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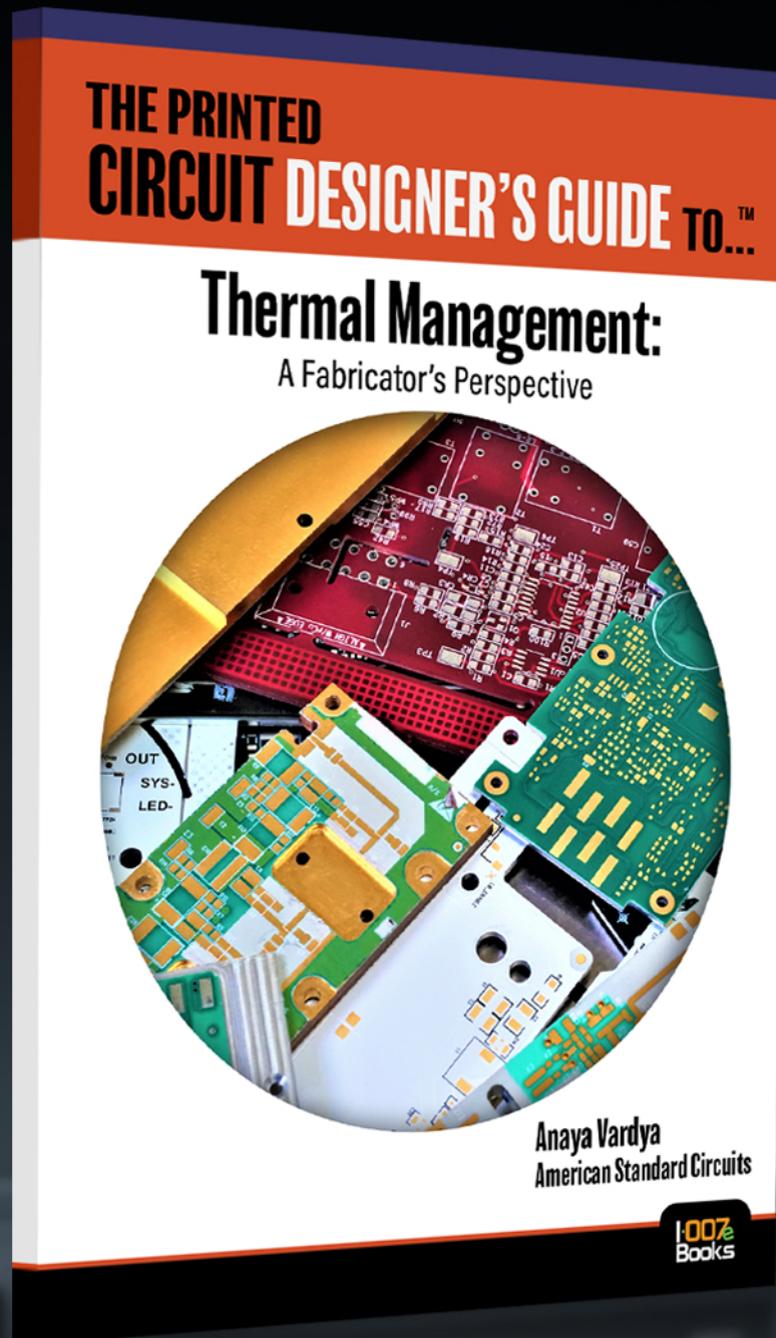


