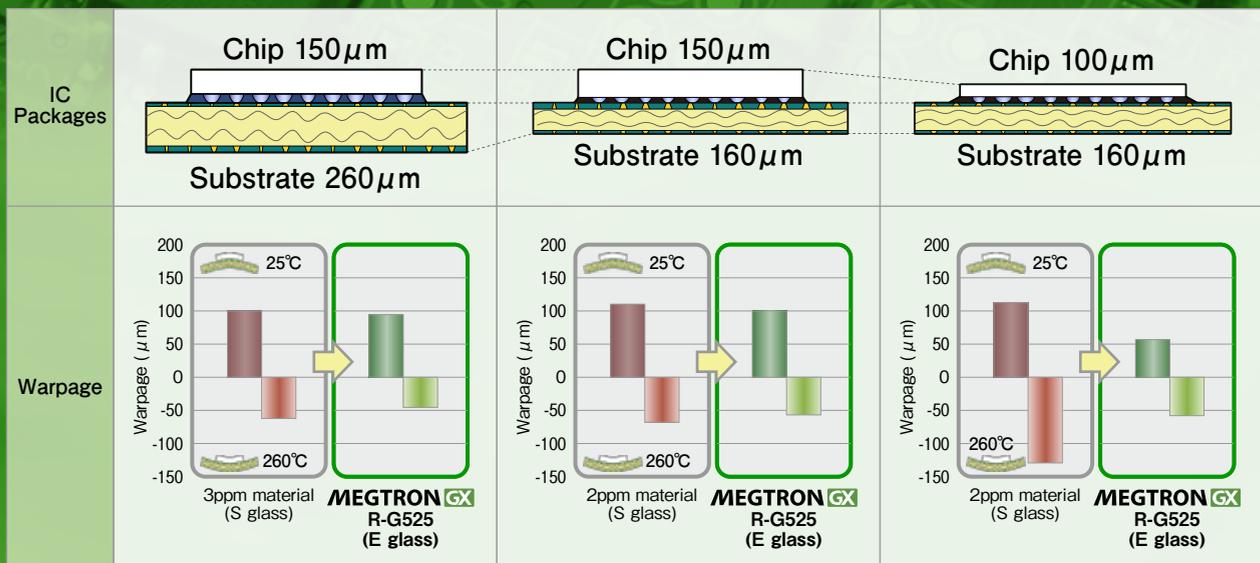
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some sort of knowledge of the company before you get there. It shows them that you care and you're interested, as well.

Goldman: *What have the last couple of years been like? I'm sure you've learned a lot, not just about circuit boards, but also about your customers.*

Hammesfahr: There are good days and bad days, but I've enjoyed it and I plan to stick with it. Every customer is different. They all have different requirements and want different things. When it comes to circuit board manufacturing, some customers will only buy stateside. With other customers, pricing is more of a requirement for them. Especially when you're dealing with higher volumes and whatnot. It's all about knowing your customers and how you can help them.

Goldman: *Tell me a little bit about Amitron and what you're finding with the company.*

Hammesfahr: We're a great company. Amitron has been in the industry for a little more than 30 years, with a 72,000-square-foot factory in Elk Grove Village, Illinois, just outside of Chicago. Amitron produces single-sided to 30-layer rigid circuit boards at any volume with flexible lead times. We have been growing and recently brought in new personnel for our engineering and quality control departments to help improve our quality and service to our customers. We also have a second factory in India which allows us to be more competitive in pricing. Plus, we have more control over the process and easier communication partnering with them rather than other offshore manufacturers where you never know how these boards are being produced.

Goldman: *Is that where your volume work goes, to India?*

Hammesfahr: Mostly. ITAR work is always done stateside. We try to keep everything stateside as much as possible—that's first and foremost. When you're going against some of these higher runners that are going against China, it gets competitive.



Goldman: *The company in India is your sister company then, and they're doing their own thing, shall we say? You're not just feeding them, but they're feeding themselves, more or less?*

Hammesfahr: Pretty much. They're their own separate entity, but our owner owns both facilities. We do have a good line of contact with them. Even with the language barrier, communication is never an issue. We have a direct line of communication with them when it comes to trying to find an order, and figuring out where everything is. It's really been helpful. I've dealt with some China shops in the past and it was a little tougher to get feedback from them. It's been a nice niche for us.

Goldman: *How about the level of technology? What are your customers requesting?*

Hammesfahr: Besides price decreases, there's a lot of quick-turn prototypes. I think nowadays

it's all about getting the quote to the customer the fastest. Making sure that everything is followed to spec on their print, even if they require stateside manufacturing and they want offshore pricing with it, you've got to work with them on it. It's important to figure out ways to make it work with your customer. Technology-wise, I'm seeing more and more higher layer PCBs come across, more condensed. You still see some single- and double-sided work that usually goes overseas.

Goldman: *For the larger volumes.*

Hammesfahr: Yeah, but what I've seen with my customer base is that they want quotes the fastest. If you can be on time with your orders, that's a huge help. Especially when you're doing quick turns of three days, two days, 24 hours. It's not always the easiest thing to do in the circuit board industry, because there are so many little things that one little process change, one little turn of the knob, so to speak, could change the outcome of the board. There are many different processes involved, depending on the technology.

Goldman: *I suppose you've gotten involved with a few of those processes?*

Hammesfahr: I have. I have an LED customer that needed a fairly bright white solder mask, and they asked us, "Is there any way we can improve on it?" So I've been working with our wet process engineer, who's new to the company—a very smart guy who does an excellent job. He's worked in some of the most high-tech circuit board shops in the area for a long time. He's been working with me in our soldering surface finish department to try and figure out how to get this solder mask to come out with a whiter finish instead of having it fade. Because once you put it through too many heat cycles it starts to yellow. So far, it's been a trial and error to figure it out, but we have been able to narrow down the cause and were able to improve it.

Goldman: *I suppose your supplier is helping on that too.*

Hammesfahr: Yeah. The vendor has been good help. That's the nice thing about being in the Elk Grove area, all these vendors are right in the same region, so I see them every day. It's also nice for material too, because a lot of the material vendors are also in the area.

Goldman: *One thing I occasionally hear from other shops is that their suppliers are not nearby, which can be very frustrating. You've got the local supply and that makes it get to your place a lot faster and makes your turn-around work a lot better.*

Hammesfahr: Yes, that's correct.

Goldman: *Tell me a little bit more about yourself. Where did you go to school?*

Hammesfahr: I went to Monmouth College in Monmouth, Illinois. A small school with about 1,500 kids.

Goldman: *Did any classmates go into this kind of industry, in engineering, for example? That's why I asked earlier if you were an electrical engineer, because that's what we always expect will come into the industry.*

Hammesfahr: I understand. They're all over the spectrum. Many of my friends have either gone into the medical industry, sales, or the banking industry. A couple of them work in the Elk Grove area, selling sandblasting equipment and other industrial products. Other than that, most of them tend to be farmers, because they're from Central Illinois.

Goldman: *What are your expectations at Amritron? I hear you're doing well in sales.*

Hammesfahr: I believe Amritron will continue to grow. It is much easier to sell for a good company. I have enjoyed building up my account base from where I started to where I am now. I couldn't be more pleased, but I could always improve and that is my motivation.

Goldman: *Well I guess that's true, and presuming that you will grow with the company, do you see yourself moving up?*

Hammesfahr: I plan to stay in sales with Amiron. There isn't much room for advancement at this point other than management. However, I want to keep growing my customer base to help Amiron grow and to continuously improve our factory. It is interesting to work with such a wide variety of accounts in all different types of industries which is why I enjoy it.

Goldman: *Your territory is Chicagoland and beyond?*

Hammesfahr: Yes, mostly Midwest to the East Coast. I work with some West Coast customers as well. There seems to be a lot of stuff out on the West Coast. Even the East Coast—they're all over. Sometimes you wouldn't even know that a company works with or has a product that deals with a circuit board.

Goldman: *It's an interesting industry, isn't it? We got started here talking about technology and selling printed circuit boards. You said new technology has helped you find leads.*

Hammesfahr: Yes, it has. The Internet is a great tool when you're trying to find different companies in the area. but it's also getting your name out there. I'm not a huge fan of the social media, because this industry's age group tends to be a little older. They're not with the social media scene so much.

Goldman: *I think if there is social media used in our industry, it is LinkedIn. I know it's the only one I use.*

Hammesfahr: I do use LinkedIn and that's a great way to find new leads. But it's also trying to talk to people and just figuring out who's got business. 'What are you looking to do? How can we help?' That's basically what I'm all about. It's roll up your sleeves, and get in front of people. Even if they tell you "no" the first time. I always say, with every no, you're just one step closer to a yes.

Goldman: *Persistence pays.*

Hammesfahr: Yes, because you know what, nine times out of 10, you don't come across

some disgruntled person who doesn't want to talk to you. They're always polite, for the most part. Or they just hang up the phone. I think face-to-face contact is much better than connecting over the Internet and email. People are lot more likely to hang up on the phone rather than tell you to your face to get out of here. Potential customers will rarely look at your email for information. A lot of it is luck, too. You make your own luck in a sense that if you're not working, you're not going to find it. It's not going to just magically appear. Even in the Elk Grove area, there's such a big manufacturing hub with so many small businesses. Every now and then, they just pop up out of nowhere and I am always keeping my eye open for new leads. I've done quotes on boards for projects that go into Legos all the way to LED lighting for the military. It's all over the place.

Goldman: *They put circuits in Legos now? I guess that's what makes it fascinating. Circuit boards are just everywhere. You have a good work philosophy and practice. That puts you ahead of the game.*

Hammesfahr: I know my generation is notorious for sometimes not having that type of philosophy. I've always been a hard worker. I worked construction. I was building indoor gun ranges out in the Baltimore area, in Fort Meade. I learned what hard work was pretty quick, especially looking for a job out of college. When I got into sales I was like, "Oh, this is great. Back hurts less (laughs)."

Goldman: *Perhaps a little cleaner and neater than working in production?*

Hammesfahr: Well, circuit board manufacturing can be a messy job though, with all the processes involved.

Goldman: *One of the things I know our industry is looking for, and feels a great need for, is process engineers in circuit boards.*

Hammesfahr: I agree. The thing is you don't have such a huge industry over here anymore. You want to bring in these students and engineers that are coming out of college, but they're

getting other jobs that are paying them more money.

Goldman: *Hmm. I suppose it's a no-brainer for them. We have to work on changing that.*

Hammesfahr: I can understand you're not going to take a lower paying job out of the good-

ness of your heart most of the time, especially with student loans to pay off

Goldman: *Unless you're really, really intrigued by it. Matt, thanks so much for talking with me today. This has been very interesting.*

Hammesfahr: Sure. Thank you. **PCB**

Americans' Economic Anxiety Declined in the First Post-Election Marketplace

After measuring increasing anxiety for more than a year, the Economic Anxiety Index has declined significantly, according to the latest Marketplace-Edison Research Poll. The decrease in anxiety reflected in the poll is due to a variety of factors, including Americans' decreasing fear of job loss in the next 12 months, declining fear of being able to pay for monthly expenses, and an overall improved feeling of financial security.

Nearing President Trump's first 100 days in office, the Marketplace-Edison Research Poll also gauges approval of the president's handling of the economy and measures the economic policy priorities of Americans.

Using responses to the poll, Marketplace and Edison Research created the Economic Anxiety Index, a number on a scale from 0-100 that is calculated from answers to a battery of questions. The Economic Anxiety Index describes just how

stressed out people feel about their personal financial situation. The higher the number, the more economic stress someone is feeling.

Key findings include:

- After reporting ever-increasing anxiety the year before the election, the Economic Anxiety Index showed a significant decrease for the first time
- The Economic Anxiety Index is now 32, down 11% from October 2016
- Americans are less worried about losing their jobs, paying their mortgage or rent, and saving for retirement than they were six months ago
- Despite the reduced economic anxiety, people are very concerned about healthcare; it is the number one economic issue worrying Americans
- Nearly three-quarters of Americans feel the government in Washington has forgotten them, and this sentiment cuts across party lines
- Nearly 100 days after taking office, President Trump's economic approval rating is 43%
- Most Americans support passing a large infrastructure bill, a policy that Trump campaigned on and one that many Democratic politicians support, but one that has not been addressed in the administration's first 100 days.



MilAero007 Highlights



[One World, One Industry: 100 Days In—President Trump and a Better Manufacturing Policy](#)

To truly increase the number of American manufacturing jobs, President Trump should support increased investment in research and development for advanced manufacturing, promote and fund STEM education in primary and secondary schools, and build stronger apprenticeship programs. It is this type of investment—in human capital and technology—that will truly help make American manufacturing great again.

[Rep. Lofgren Discusses U.S. Policy Priorities with IPC Member TTM Technologies](#)

Executives and staff at an IPC-member facility held a town hall discussion with Congresswoman Zoe Lofgren (D-CA) on the federal policy issues facing the advanced manufacturing industry. Rep. Lofgren took a tour of TTM Technologies, Inc. in San Jose, getting a first-hand look at the high-tech work being done in TTM's facility.

[Capitol Connection: IMPACT Update—To CEOs on Why You Should Attend IMPACT Washington, D.C. 2017](#)

Here at IPC, we place a high priority on making our presence known in the halls of government, because so many policy debates have a direct effect on the electronics manufacturing industry. IMPACT Washington, D.C. 2017 is a chance to join with fellow industry executives in advocating for better public policies for a stronger, more advanced manufacturing economy.

[Eagle Electronics Accelerates Production with Two Lenz Drilling Machines](#)

Brett McCoy, COO for Eagle Electronics of Schaumburg, Illinois announced that his company has recently placed a purchase order for two Lenz DLG 615-2 Y765 drills.

[Electrotek Receives Nadcap Accreditation for Electronics, Printed Boards](#)

To demonstrate their continued commitment to quality, Electrotek Corporation announces that they have been successful in achieving Nadcap ac-

creditation for electronics, printed circuit boards.

[Capitol Connection: Drumroll, Please... Announcing the IPC Government IMPACT Awardees](#)

Government relations are essential to our industry as many of the policy debates taking place will have long-lasting impact on our industry. Tax and regulations reform, immigration, and environmental regulations are up for debate and it is time for our industry to take a seat at the table.

[U.S. Army Picks BAE Systems to Design Next-Generation Space and Missile Defense Technologies](#)

BAE Systems has been chosen for a position on a new eight-year, \$3 billion indefinite delivery, indefinite quantity (IDIQ) contract to continue supporting the U.S. Army's Space and Missile Defense Command/Army Forces Strategic Command (SMDC/ARSTRAT).

[HT Global Circuits Acquires Pho-Tronics](#)

HT Global Circuits, a manufacturer of printed circuit boards, has acquired fellow PCB manufacturer Pho-Tronics for an undisclosed sum. Pho-Tronics will continue to be operated by the existing management team.

[UW Security Researchers Show That Google's AI Tool for Video Searching Can Be Easily Deceived](#)

University of Washington researchers have shown that Google's new tool that uses machine learning to automatically analyze and label video content can be deceived by inserting a photograph periodically and at a very low rate into videos.

[One World, One Industry: IPC's Global Policy Framework for 2017—Smart Advocacy for the Industry](#)

As President Trump was being sworn in and as the new Congress was getting down to work, IPC released its Global Policy Framework for 2017. As we work to represent more than 3,800 member facilities across the electronics industry's global supply chain, IPC will adhere to this framework to guide our policy work in the coming months.



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Initial findings are showing a reduction in "Opens" of 27%. The reduction of scrap material and improved productivity increases the ROI.



Industry Knowledge— Preparing the Next Generation

by **Patty Goldman**

I-CONNECT007

While at IPC APEX EXPO 2017, I took the opportunity to chat with IPC's David Bergman, VP of Standards and Technology, and Kris Roberson, manager of Certification Development and Training. We discussed IPC's upcoming training programs for young engineers within a company, as well as some new programs for high school and college students pursuing an engineering career.

Patty Goldman: *I'd like to talk with you today about training and education, IPC's involvement, and what you're doing. Of course, I'm mainly interested in the printed circuit board end of things, because our May issue focuses on training, education, hiring, how to get the right people in, and the difficulties everybody's having. We always talk about the graying workforce here in our industry. So I thought I would open it up to you two to give me your thoughts and tell me what IPC's up to, and we can go from there as questions arise.*

Dave Bergman: Patty, you've been a long-time IPC member, so you know a lot about our educational opportunities: our traditional face-to-face

events, which are papers at trade shows or conferences where a speaker gives a 30–45-minute talk on work that their company has done. Another level of that is a workshop, where someone with significant expertise presents for a half a day or a full day. These are face-to-face events that IPC has done for many years. This can be a challenge for many new folks who may not be able to get to an IPC meeting or don't know about IPC. I don't see that issue going away, but I see that a lot more opportunities are needed to provide industry knowledge to next generations.

We are also involved in certification training to our most popular standards. This was demanded by the EMS members of IPC. These companies needed something that allowed them to document their training activities, which was a requirement for ISO 9000 and so they asked IPC, as their association, to create a training and certification program. So IPC created our IPC-A-610 certification program in the mid-'90s and we have added to those over the years. This has become the most widely adopted IPC program of all time. We've had hundreds of thousands of people trained and certified to IPC standards. And these are global programs so that they're delivered everywhere electronics are manufactured. We work through a network of partners,

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-Thomas Hofmann, CEO/Owner



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Dave Bergman

our licensed training centers that are delivering the training, and through this network IPC has been able to spread the word and knowledge of IPC standards globally.

At the industry's request, we have built programs on IPC-A-610, our assembly standard, IPC-A-620 for wire harness, and IPC-A-600, which is the printed circuit board acceptability document. We have a certification program for designers. And most recently, since you expressed interest on the PCB side, for IPC-6012, our printed circuit board standard. And not to leave out rework and repair, we have a training and certification program for IPC-7711/21. IPC's goal is to be responsive to our members and supportive of the industry. If the industry says they're interested in new program, IPC seeks ways to try and deliver a helpful offering. While the IPC certifications have been in existence for over two decades, it is important to continually refresh the content—not just when the standards get revised but also to take advantage of technology. The certification programs are instructor-led, but we moved the testing to online. Online testing allowed us to random-

ize questions and answers, which provided additional integrity and it allowed us to more easily gather data on the responses. We're working right now to do psychometric analysis on the questions which will better ensure training has been effective and knowledge transferred. We're going to be doing more question writing this year to increase the question pool and help keep the testing fresh.

I guess the most exciting thing to talk about would be IPC EDGE, which was launched in July of 2016. IPC EDGE gives us the ability to blend live presentations with online learning, or completely online offerings. This gives us the ability to reach people 24/7 globally, and will help us spread the industry knowledge to the next generation. To date we've rolled out a couple of programs in the EDGE launch.

Almost as long as I've been with IPC, we've done worker-level training using multimedia, starting with 3/4-inch videotapes to VHS to DVD to online streaming, and those are programs that the industry has used successfully for many years. We've taken those and put this content into EDGE so that people can access this library 24/7, at their convenience. We see companies using collections of these to achieve their internal training goals. I think it's a less expensive way to be able to put on a class. This year will be focused on a needs assessment from the industry and building a roadmap of offerings to address these needs. Because if you start brainstorming on all the things that we could put on IPC EDGE, the list is long and we have to prioritize.

Goldman: *One thing that I've noticed about EDGE is, of course, that it's all geared toward electronic manufacturing, as opposed to printed circuit board manufacturing. There isn't one thing there for PCB fabricators to use. But Kris, go ahead and maybe we can also discuss plans for the future for the circuit board half of things.*

Kris Roberson: As Dave was saying, and as you've mentioned, one of the trends that we've seen is the graying of the industry, and part of the upcoming generation—my kids, and even into grandkids and such—they are strongly online geared and very much digital learners. We had a

discussion at our committee chairman meeting, and I think at the technical activities executive committee (TAEC), about even doing away with paper copies of things in general and we really did see the dichotomy. There was the old guard, so to speak, who said “we have to have paper, it’s never going away,” but in the case of some of the professors—some of the committee leadership is also working with colleges—they say the generation coming up doesn’t use paper at all. They haven’t printed anything in the last two years, it’s all digital, and so going through IPC EDGE is really an excellent way to gear toward the common learning.