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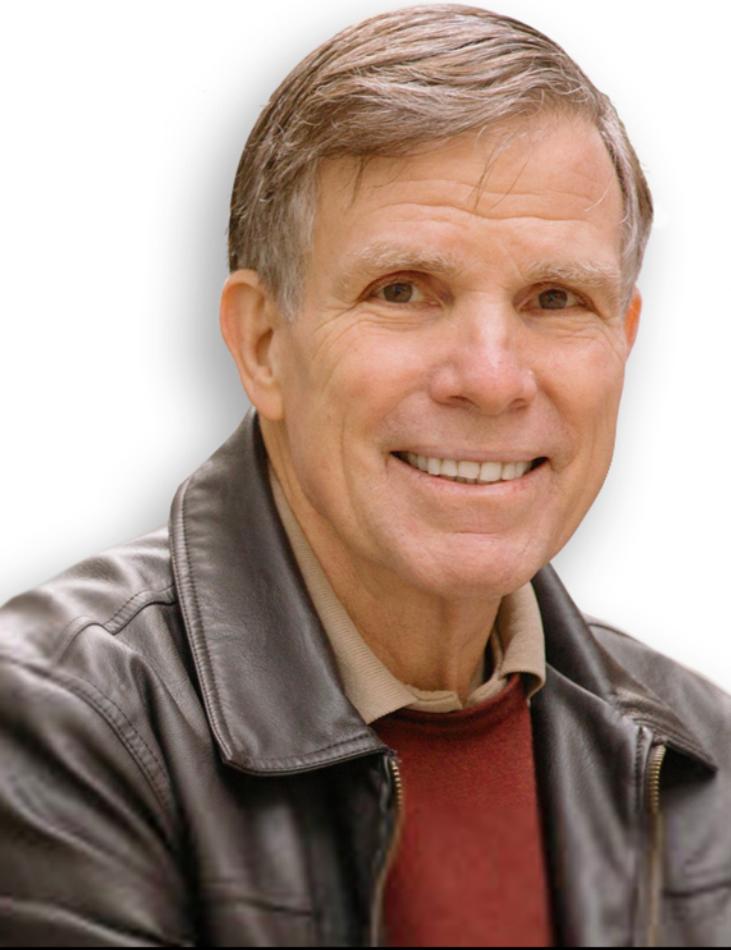
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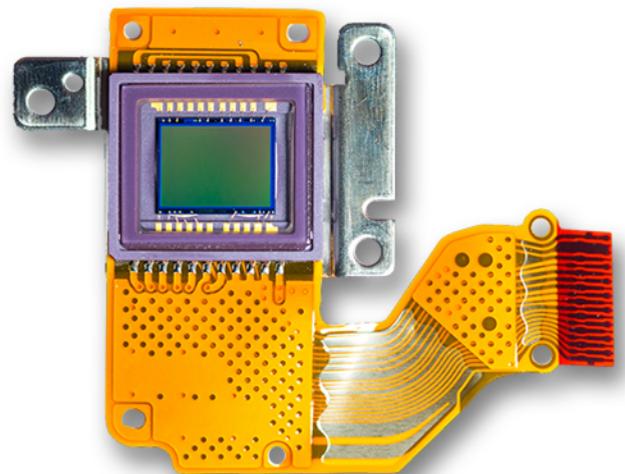
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Hiring and Training

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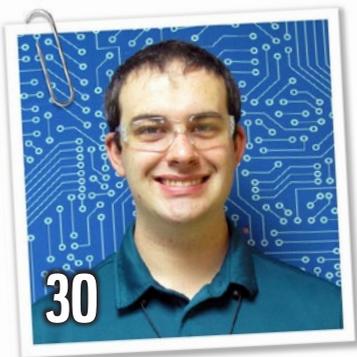
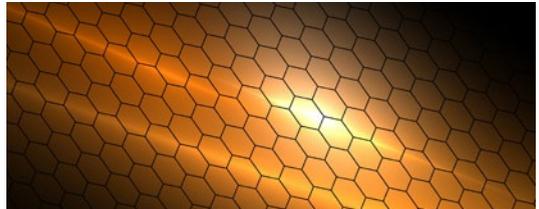
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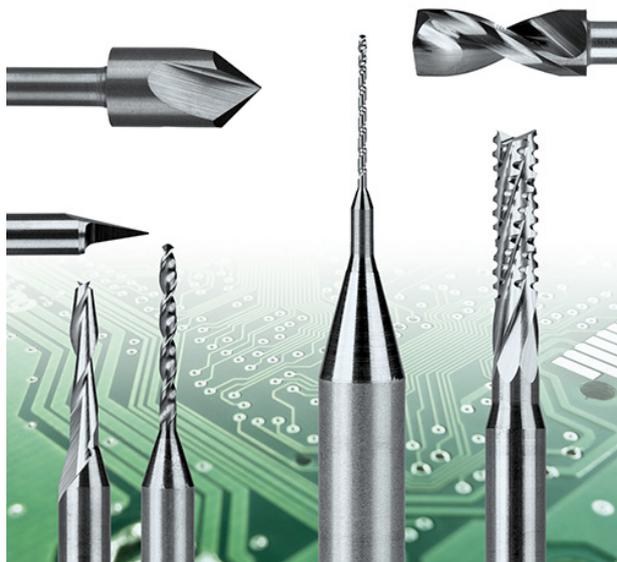
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Hiring and Training