Presentation format aside, yes, I agree we’re a little light on the circuit board fabrication side. In our defense, it has been our smallest program and not as much emphasis has been placed on the A-600 or the 6012 but it is starting to build. I’m hearing more from fabricators, especially overseas—China and the UK—that they’re starting to see an increase in demand for those, so that’s a good thing. We’re hoping to see more of those, but as Dave was saying we’ve got new programs coming out this year. The A-610 and the J-STD-001 revisions for the G Rev are coming up. We’ve got in-person possibilities. Now these are in investigation so far. We haven’t put anything hard together, but the A-640, which is the brand new fiber optic acceptability doc, is coming out and that one seems to be generating a whole lot of interest. We’re talking about possibly partnering with a vendor that already has a program together and tweaking it or purchasing it, whatever we need to do to match the A-640.

The other one is the A-630 Electrical Enclosure (or box build), so the opposite end of where the circuit boards are. The A-630 is building up and we’ve had a lot of interest in a training program wrapped around that one. The documents in their A Revision now are aiming to be released by the end of the year and we’re keeping an eye on the content there. We didn’t do a training program around it initially because it was a fairly thin document that would have been a small program, and we didn’t want to put something out just to put something out; we wanted to have some content in it.

But then going back to the EDGE program, specifically coming up is IPC-6012DA for automotive, which is a hot topic right now. I’m currently working on the add-on certification that will be our first add-on certification delivered through the EDGE program. The concept is that someone would have gone through the face-to-face 6012 training, so we’re not taking away the face-to-face certification; that’s a cornerstone.

Bergman: If I could chime in, Patty, that’s an offering for your PCB interest. We haven’t forgotten; 6012 is our printed circuit board standard and this is the 6012DA which addresses needs of the automotive industry.

Roberson: The 6012 automotive just came up and I think it was one of our first that was really pushed hard from the European community. We had a lot of European interest with the big guys over there.

Goldman: *That makes sense.*

Roberson: So this one’s going to be going out. Somebody will have the 6012 base certification and then the intent is to allow them to go onto IPC EDGE and take this course, complete it, and then they would have the add-on certification for the 6012 automotive. Continuing again with the board specs, we’ve had a lot of interest in the 6013 and the 6018, and again these are the 6010 series, as we call them. As you know, the 6013 is for flex and the 6018 is also a circuit board standard. But with both of those, we’re looking at the same type of concept where it’s an add-on certification for the 6012. Somebody who has their 6012 already can go onto EDGE or could get the additional information. Basically, I’m calling it a differences module where we say, “OK, 6012 says this, and here’s where the changes are for 6013 and 6018.”

We’ve got a number of things that are coming along geared toward the upcoming individuals and the learning styles that they have. For the design programs, we’ve talked with and held the CID program. We actually held a beta class to work with North Carolina State to get this information down into the college level. Gary Ferrari from EPTAC helped with that.

Goldman: *Get it into the colleges at least and get them into our industry right away, right?*

Roberson: Exactly, and that's a big thing that I think John Mitchell, the IPC board and all of us have seen; in order to get the interest and bring in the younger ones, we've got to do it before they hit the industry. Because once they hit the industry they come in and somebody says, "Okay, we need you to do IPC certification here," and they respond, "What the heck is IPC?" We need to introduce this in college, tech college, even as far back as high school and offer introductory courses, not necessarily a certification, but work with the training centers to get them to have their soldering 101 classes and garner the interest. Then we can steer a few of the engineering candidates, not necessarily away from the EE or the ME, which are fine courses, but maybe into a manufacturing engineer or a process engineer.

Speaking of process engineers, there's a big push coming out in the form of a new committee we've put together for a process engineering course, and from our meeting at APEX it is turning out to be quite a production. By that I mean it's not going to be a single one-off class where you sit down for a week and you get the rubber stamp and you say you've learned a standard. The goal with the process engineering class is it's a longer-term thing, a year to two years to completion, and the concept the committee is working on now is more along the lines of what the CID does.

To become a CID instructor, there's a mentoring program and an approval process—those kind of things. The process engineering course, as it looks like now, will have a limited number of candidates for each cycle. If somebody wants to do this program, they would complete our application process, and they would talk to the approval committee. Once approved, they would start with courses like the J-STD-001 or the A-610 or the 6012, whatever is appropriate.

They would show knowledge and learning of each of the process steps. Putting together a design proposal, going through the design aspect, putting together a process, putting together a time-temperature profile, everything that a general process engineer would need to know, and they would be mentored, by one or more

of the committee members. At the end of that process, they would have a report compiled and they would talk to the committee and present their findings: "Here's what I've learned and here's the general process." The end-goal is for someone to have become a certified IPC process engineer. It can be held up as a real accomplishment and not just a piece of paper certification.

Goldman: *Is that expected to be something where people are in college, or they're already hired at a company and they're aspiring to be a process engineer?*

Roberson: It can be either way. We're not going to exclude others, but the aim initially is going to be the younger engineers, along the same lines as the emerging engineer program. We're hoping to have the younger folks come in and get this from the beginning of their career and see the entire process overall, rather than being stuck in the middle and filtering out and find all these extra processes along the way.

Goldman: *There will have to be some troubleshooting sessions along the way.*

Roberson: Exactly. I started as an operator on the line and worked my way up through machine technician, engineer and so on. Been there, done that sort of thing in the last, well, only 30 years compared to you and Dave, who have been around a while longer than that—not to say you're old (laughs). What I mean is, having seen it from inside and outside, a person needs to know what the process should look like to know when something goes wrong and where's it going wrong. Then you can focus in, rather than take the shotgun approach.

Goldman: *So, when you say young engineers, they're already at a company and want to move along or gain a lot more experience and knowledge, without a hard knock way maybe.*

Roberson: Yes, but it could be for college level as well as when they're coming in, because we're talking about having allowances for having taken certain courses in college to meet these things. If it's a college student coming in



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we can say, “Hey, if you want to get this, here are some courses at your local college that will aim you in the right direction.” And then completing those would work toward fulfillment of the requirements.

Bergman: The fact that we have IPC EDGE available gives us a lot of options, and one of the reasons why we want to spend time on preparing a roadmap is because there’s an enormous amount of education to be done. For example: One of our member companies has taken several of our videos and built a monthly program for workforce retraining. This company finds people out of work from other industries, runs them through a crash course and turns them into productive employees who can work in an electronics manufacturing environment. This company has wrapped company-specific needs around training resources from IPC and they’ve had very good success. We’re going to be releasing a case study on this within the next couple of weeks. So this raises the question: Could this be done at an industry level?

We had a keynote talk at APEX last year on the robotic competitions and trying to get education in front of young kids, high school kids^[1]. IPC EDGE gives us an enormous potential. If you’re looking to get more new people into the industry, what better way of getting them while they’re excited and engaged in projects including electronics manufacturing. We have the possibility of delivering both education as well as promoting the importance of our industry as a career path. Workforce retraining is certainly going to be high on our roadmap and is of interest to our current administration in Washington, as well as globally.

Kris mentioned the 6012DA automotive and how it was European-initiated. The thing that fascinates me about that particular document was that, as soon as it was available, an automotive company in China said, “We really need some training around that, because it’s important to us and we want to have people trained to the 6012DA.” So that drove our interest in creating the program. Demand for education can come from anywhere, which again stresses the need for a good roadmap.

Goldman: *Here’s another thought; I talked with Doug Pauls and he told me a great deal about the Rockwell-Collins Roadshow, as he calls it, where he and another fellow go out to the high schools in Iowa, where Rockwell-Collins is located, and put on this little roadshow with some demonstrations. Basically, the idea is to generate interest in high school students to consider a manufacturing engineering type career. They’ve been doing it long enough that they’re actually seeing results where Rockwell-Collins has hired people that became interested in engineering because they saw this roadshow in their high school. I thought that was good news.*

Bergman: That’s cool. I believe Rockwell-Collins is very proactive. They have been really engaged in our emerging engineer program as well.

Goldman: *Yes they are, and he tells me they have made a roadshow available for others to pick up and use around the country. That would really get the word out, shall we say. IPC does training—you do this, you do that, but you can’t be everywhere. How about every company picking a high school and going to it and talking about engineering and our industry? We could talk all day about this kind of stuff.*

Bergman: Yeah, we were talking about this yesterday and John Mitchell mentioned, “We’re 120 people globally supporting a \$2 trillion industry.” So, you need to be creative to get everywhere.

Goldman: *And you know how people often say, “Well, why doesn’t IPC do that for us?” IPC can provide tools and that kind of thing, which is what IPC and IPC volunteers do really well, but you don’t go out and teach the person. Somebody’s got to want to do that and they’ve got to learn it themselves, too.*

Roberson: Yes, we’re happy to come onsite and assist in some of these things.

Goldman: *Are there any other areas where you see possibilities or that you’ve been concerned about, or that people have told you they’re concerned about?*

Roberson: That's really the big one: What are we going to do as the retirees move along and then the baby boomers, and even the next group? We need to pass along this knowledge.

Goldman: Yes, and quickly.

Bergman: Exactly. For example, we have some plating folks that do great troubleshooting and have the background, useful education information and knowledge that comes from 20+ years of experience. How can you boil that down or capture that experience so that it's available for somebody who's got five years or less in the industry? We see a need for that in the printed circuit board area. We certainly see it in the assembly area and so that's something that we're also considering to try to capture.

You've got guys like Mike Carano who has done education classes forever. Wouldn't it be great to have a virtual Mike and capture some of his education and knowledge for delivery via IPC EDGE? This way Mike would be available anywhere/anytime for people that just can't travel or who want to learn outside of working hours. To be able to pass the lore you've got to capture the lore. Industry experts will retire one day and if you can preserve knowledge collected from decades of experience, the industry will be better off for it.

You have to be able to take something that worked in a face-to-face workshop and make it so that it's a useful training tool. I was learning something about instructional design just yesterday. You've got to now deal with online learning and make sure whatever you're developing is useful for the medium that you're delivering it in, and the first thing is you can't have somebody sit around for two hours and then have a coffee break, because there are no coffee breaks. You need to break the learning into chunks, in some fashion, so that people feel they can do it in five minutes, 10 minutes, 15 minutes here and there, so it's not so overwhelming.

Goldman: In the online learning you have now, certainly somebody can hit a pause button and come back in five minutes, or doesn't it work that way?



Mike Carano

Bergman: It does work that way, and that gives you some availability there, but at some point when you're developing a class you need to consider how you are going to best drive knowledge retention. How are you going to have the people demonstrate the knowledge? Is it just pushing information to you or do you want them to take a quiz? Whatever the learning is, you want the learning to be effective and you have to consider that while you're initially pulling it together.

Roberson: Along those lines, if we jump back to EDGE here, we've got a couple of things that we're calling the foundation courses, which are aimed toward the younger crowd. We've basically taken some of the existing video courses and each one has a document of completion. I hesitate to call it a certificate just because that gets confused with the official IPC certification, and for the most part they're not a certification as such, they're just informational. But for example, it contains foundational courses for 6010 and 7711, and it goes through the soldering 101, the ESD program, the basic seven sins of soldering, etc.

We've got those available that could be used all the way down into the high school level, plus on EDGE we do have the new ESD program that we just put out. It is a certification program in conjunction with the ESD/EOS Association. I like to call them the ESDA because it's easier to say, but it's a course where someone who wants to be an instructor can go on and get certified as a CET, Certified ESD Trainer,

and then take the CES, I think they call it, the Certified ESD Specialist program. They can deliver it through EDGE at their facility and then they add on their own company-specific content and it's customizable for the companies. I know that one is a fairly new model of how we've been delivering things. I haven't seen the numbers, but from what I understand it's been well-received.

Also, Ayana Nickerson, our Senior Certification Director, asks, "OK guys, what do you need? What are you really seeing? Where do we need to focus? What can we do to help?" We're getting feedback from the industry that allows us to see the gaps.

We at IPC can hear all sorts of things anecdotally, but if we don't go out there and talk to people we won't get the actual needs, which is something that I'd love to see even out of this interview after it's posted—if people have ideas, send them to us: "We see this need in our business." Send it to the IPC answers desk^[2] or the IPC liaisons or the cert team. We need to know what the industry needs.

IPC is here with many tools and we'd love to make those tools available as a limited-sized organization. As you say, "Oh, IPC won't do this." Well, we'd love to. The problem is we would have to hire more staff, which of course, we have to pay for; this leads to the old topic of, "Oh, I pay all the time for IPC and what does it get me?" Well, there's a whole lot that IPC is doing and we can partner more easily and efficiently than trying to do it ourselves.

Goldman: *Yes, you can't just do it yourself because you could end up going down the wrong path. You need people and companies to direct the effort and to participate, and so forth.*

Roberson: Absolutely; it's easy to say, "Oh, I want this." Okay, great, now how can we do that?

Goldman: *Do either of you have any final thoughts?*

Bergman: I think we've hit it pretty well. I don't see the traditional face-to-face activity going away. We're still holding conferences, in fact



Kris Roberson

we'll be holding them in the U.S., Europe and China so that still holds a significant place, but the real enhancement or the new activities are going to be the online learning through IPC EDGE. Since we're just at the very early stages, that's what you're going to hear most from IPC for the next year or so because we have so much work to do to lay it all out, and we want to keep it very visible so the industry knows that this new tool is available and they can help us guide the content.

Goldman: *This is all great information. Thank you very much, I really appreciate your time. PCB*

References

1. [I-Connect007 Interview with Dean Kamen](#), founder of FIRST.
2. IPC answer desk: answers@ipc.org.

To reach David Bergman, [click here](#).

To reach Kris Roberson, [click here](#).

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The Desmear Defect Guide

by Michael Carano

RBP CHEMICAL TECHNOLOGY

Introduction

Several defects that are related to the desmear process are presented in this month's *Trouble in Your Tank*.

Inadequate or excessive desmear will lead to several PTH defects and failures. Resin smear, ineffective texturing of the resin, and even overly aggressive desmear will contribute to poor plating, adhesion failures and a myriad of other non-conforming defects. However, proper troubleshooting protocol dictates that the engineer also looks at drilling as the contributor to these and other defects. As an example, drilling can cause torn out glass bundles, extremely rough hole walls as well as excessive smear. Poor drill practice may also lead to wedging at the B-stage-to-copper foil interface. These are just a few of the defects that are presented in this column.

Root cause of these defects and the subsequent effect on PTH quality and reliability are also presented.

1. Excessive Etchback

Description: Excessive glass and excessive positive etchback.

Characteristics: Can lead to plating folds, barrel cracking, glass voids, and uneven copper plating in the holes.

Possible Causes:

- Temperatures of the solvent and permanganate steps are too high.
- Dwell times in the solvent and permanganate steps are too long.
- Concentrations of the solvent and/or permanganate steps are too high.
- Excessive in feed rates (too high of a chip load in drilling).
- Drill is punching its way through the stack.

Besides the excessive etchback on the section at the right, there is concern about long-

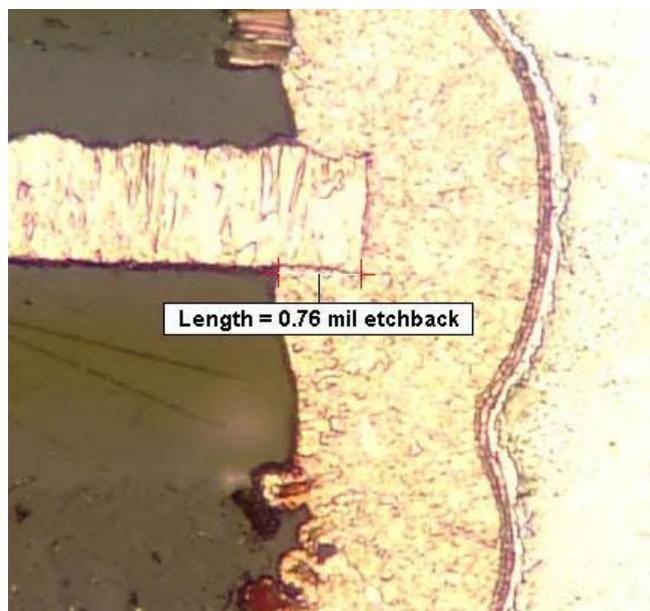
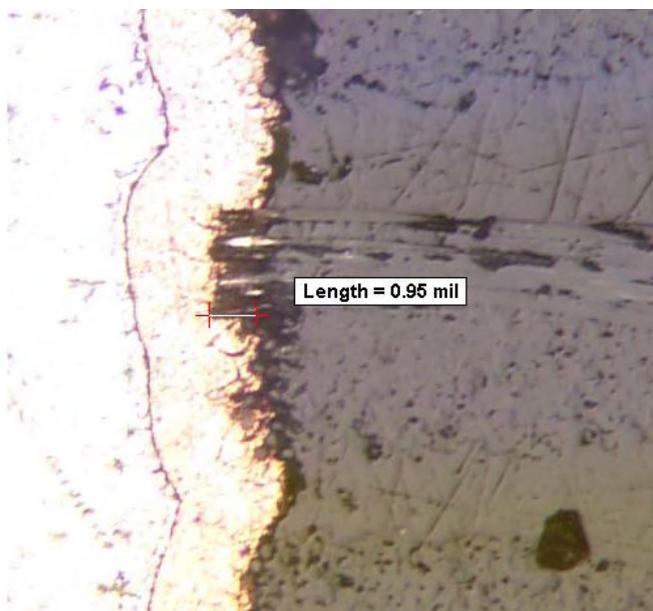


Figure 1: Excessive etchback (right) and glass fiber bundle protrusions (left).
(Source: IPC-9121 Process Effects Guide)

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Figure 2: Excessive etchback leading to plating folds. Etchback exceeds 0.003 inches.

term reliability at the post interconnect. Yes, there is a three-point connection shown in the right section of Figure 1. However, with such deep etchback, there is a great risk of copper plating folds (Figure 2).

2. Wedging

Description: The resin is preferentially attacked along the edges of the innerlayers.

Characteristics: Can lead to plating folds, barrel cracking, wedge voids, and uneven copper plating in the holes.

Possible Causes:

- a) Too much caustic in the solvent and/or permanganate step.
- b) Improper bonding (oxide or oxide alternative) process.

With respect to improper bonding, one should also pay close attention to the actual multilayer bonding process itself. Some questions to ask are:

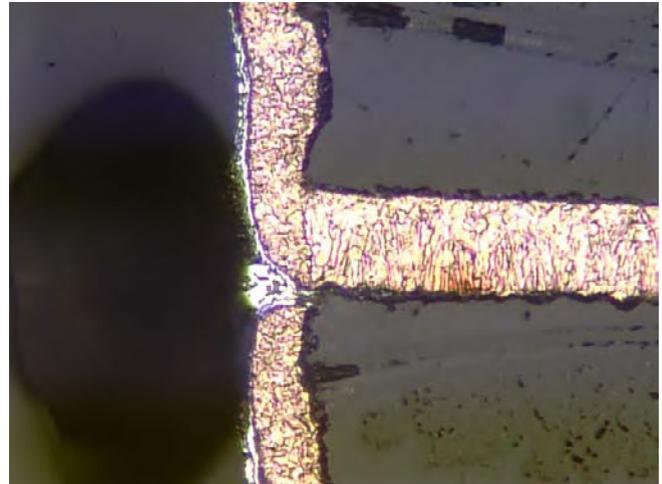


Figure 3: Note deep wedging between B-Stage and copper foil—wedging leads to plating void.