Nolan's Notes

by Nolan Johnson, I-CONNECT007

As if keeping skilled employees on your staff hadn't already been a challenge, the events of 2020 certainly made it harder. And yet that makes for good opportunities if you're an experienced candidate looking for new challenges (or a chance to move somewhere new).

A casual review of mainstream U.S. media uncovers example after example of job sectors that collapsed under the weight of the COVID-19 pandemic. If you read my column for this month's *SMT007 Magazine*, then you're familiar with just one such story. I'm sure you know someone whose job was affected negatively. The restaurant industry—the whole hospitality industry, for that matter—has been decimated while we wait out the pandemic. As I write this, the news out of Orlando, Florida, is that Disney is laying off 32,000 employees. Out west at Disneyland in Anaheim, California, the return to lockdown across the state has resulted in another wave of layoffs. In Las Vegas, the MGM Resorts conglomerate laid off 18,000 in October, according to news reports.

The repercussions rattled up and down the hospitality “supply chain.” Airlines, for example, reduced flying staff in response to the drop in passenger travel. In August, American Airlines laid off 19,000 workers, and Delta Airlines furloughed 2,000 pilots. (Delta and United both lost over \$10 billion in each of the last

two quarters.) Moving ever closer to our industry, Boeing laid off 7,000 in October, after having laid off 19,000 over the summer.

Yes, in some industries, it's as if a bomb went off, taking out everything in its path. The bomb went off in our industry too, but the shrapnel was in the form of invoices and orders. Our role as an essential industry means that not only do we stay open, but the need for our products makes us busier than ever. As my I-Connect007 colleague Andy Shaughnessy, commented, “When I'm talking to people outside the industry, especially those who've lost their jobs, I try not to mention that our industry is crazy busy.”

There are a *lot* of jobs for a good process engineer; lateral and upward moves are quite possible. If you have applicable industry experience, you're extremely employable. Take a tour through I-Connect007's help wanted section in the back of this (and every) issue, and you'll see what I mean. If you need more data, we've taken the liberty of posting an example list of the positions open at TTM, a global manufacturer of printed circuit boards. In this issue, we consider the perspective of the employer, the seasoned technical professional, and the new-hire engineer. How do these three groups best combine to fill the skills gap that our industry faces?



This month, Dan Beaulieu, I-Connect007 columnist, submits a feature article titled “The Millennials and Seasoned Veterans: Your Future Lies in Both.” Dr. John Mitchell, IPC president and CEO, focuses his column on how expert trainers can assist in transferring the knowledge to the next generation, followed by a feature article diving deep into I-Connect007 coverage of staffing and hiring over the past two years. This detailed look at our recent conversations brings a number of themes into focus.

In “The Calumet Files,” seven young engineers currently starting their careers share their experiences and, in the process, help us all understand what it is that makes electronics manufacturing a more attractive career for new hires. I-Connect007 Publisher Barry Matties brings his professional expertise in team-building to our pages as well, discussing how hiring should be considered as an investment.

Long-time columnist Todd Kolmodin posts his column in “Training the Force or the Few.” And fellow columnist George Milad steps out to discuss training for plating processes.

We shift gears with an engaging interview with IPC Board Chair and Summit Intercon-

nect executive Shane Whiteside, in “Whitesides’ View From the Summit: An Industry Perspective.” And we follow that with “Leading by Going the Extra Mile” from Didrik Bech at Elmatica.