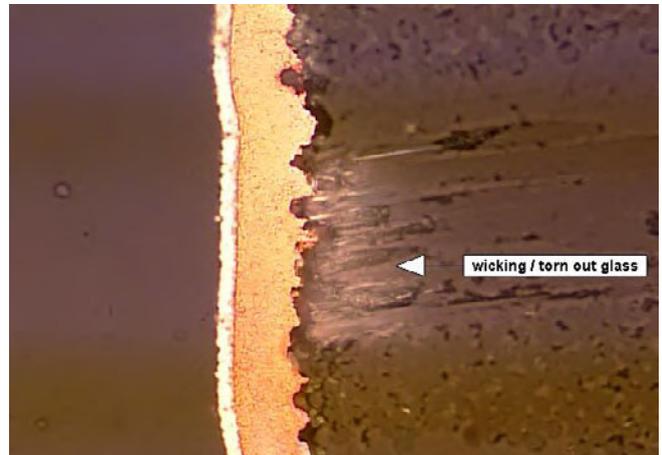


Figure 4: Plating along glass fibers, also known as wicking. (Source: IPC-9121 Process Effects Guide)

1. What is the rate of heat rise in the multilayer stack?
2. Are there concerns with moisture, in the laminate or prepreg?
3. What is the optimum cure of the resin material?

3. Wicking

Description: The resin does not encapsulate the glass bundles near the hole wall and appears as glowing glass bundles when illuminated.

Characteristics: Can lead to plating folds, barrel cracking, glass voids, and uneven copper plating in the holes.

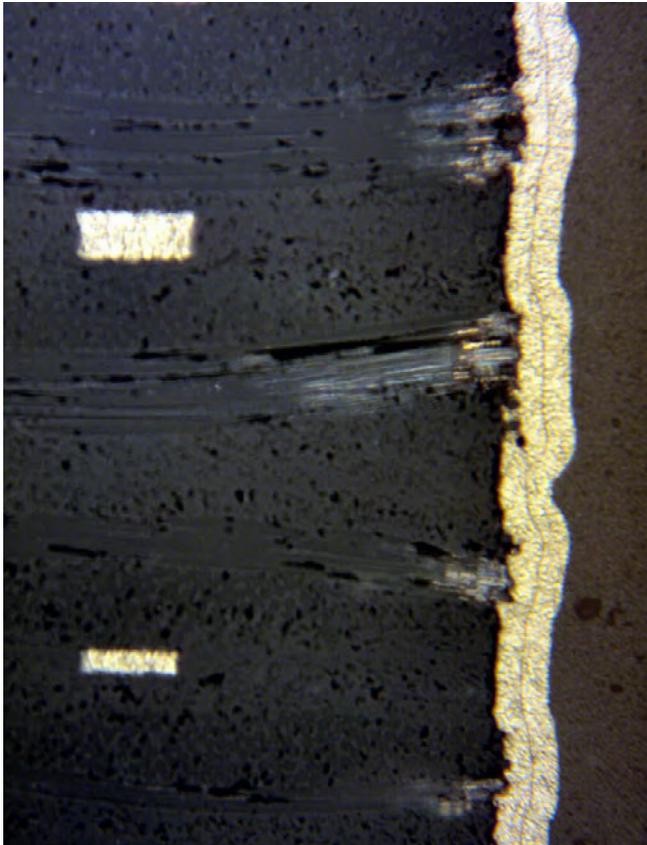


Figure 5: More examples of wicking. Note torn out glass bundles, the most common effect. (Source: IPC 9121 Process Effects Guide)

Possible Causes:

- a) Improper lamination process.
- b) Too little resin content in the laminate.
- c) Improper drilling parameters.
- d) Improper glass-etch process.

4. Hole-wall Pullaway

Description: The plated copper bulges out from the resin area on the hole wall.

Characteristics: Can lead to barrel cracking and can be brought on by inadequate texturing of the resin of the hole wall.

Possible Causes:

- a) Too much solvent absorption caused by solvent parameters being set too high.
- b) Too much solvent absorption caused by permanganate parameters being set too low.

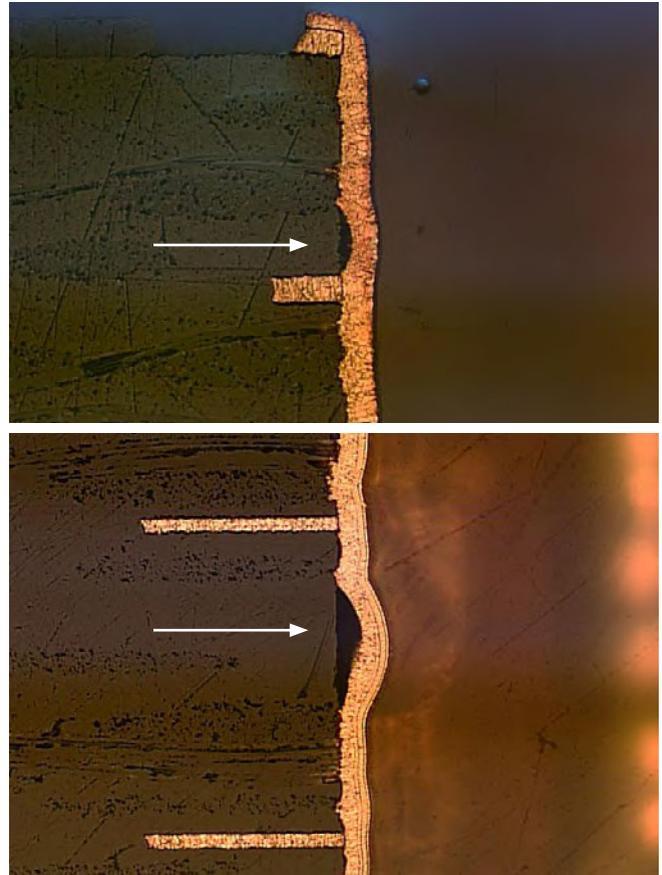


Figure 6: Hole-wall pullaway. Note a blister or bulge of the plated copper from the sidewall of the via.

- c) Under-cured laminate.
- d) Laminate that can not be properly textured by using permanganate desmear processes.

5. Interconnect Defect Caused by Drill Smear

Description: A fine line seen between the innerlayer and the plated copper when no positive or negative etchback is seen.

Characteristics: Interconnect defects can cause opens.

Possible Causes:

- a) The desmear parameters are set too low.
- b) Improper drilling parameters.
- c) Improper metallization processing can cause similar-looking defects.



Figure 7: Note fine-line interconnect defect caused by drill smear that was not removed from interconnect.

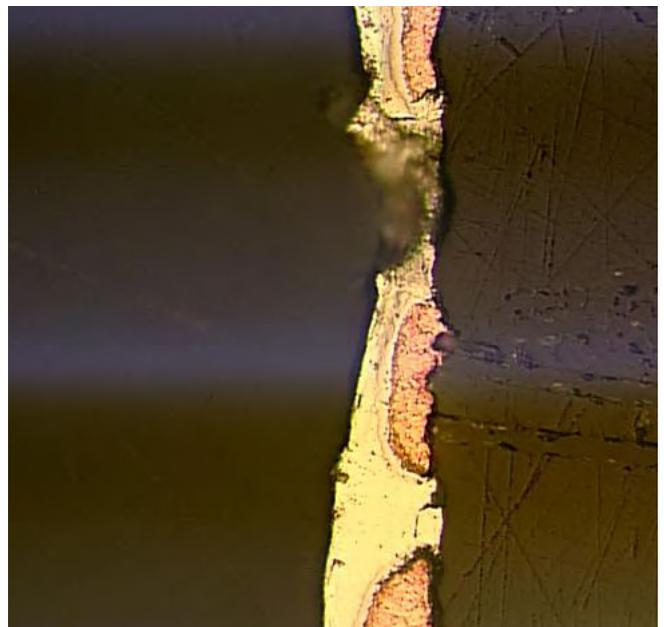
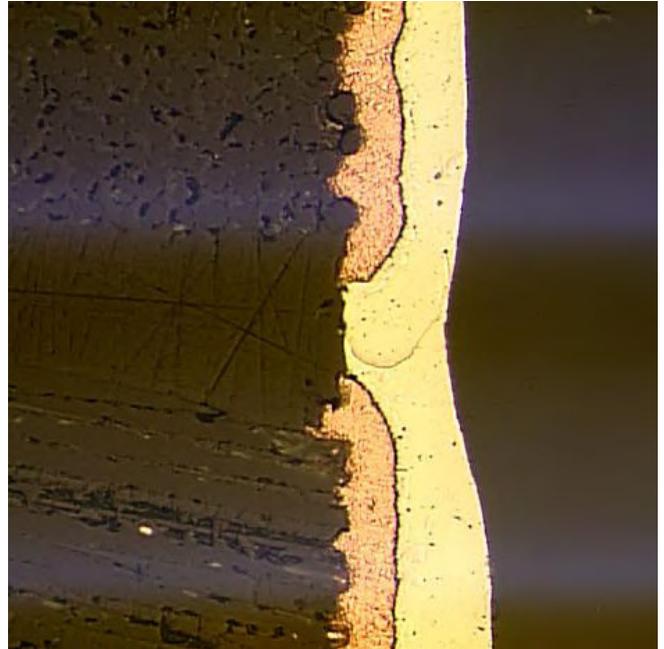


Figure 8: Voids in plated through-hole. (Source: RBP Chemical Technology)

6. Voids

Description: An area, most commonly on resin, where there is a gap in the plated copper in the holes.

Characteristics: Voids can cause opens.

Possible Causes:

- a) Incomplete neutralization of the permanganate.
- b) Improper shadow or other metallization processing.
- c) Under-cured resin.

The lessons learned are many:

- Optimize drilling including monitoring of chip loads and drill bit quality
- Ensure proper cure of the resin during lamination
- Desmear may require additional help from plasma as the higher performance resin materials are more resistant to attack from alkaline permanganate
- Do not expect the electrolytic copper plating process to make-up for poor hole-wall quality and the existence of wedge voids **PCB**



Michael Carano is VP of technology and business development for RBP Chemical Technology. To reach Carano, or read past columns, [click here](#).

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Flying Probe Testing vs. IPC-9252B

by Todd Kolmodin

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Flying probe testing is extremely popular in today's manufacturing theatres. The main factor is cost reduction in contrast to dedicated fixtures and fixture testing. However, there are some limitations in flying probe testing when gauged against industry specifications—specifically, the use of indirect vs direct testing in Test Level C. Table 4-1 of IPC-9252B outlines the methodologies allowed over the different Test Levels. This month we will be discussing Test Level C as this level raises the most questions regarding the use of direct versus indirect test methods when testing product in the Test Level C class. First, we need to define some terms used in flying probe testing.

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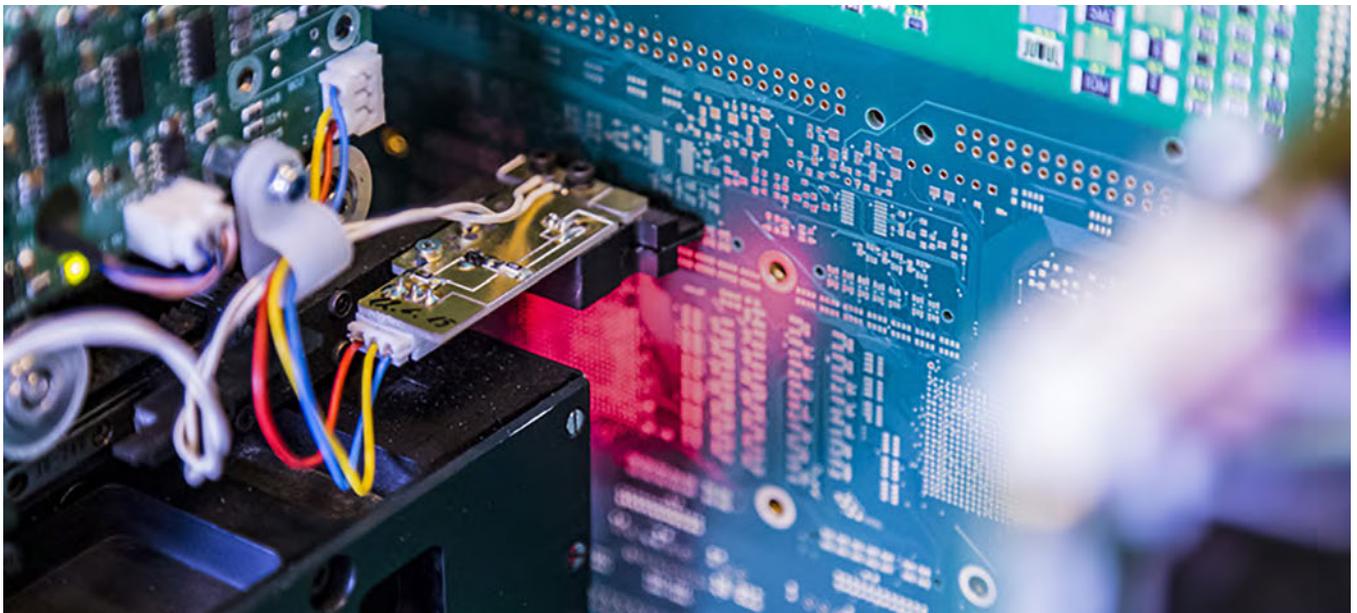
The term AABUS, or “As Agreed Between User and Supplier,” is used in IPC specifications where actions within a specific requirement are allowed, but require the mutual agreement between the user and manufacturer. This term is important as it amplifies the requirement for correct flow-down of customer requirements and any special allowances or deviation of the

industry specifications. (See my [April column](#) regarding flow-down.)

Adjacency and Adjacency Window

The terms ‘adjacency’ and ‘adjacency window’ are used with flying probes defining the area for which the isolation test is performed. There are two types of adjacency: horizontal (line of sight) and vertical (Z-axis). As with fixture testers and parametric testing, the flying probes cannot accomplish a full parametric isolation test as they simply do not have the hardware. So the industry has accepted the practice of adjacency. How this works is that when a single net is interrogated for shorts it is tested against other nets in range or that are adjacent to that net. That range is defined as the adjacency window. The adjacency window is user-definable, however the specification IPC-9252B has recommended 0.050” (1.27 mm) as a default value for horizontal or line of sight adjacency.

When programming for vertical adjacency, there is more information required and the window is variable. One needs the stack-up in-



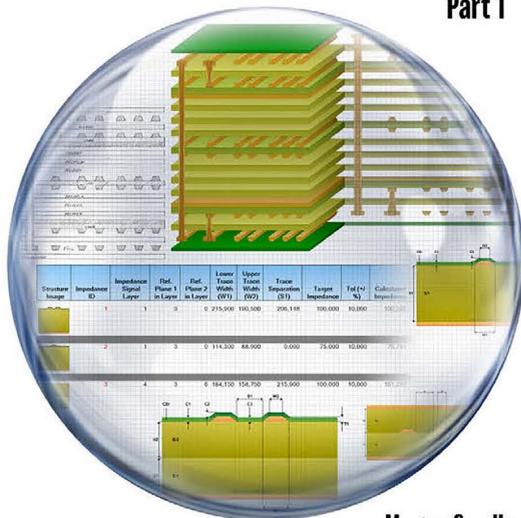
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Adjacency Measurements Example

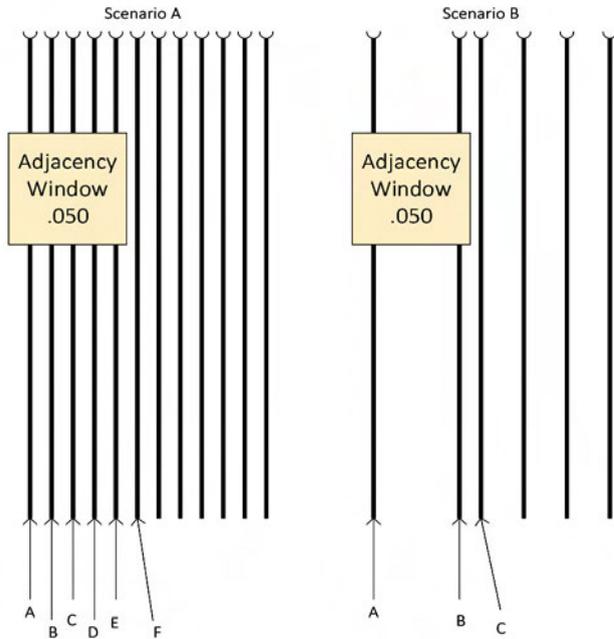


Figure 1: Adjacency windows.

formation as well as the core and foil thicknesses. If the vertical adjacency window is programmed too shallow, the risk of missing shorts to the adjacent later(s) is possible. If the window is too large you risk picking up too many layers and the test may become much longer than intended. It is necessary to remember that if the adjacency window is changed it can affect the time taken during for the isolation test to be performed. This is directly proportional to the window size. As the adjacency window increases the time to perform the test increases, as the Adjacency Window will possibly pick up more net “in range.” Figure 1 illustrates how the window can affect the test based on the topography of the PCB using horizontal adjacency.

In Figure 1 we see two scenarios, scenario A and scenario B. When performing the isolation test this becomes important as the amount of measurements required during the test can be significantly different and affect time to perform the entire PCB test. In scenario A we see six different nets labeled A through F. We also see an adjacency window of .050”. What we see here is when Net A is tested for shorts, it must be tested against nets B through E. This is four

measurements. You will notice that Net F is not tested to Net A. Net F does not fall within range of the adjacency window.

Now in Figure 1 Scenario B, we have the same adjacency window but in this case, we have nets shown labeled A through C. When the isolation test is performed on net A there will be only one measurement. Net A will be only tested against Net B. Net C is again not within range or inside the adjacency window and therefore is not tested against Net A. So in Figure 1 you can see that PCB density can affect the amount of measurements required to perform the isolation test and thus affecting time required.

Direct Mode

Direct mode utilizes direct resistance measurements for all nets on the PCB. What this means is that during the continuity (opens) test all test points of the net are tested against the continuity threshold. Any net that violates the required resistance will be reported as a fault.

When the isolation test (shorts) is performed, each net is probed using the required voltage and isolation parameter. One must remember that when flying probes perform the isolation test they are performing it via an adjacency window as defined previously.

When direct mode is used, each PCB will take the same amount of time to test. This is because every net will be tested for continuity and isolation the same way each time. PCB 2 will take the same time as PCB 1 as well as PCB 3 and so on.

Indirect Mode

Indirect mode (also termed indirect testing by signature comparison or discharge testing) is the method where the flying probe develops speed over direct mode testing. In this method, the machine develops a capacitive master by gathering a capacitive signature of the board and then comparing subsequent boards to it. When the first PCB of an order is tested, the machine places a reference probe or probes down on the PCB reference plane or planes. It will then use the remaining probes to read a signature from all nets and record those findings to the master. Depending on the type of machine,

this may be direct capacitive measurements or capacitive “counts.”

When the capacitive gather is complete on the first board it will perform a full direct mode test to validate the first board is actually conforming and does not have any defects. If no defects are found the capacitive master is written as “golden.” If any defects are found, the master still will be written but the defective nets will be discounted from the master as they were non-conforming. When the second board is tested, the capacitive gather is done again. When it is complete the machine will compare the values from board number two to the master. If any of the readings are not within tolerance of the master, those nets will be placed in a retest file for direct mode probing. This could be for either possible opens or shorts. The amount of direct mode probing will be controlled by the anomalies found during the capacitive gather. The less discrepancies found against the master the less direct mode probing will be done. This is how the speed is gained during indirect testing.

Test Methods vs. IPC-9252B Test Level C

Now that we understand the two basic methods used in flying probe testing, what impact does this have on product in Performance Class 3? This can have a large effect based on whether indirect testing can be done or not. The 9252B specification does allow indirect testing for Performance Class 3 (Test Level C), but has the caveat of AABUS as defined previously. So as one reads the specification, if the allowance for indirect testing has not been stipulated in the flow-

down, P.O., or customer specification, the default flying probe test method for Performance Class 3 (Test Level C) is direct mode.