Then, Steve Williams brings us part two of his column, “Simplify your QMS Documentation Through KISS.” Mike Carano’s column rounds out this month’s columnists by discussing final etch from a process engineer’s perspective. And we close with a special report from I-Connect007 technical editor Pete Starkey on a recent Ucamco webinar exploring front-end automation. Steven Covey’s book, *The 7 Habits of Highly Effective People*, lists one habit in particular that fits the current job market: “If you wish to be understood, seek first to understand.” It is our hope that this issue of *PCB007 Magazine* helps job-seeking readers better understand the employer’s perspective as well as the other way around. **PCB007**



Nolan Johnson is managing editor of *PCB007 Magazine*. Nolan brings 30 years of career experience focused almost entirely on electronics design and manufacturing. To contact Johnson, [click here](#).

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Millennials and Seasoned Veterans: Your Future Lies in **Both**

Feature by Dan Beaulieu
D.B. MANAGEMENT

There is no doubt that we are having a crisis when it comes to the workforce in our industry today. In the PCB and PCBA industries, as well as most manufacturing industries, there is a definite shortage of good people we can hire. Seasoned veterans are aging out, while youngsters want to spend their lives doing something they love, which, often, is not manufacturing.

Our problems with offshore competition do not just lie with popular reasons like unfair trade practices, packing the market, and cheap labor; we simply don't have enough people entering our ranks. One of the more insidious problems at this time is finding people from a dwindling labor pool. We are losing people to age at one end and not recruiting enough people at the other end to make up the difference or allow us to grow as well. Even if business did come back from offshore, we would have a problem handling it at all. This is a real problem, albeit not necessarily an insurmountable one.

But there is some good news about bringing younger blood into the fold. One of the side effects of COVID-19 is that it has left a lot of recent college grads high and dry when it comes

to finding a job. Some of the more astute companies have already taken advantage of this and are hiring fresh graduates. Now they might not think manufacturing PCBs is an ideal job, but for right now, it's a job. There is a reason for some optimism here. If we can get them to stick around when things in the world improve, that would be a good thing.

Then, we have the issue of people working in our shops, and the blue-collar workforce has been so difficult to find the past few years. What do we do about them? How do we get them to enter our workforce and stick around for the long run? Here are some ideas for not only attracting young people but getting them to stay for a career as well.

Hiring: It All Starts With the Right Process

"I hire people brighter than me, and then I get out of their way." —Lee Iacocca

The hardest thing about any business is finding, hiring, and keeping good people. It has always been a problem, no matter what the condition of our economy is. The problem with so many businesses is they don't take the time to do it right. They are too busy managing day-to-day affairs to lift their heads long enough to take the time to hire the best people. Often,



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they need a person yesterday, so they are appreciative when they can find someone (or anyone). This leads to a great deal of frustration for both the owner and the people they hire.

Nothing is more important than hiring the right people.

As Larry Bossidy said, “I am convinced that nothing we do is more important than hiring and developing people. At the end of the day, you bet on people, not strategies.” Nothing is more important than hiring the right people. With that in mind, here are six tips to ensure you hire the right people:

1. Hiring is a process, so have a plan: To be successful, you have to plan ahead. Have some kind of idea where your company is going and what your employees’ needs are going to be when you get there. Plan for those needs in advance. That will also give you the right amount of time to hire the right people.

2. Know exactly what you want: What is the job, and what kind of person do you need to fill that role? No matter the job and whether it’s full-time or part-time, you need to have a well-thought-out job description. Describe not only what the job is but also who the right person for the job would be.

3. Hire slowly and fire quickly: Take your time. The old adage, “If you don’t have time to do it right, when will you have time to do it over?” applies here. Take your time and hire carefully. It will save a lot of time in the long run.

4. Keep the application form simple: Make it very clear. Use the job description you developed in #2 as the format for your job application.