How much of an impact can this be? It can be substantial based on the amount of test points, nets and adjacency pairs. We performed an experiment across five different PCBs with different amounts of test points, nets and adjacency pairs. In Table 1 we show the five different boards with their individual attributes.

Each of the PCBs 1–5 were tested in both direct mode and indirect mode. For our discussion, we will be doing a comparison based on the amount of measurements taken to test the individual boards. The reason we have used measurements instead of time required is that PCB topography is a variable and mechanical travel will not be the same nor can be correlated to test points. Measurements more directly show the contrasting between test methods.

For each of our PCBs in our experiment all went through direct mode test, indirect master generation, and indirect subsequent board test.

In Table 2 we see how many measurements are taken for each type of test. As we discussed earlier, the amount of measurements required to perform direct mode test will not change. However, for indirect mode testing we see significant differences in the amount of measurements required. The indirect column is the amount of measurements required for subsequent boards prior to direct mode retest, as this can vary from board to board. What sticks out to us immediately is the advantage we see using Indirect testing vs. direct testing. In just our control group we

	Test Points	Nets	Adjacent Nets
PCB 1	5,865	1,762	18,840
PCB 2	5,677	1,671	17,517
PCB 3	4,291	1,325	12,433
PCB 4	10,871	2,440	24,451
PCB 5	28,728	7,088	69,053

Table 1: PCB group.

	Test Points	Indirect	Direct	Indirect to Direct
PCB 1	5,865	7,012	22,943	327%
PCB 2	5,677	6,753	21,523	319%
PCB 3	4,291	5,061	15,404	304%
PCB 4	10,871	12,515	32,882	263%
PCB 5	28,728	33,263	90,693	273%

Table 2: Indirect and direct test method measurements.

	Test Points	Indirect	Direct	Hybrid Test		Indirect to Direct	Hybrid to Direct
PCB 1	5,865	7,012	22,943	10,910		327%	210%
PCB 2	5,677	6,753	21,523	10,559		319%	204%
PCB 3	4,291	5,061	15,404	7,879		304%	196%
PCB 4	10,871	12,515	32,882	20,525		263%	160%
PCB 5	28,728	33,263	90,693	53,821		273%	169%

Table 3: Indirect, direct and hybrid test measurements.

saw 263–327% difference in required measurements. Even though we see significant advantages to use Indirect over direct mode if there is no AABUS or allowance via procurement document, customer specification or other means we are bound to IPC-9252B and direct mode.

Hybrid Indirect Mode

What if there was a way to incorporate some of both modes into a method where capacitive gather is done, direct mode continuity is done and finally the isolation test via adjacency is done based on the results of the capacitive master? Well there is! The main requirement of most Test Level C product is the continuity resistance. In the IPC-9252B standard this is 10 ohms. The argument has been that in indirect mode you do not necessarily test the net for 10 ohms unless it happened to be captured in the retest file during capacitance gather. However, with this hybrid test the capacitive gather is done as normal for indirect testing and the first board will receive the full direct mode validation as required. The change is how the second and subsequent boards are tested. They will receive the capacitive gather but this will only be used for retest during the isolation adjacency test. With the hybrid test all nets will be tested for continuity as in direct mode. For isolation, only nets that were found possibly faulty during the capacitive gather and placed in the retest file will be tested. This will reduce the amount of isolation tests required.

So how does this new mode compare against direct and indirect mode? In Table 3 we have added a column for hybrid test.

We see from Table 3 that we still have a reduction in measurements over our direct mode baseline. Of course, we did not expect the reduction as shown for indirect testing but the reduction to 160–210% is quite favorable. In fact, if we average our results from our control group, we see that 297% more measurements are required in direct vs. indirect testing. We also see that there is an average of 188% more measurements required in direct mode vs. hybrid test mode.

Conclusion

When flying probe testing under the requirements of Test Level C, we are bound by the default direct mode. We can see from our experiment that this could cause an average increase in measurements of 297% over indirect testing. However, without satisfying the AABUS requirement the extra measurements are required. And yes, this will take extra time. **PCB**



Todd Kolmodin is the vice president of quality for Gardien Services USA, and an expert in electrical test and reliability issues. To read past columns, or to contact Kolmodin, [click here](#).



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China—A Critical Partner for Trade

by John Mitchell

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Count me among those business leaders who thought the Trans-Pacific Partnership (TPP) was on the right track last year and would have brought significant benefits to all nations, including the United States.

Before President Trump withdrew the United States from the TPP trade negotiations, I had argued it would have unified the world's most dynamic economic region—bringing together developed and developing countries that collectively represent 825 million consumers and 40% of the world's economic output.

TPP would have eased cross-border trade and simplified international supply chains by eliminating tariffs, increasing transparency, and instituting stronger protections for intellectual property, labor, and the environment.

Another practical outcome would have been pressure on China—the world's second largest economy—to eventually join. So sweeping was the TPP in its scope, with member nations including Japan, Singapore, Vietnam, Australia, as well as the United States, Mexico, and Canada—that China would have had little choice but to at least harmonize its trading practices with TPP countries, if not eventually join as a full-fledged member.

Fast-forward to today. With President Trump having kept his campaign promise to withdraw the United States from the TPP, the pact is considered all but dead. But beyond that, contin-

ued rhetoric from the Trump administration indicates a reluctance to embrace multilateral free trade deals and to move toward a more protectionist “U.S. first” trade policy.

This is a mistake, on a number of fronts. First, in an increasingly interconnected world, free and fair trade is mutually beneficial. With respect to the United States and China, our economies are already inextricably linked. The two countries are each other's second-largest trading partner, with bilateral trade reaching \$519 billion last year. And this trade is on an upward trajectory.

In the electronics industry, nearly 20% of IPC's member companies are Chinese, and those firms and many of their foreign partners depend on predictable and open trade rules to help secure their supply chains. Why would we erect new barriers to trade with China, or skip the opportunity to lower existing barriers?

Second, by sitting out the negotiations for multilateral trade agreements, the United States allows the rest of the world to “set the table,” and loses influence in critical negotiations that could strengthen its own economy. Earlier this spring, President Trump cited the high international tariffs imposed by some countries on American motorcycle maker Harley Davidson as an example of unfair trade. And yet, Harley Davidson CEO Matt Levatich publicly supported TPP because it would have completely eliminat-



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ed some tariffs, such as the 74% tax on the company's motorcycles sold in Vietnam.

Former U.S. Trade Representative Michael Froman recently put it this way^[1]:

“If the U.S. remains near the sidelines, then our businesses—from agriculture and manufacturing to services industries—will likely find themselves excluded from important markets, or competing under a set of rules that don't necessarily play to our interests and values. That's why it's ultimately important for a TPP-type regime to be put in place in whatever fashion it can be.”

And there are other TPP-type regimes out there, ready to move forward with—or without—U.S. involvement.

The RCEP

For instance, the collapse of TPP makes imminent the completion of the China-led Regional Comprehensive Economic Partnership (RCEP) more likely. Encompassing 16 countries so far, the RCEP is potentially an even larger multilateral trade agreement than TPP by population. RCEP potentially includes more than three billion people (about 46% of the world's population), representing a combined GDP of about \$21.3 trillion, and accounting for about 30% of world trade.

Whereas before, the United States was an active party to multilateral negotiations in a U.S.-led deal that excluded China, now those roles have reversed. Now China has the greatest power to influence the terms of the RCEP, to which the United States is not a party.

Multilateral vs. Bilateral

Finally, the Trump administration has signaled its distrust of multilateral agreements, on the theory that it could negotiate better deals for the United States in a series of bilateral talks.

While this may be true in some cases, it ignores the reality that globalization and multilateral free trade agreements have been the growing trend worldwide for more than 60 years. And for good reason. As Brookings Institution fellow Geoffrey Gertz notes^[2]:

“In today's economy, bilateral relationships do not capture how international trade works in prac-

tice. Factories do not simply produce at home and export final goods to a foreign country; rather, firms participate in global value chains, where stages of production are divided across multiple countries.”

Harmonized standards across a group of countries are far more efficient, thus speeding fulfillment and lowering supply chain costs.

U.S.—China Negotiations

Which brings me to my final point: The Trump administration has hinted that it would consider retaliatory actions against China. Far from embracing that nation as a favored—essential—trading partner, retaliatory actions such as new tariffs on Chinese imports could backfire on the United States.

If new U.S. tariffs and barriers to Chinese goods are too severe, they could spur China to retaliate by raising its own tariffs on imports, or developing non-U.S. alternatives to its needs. We've already seen this with microchips. Rather than negotiate with the United States on microchip imports, China instead chose to develop its own chips with its own IP, which has lowered the country's dependence on imports and decreased the market share of foreign chipmakers there.

At the end of the day, U.S. trade with China is integral to the success of both economies. And to ignore multilateral trade agreements is to ignore a fundamental truth: In 2017, globalization is continuing—either with the United States, or without it. Remaining engaged as a global leader on trade is the path that will make America greater. **PCB**

References

1. [Former US Trade Official: China will fill Asia Pacific trade void.](#)
2. [Trump's Bilateralism and US Trade Partners](#) by Geoffrey Gertz, *Global Trade Magazine*.



John Mitchell is president and CEO of IPC—Association Connecting Electronics Industries. To read past columns or to contact Mitchell, [click here](#).

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- A combination of 10 years' sales, product marketing, product management, or business development
- US citizenship and fluency in English
- Working knowledge of PWB and IC development
- Strong communication and customer skills
- Must be able to work independently with limited supervision
- Excellent interpersonal communication and organizational skills to work with clients, team members, and management staff
- Multicultural experience in Germany or Japan
- International business

[Click here for more details](#)



Advanced technology manufacturer of printed circuit boards in Huntington Beach, CA is looking for manufacturer's representatives in Southern California. Please forward inquiries to Crystal Barrett. (585) 254-2989 ext. 225

[Click here to apply](#)



Flexible Circuits • Heaters • Assemblies

HELP WANTED

In order to support its continued growth and leadership position, All Flex Flexible Circuits and Heaters is seeking a TECHNICAL APPLICATION SALES ENGINEER for our inside sales team. Candidates are to have 5+ years in the PCB industry including a minimum of 2 years with flexible circuitry and/or flexible heaters. Experience in component assembly and flexible heater design is a plus.