5. Develop good interviewing skills: The interview is where you really get to know your candidate. You can tell much more from an interview than from what is included in a resume, cover letter, or job application. Think

hard about your interview process. Develop a set of questions that will help you discover what you need to know about the candidate.

6. Show them the future: If you are serious about your company, then you have a vision for that company. Share it with the candidate. Get them excited about working for your company, and most of all, show them that this is not just a job but a career; it’s a future.

Probably the most important piece of advice is to be thoughtful and take your time to do this right. In the words of Amazon’s Jeff Bezos, “I’d rather interview 50 people and not hire anyone than hire the wrong person.”

How Do You Keep Them?

You’ve hired them. Now, how are you going to make these jobs so interesting that people are going to want to make a career out of them (which is one of the more pressing problems that business owners have)? It is not only about finding and hiring good young people but also keeping them. Here are five suggestions that will hopefully help you retain new hires:

1. Promote the good aspects of working for your company: Make sure your company has a good reputation not only in terms of your market but also in terms of being a good company to work for. There are websites now where employees can review what it’s like to work for your company. If you have employees who are content, ask them to post a review.

2. Offer a referral fee to your employees: Reward employees for recommending a good candidate. Pay them a fee if the candidate works out.

3. Don’t just offer them a job; offer them a career: This is critical. Let them know from the very beginning that they can make a good living working in your business. Let them see the future and how bright it can be if they do a good job.

4. Offer flexibility: Offer as much as you possibly can, especially in these hard times. Try to meet your employees’ needs. People have kids and other obligations, so it’s part of our job as business owners to navigate these tricky waters.

If the candidate is someone you want on your team, then try to make their schedule and your needs work. This one is not easy, but it can be a key to getting the best people on your team, especially right now.

5. Create a sense of mission: Show them the bigger picture. Share your vision of being the best company in your field, whether that is the best PCB shop or the best design company, etc. This is one of the best ways to get them motivated for the long haul.

One certainty is that any company is only as good as its people. And its people are only going to be as good as you and your company motivate them to be. In the end, that's the best way to grow your business.

The Importance of Mentoring and Training

Now that you have gone to all of this effort to find and hire good young people, how are you going to assimilate them into your company? How are you going to train, educate, and prepare them to assume the next phase of your company's future? Aha! This is where seasoned veterans come in. You must develop mentoring and training programs that are similar to the apprenticeship programs of old.

You have to convince your veterans that it is in their best interest and the interest of the company to pass on their years of experience to newcomers. And this has to happen at all levels, from top-level management to quality engineers and line operators. I'd recommend that your company develop a formal training program, and sooner rather than later. Here are eight guidelines I recommend:

1. Choose the right seasoned vets: Not everyone is a great teacher, and your best person in that particular position might not be the best teacher. Keep that in mind.

2. Develop a formal step-by-step program for each position: The good thing is that one teacher can handle more than one person.

3. Develop a complete orientation program, including:

a. The history of the business whether it be PCB or PCBA.

b. A history of your particular company, including how it started, who started it, and why they started it. Include company lore, too, as they are great stories that are handed down from one generation to another.

c. An on-the-job training program for at least two weeks where everyone who joins the company has to spend time on the floor and experience every operation first-hand.

4. Show them the future: Work with the new employees to help them to choose the right career path. This should be done in detail, explaining to them where each path leads right down to year-to-year progress and possible earnings they can achieve if they stick with it. This is important. Most young people have no idea how much money they can earn in manufacturing.

5. Develop team-building opportunities to help everyone work better together.

6. Instill company pride in all of your employees.

7. Demonstrate some of the contributions your company, your products, and your industries are making to improve the world: We build important things in our industry. Our products have been to space, save lives every day with medical electronics, keep the world safe with the defense industry, and are at the cutting edge of new innovations, from private space exploration to electric and autonomous vehicles. Give them something to be proud of that they're excited to tell their families about.

8. Treat your seasoned veterans with the utmost respect: Making a point of appreciating your seasoned veterans will ensure that young hires will follow their example.

And most importantly, be intentional during the entire process. Act as if you are investing in your future because, in the end, you're doing exactly that. **PCB007**



Dan Beaulieu is president of D.B. Management Group and an I-Connect007 columnist.

Expert Instructors Share Knowledge With the Next Generation

One World, One Industry
Feature Column by Dr. John Mitchell, IPC

You may be familiar with the IPC Electronics Workforce Training Initiative—an expanding series of education programs created to help the electronics industry overcome gaps in workforce skills—but do you know anything about the instructors who help develop and provide the training? IPC is fortunate to work with a team of subject-matter experts and instructors who share their significant knowledge and skills with the current and next generation of the electronics manufacturing workforce.

Kris Moyer and I first met at IPC APEX EXPO. Kris is a part-time faculty member at Sacramento State and an active IPC volunteer. He is currently the chair of the 1-13 Land Pattern Subcommittee, co-chair of the D-21 High-Speed, High-Frequency Design Subcommittee, and an active member on at least a dozen other committees. Kris also works with the IPC Education Team in developing PCB design training

programs, which he also teaches. He talked to me about his experience teaching for IPC.

John Mitchell: Kris, you work as a PCB designer, college professor, and volunteer on several IPC committees. What drives you to teach IPC Electronics Workforce Training Programs as well?

Kris Moyer: I enjoy teaching. My mother was a teacher, and it runs in the family. I enjoy teaching what I know to the next generation. There is so much to learn, and a big part of the skills gap is that boards have become so much more complex. Historically, board design was just drawing lines and connecting Point A to Point B, but everything has changed. Digital designs are the norm now, and the sizes of components are much smaller, making design much more detailed.





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Mitchell: How did your career experience lead you to teaching?

Moyer: When I was just starting out as an engineer, I wasn't familiar with the requirements for electrical assemblies, so I read IPC-2221 and IPC J-STD-001 cover to cover to familiarize myself with that standard. I recognized that the basics in design were one of the most important courses to teach new students, so I worked with the IPC Education Team to develop the PCB Design Fundamentals I and II Programs. These courses introduce the concepts and skills required to create designs that comply with IPC standards. I also worked with the IPC Team in building several advanced level design courses that will build on the knowledge gained from the Fundamentals Programs.



Kris Moyer

Mitchell: Are you working on any new courses with the IPC Education Team?

Moyer: Yes, we are currently working on some new courses that will be released in 2021: embedding component design, printed and wearables, and RF design boards.

Mitchell: How does this curriculum of PCB design courses help not only learners but also businesses?

Moyer: The PCB design fundamentals courses provide organizations with a means of rapidly training new designers. Once those designers learn the basics, IPC offers a catalog of advanced-level training for specific skill sets. Most importantly, all of the IPC design courses are a combination of theoretical design training, practical application, and an understanding of how IPC standards are applied to the specific design area.

Mitchell: When does the next set of courses begin?

Moyer: The next IPC PCB Fundamentals Course is scheduled to begin on February 9, 2021. You can find the detailed course catalog at training.ipc.org.

These courses introduce the concepts and skills required to create designs that comply with IPC standards.

Mitchell: What courses do you teach for IPC?

Moyer: I teach PCB Design Fundamentals I and II and additional specialty courses, including PCB Design for Advanced Packaging, PCB Design for Rigid-Flex Boards, PCB Design for Military and Aerospace Applications, and PCB Design for Extreme Environments. The courses utilize interactive webinars, on-demand recorded class sessions, job-specific exercises, and team projects to facilitate mastery of the key concepts required by circuit board designers.