The position involves providing extremely high responsiveness and follow-up to assigned accounts and new prospect inquiries. Although primarily an inside sales service provider, the individual must also be able to travel several times per year to support tradeshow and in-person customer support. The position provides technical application knowledge to assist customers in the design and use of flexible circuits, heaters, and assemblies, a key service that All Flex provides.

Background to include:

- Success in a team environment
- Managing large customers – ideally in medical, military, aerospace, and industrial markets
- Proficiency in Microsoft Office Suite with good typing/keyboard skills
- Attention to detail
- Good organization skills in handling multiple activities at the same time
- Professional telephone and e-mail communication skills
- Experience working trade shows
- Good listening and customer management abilities

This position is located in Northfield, MN.

[Click here to apply](#)



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HELP WANTED ADS



ventec
INTERNATIONAL GROUP
騰輝電子

OEM Account Manager USA (IMS Materials)

Want to work for a globally successful and growing company and help drive that success? As a US-based key member of the global OEM Marketing Team, your focus will be on IMS (insulated metal substrates) materials that deliver exceptional thermal performance, reliability and quality, particularly demanded by automotive and other LED lighting and DC power conversion applications. Combining your strong technical PCB manufacturing and design knowledge with commercial acumen, you will offer OEM customers (buyers, designers, reliability engineers and the people that liaise directly with the PCB manufacturers) advice and solutions for optimum performance, quality and cost.

Skills and abilities required for the role:

- Technical background in PCB manufacturing/design
- Solid understanding of IMS materials
- Sales knowledge and skills
- Excellent oral and written communication skills in English
- Experience in making compelling presentations to small and large audiences
- Proven relationship building skills with partners and virtual teams

This is a fantastic opportunity to become part of a successful brand and leading team with excellent benefits.

Please forward your resume to:

[Click here to apply](#)

mention "OEM Account Manager USA"
in the subject line.

saki

The Future in Focus

Field Application Engineer

SAKI America, manufacturer of automated optical, solder paste, and X-ray inspection and measurement systems for the electronics industry, seeks a Field Application Engineer, based in its Fremont, California headquarters. Responsibilities include communicating with customers, sales representatives, and pertinent Saki personnel to understand the customers' applications, assist in equipment selection, perform equipment installation, and provide assembly process assistance, training, support, maintenance, troubleshooting, and services for Saki's products and technologies, at SAKI America's headquarters, regional offices, and customer sites. Perform product and process demonstrations and presentations to customers, agents, and colleagues, assist with trade show activities, and work with factory and development teams to communicate new product ideas and customer suggestions/requests.

Job requirements:

Two-year technical degree (four-year preferred) or equivalent experience. 3-5 years combined experience in customer and technical support with 5-7 years in SMT manufacturing process with SPI and AOI understanding. The ideal candidate will have experience running and programming SPI and AOI systems. Competencies should include excellent verbal and written communication skills, a working knowledge of computer-based business applications, understanding SPC collection and use in a manufacturing environment, problem-solving skills, use of tools such as Six Sigma, and electronics/electromechanical troubleshooting capability. The position requires up to 75% travel (3 weeks/month).

[Click here to apply](#)



MivaTek

Global

Application/Sales Engineer

Positions available East, Midwest and Western United States. Position will focus on supporting sales and applications development for Miva Technologies DLP direct imaging system for the PCB and micro-electronics markets. Experience with photoresist and imaging preferred but not required.

Send resume and contact information for both positions to Brendan Hogan.

Service Technician

Positions available for Eastern and Western United States. Service Technicians will support our rapidly expanding installed base of Miva Technologies DLP imaging systems as well as other systems sold by the company.

[Click here to apply](#)

W A N T E D



C O N T R I B U T O R S

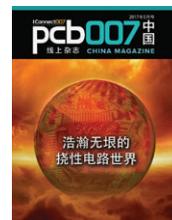
Help Wanted: I-Connect007 contributors!

Are you an expert at PCB design, fabrication, assembly, or a related industry skill? Do you have a desire to share your unique perspective and knowledge? If so, we'd love to hear from you. The PCB Design Magazine, The PCB Magazine, PCB007 China Magazine and SMT Magazine are seeking feature contributors and regular columnists.

Being an I-Connect007 contributor does have its benefits: you can share your published articles from our industry-leading technical publications with your byline on websites, blogs, social media, and more.

For more information, contact our editors:

[SMT Magazine](#), [The PCB Magazine](#), [The PCB Design Magazine](#), and [PCB007 China Magazine](#).



I-Connect007
GOOD FOR THE INDUSTRY

TOP TEN



Recent Highlights from PCB007

1 Flex Talk: Flex Material Handling—An Inside Peek

As increasingly more designs move to flexible materials to take advantage of space, weight or packaging benefits, it has been clear that flexible circuits require a different set of rules than their rigid counterparts. We spend substantial time working through the design to ensure that flex is as robust as possible.



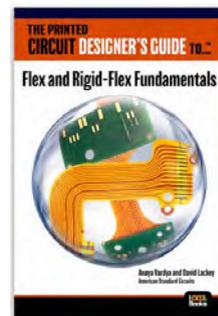
2 A Conversation with Gene Weiner

In a discussion following the PCB Executive Forum at IPC APEX EXPO in February, Gene Weiner opened up to Barry Matties and Patty Goldman on the state of the North American electronics industry supply chain and the importance of cooperative efforts up and down that supply chain.



3 American Standard Circuits Discusses e-Book on Designing Flex and Rigid-Flex

American Standard Circuits is an industry leader when it comes to high-technology printed circuit boards, especially flex and rigid-flex printed circuit boards. So, it was natural that they would write about flex and rigid-flex for I-Connect007's new "Guide to..." e-book series.



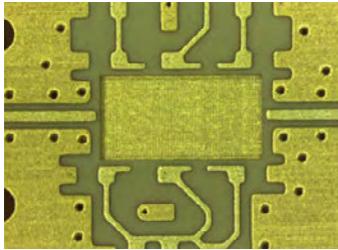
4 All About Flex: Flex Circuit Stiffeners

Many flexible circuit designs require selectively bonded stiffeners...they're just too flexible! Stiffener materials can be any number of materials, but they are usually polyimide films or FR-4 glass/epoxy substrates and are available in a wide variety of thicknesses.



5 PCB Technology Requirements for Millimeter-Wave Interconnect and Antenna

The work done by Optiprint AG in support of MiWaveS substantiates that PCB technology can satisfy the engineering requirements for mmW circuitry providing the manufacturing capabilities can match the positional accuracy, feature tolerance and surface finish requirements.



6 Elmatica's New Technology Results in an Increase for Flex and Rigid-Flex Printed Circuits

Elmatica has reported an increase in the demand for flex and rigid-flex boards in the Nordics. New advanced technology requires flexible circuits to fulfill challenging form-factor requirements, eliminate connectors and improve performance.

7 MACFEST: Benchmarking a New Solderable PCB Finish

New, innovative manufacturing procedures have been developed by the recently completed project, Manufacturing Advanced Coating for Future Electronics Systems (MACFEST), which has been funded by several partners and the government's Innovate UK.



8 Printed Circuits LLC Pursues Further Capacity and Technology Upgrades to Start 2017

Rigid-flex circuit board manufacturer, Printed Circuits has started 2017 with a few enhancements to their equipment line up, designed to increase capacity, improve technical capability and reduce process time for their customers.

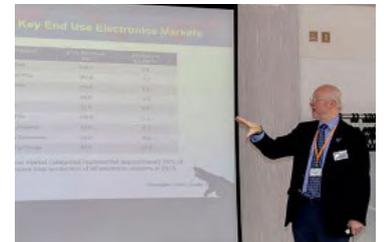


9 Weiner's World—March 2017

The CPCA show held at the China International PCB And Assembly Show was moderately busy even though the new venue was not quite ready (no escalators, the "water closets" not fully finished, the heat was only on for a few hours one day). It showcased products for PCB Manufacturing, Electronic Assembly Materials and Manufacturing Services.

10 EIPC Workshop on PCB BioMEMS

The Premier Inn conference centre at Heathrow Airport was the venue for the EIPC workshop on PCB BioMEMS. What, I hear you ask, is a PCB BioMEMS? This is an abbreviation for biomedical (or biological) microelectromechanical systems, otherwise known as lab-on-chip.



For the latest PCB news and information, visit: PCB007.com



Events

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For the SMTA Calendar of Events, [click here](#).

For the iNEMI Calendar of Events, [click here](#).

For the complete PCB007 Calendar of Events, [click here](#).

[ICT 43rd Annual Symposium](#)

May 9, 2017
West Midlands, UK

[What's New in Electronics Live!](#)

May 9–10, 2017
Birmingham, UK

[Thailand PCB Expo 2017](#)

May 11–13, 2017
Bangkok, Thailand

[EIPC 2017 Summer Conference](#)

June 1–2, 2017
Birmingham, Solihull, UK

[JPCA Show 2017](#)

June 7–9, 2017
Tokyo, Japan

[IPC Reliability Forum: Emerging Technologies](#)

June 27–28, 2017
Düsseldorf, Germany

[24th FED Conference](#)

September 15–16, 2017
Bonn, Germany

[SMTA International 2017 Conference and Exhibition](#)

September 17–21, 2017
Rosemont, Illinois, USA

[electronicAsia](#)

October 13–16, 2017
Hong Kong

[IPC Flexible Circuits: HDI Forum](#)

October 17–19, 2017
Minneapolis, Minnesota, USA

[TPCA Show 2017](#)

October 25–27, 2017
Taipei, Taiwan

[productronica 2017](#)

November 14–17, 2017
Munich, Germany

[HKPCA/IPC International Printed Circuit & South China Fair](#)

December 6–8, 2017
Shenzhen, China



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I-Connect007 Presents



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board real estate

JULY:
The State of MilAero
Update on the military
industry

AUGUST:
Process Step Elimination
Streamlining and
automating your processes

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