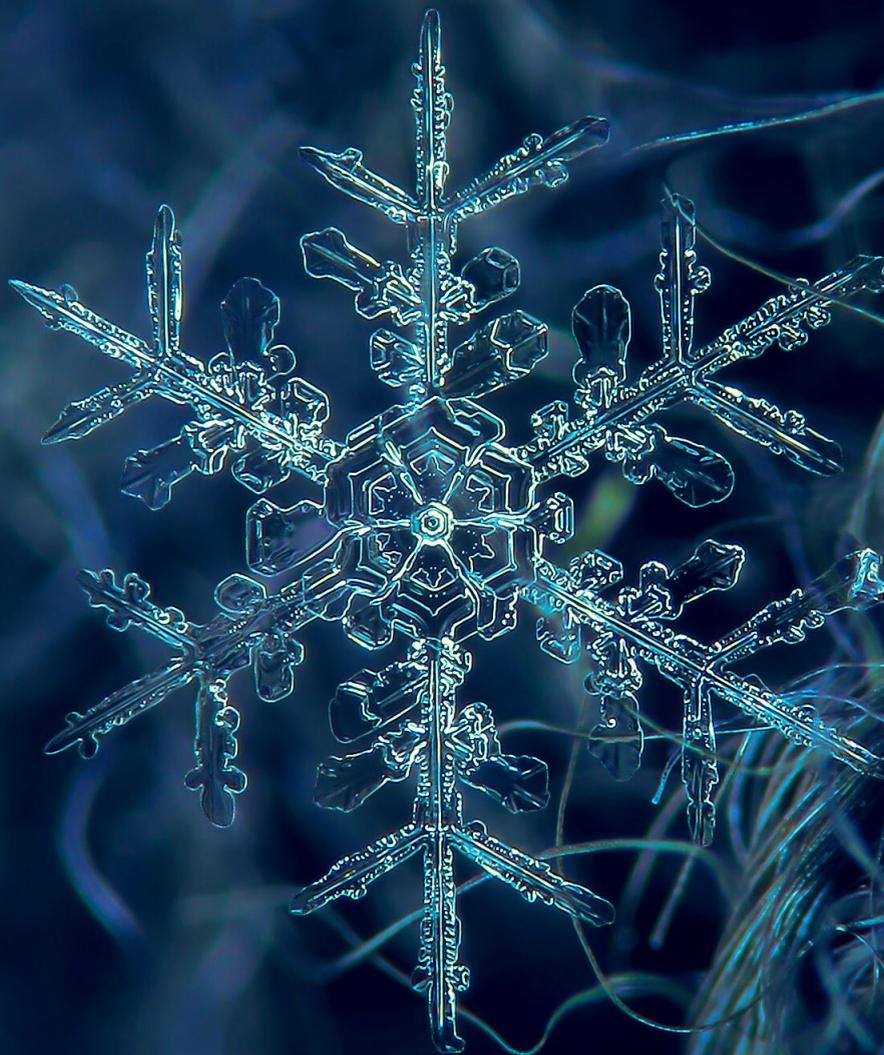
Conclusion

If you're planning your educational opportunities for 2021, then look no further than IPC's Electronics Workforce Training. Courses include detailed illustrations, video presentations, interactive activities, and practice quizzes, all formulated to make complex topics easy to understand and master. Each topic is carefully selected to align with the skills and competencies vital to advancing an electronics career at any level. The full course catalog is available at training.ipc.org/products. **PCB007**



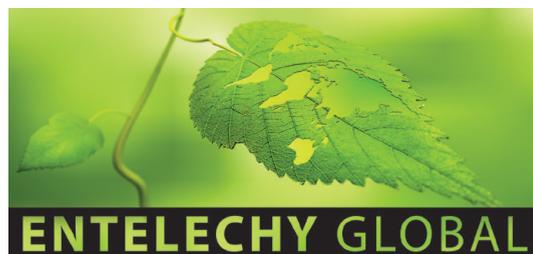
Dr. John Mitchell is president and CEO of IPC. To read past columns or contact him, [click here](#).

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Hiring and Training: Powerful **Insights** From Industry Leaders

Feature by Nolan Johnson
I-CONNECT007

Staffing is an issue. We all know it and feel it. Skilled workers are difficult to find, and expertise retires to the sunbelt faster than the industry can replace it. How we respond to this “brain drain”—as an industry and as individual companies—will likely decide our future. It’s no wonder, then, that staffing and hiring are on the minds of the industry leaders.

When we conduct interviews with industry experts, particularly heads of companies, we often ask them about their experiences with staffing and training. These conversations bring insight into the exact issues most of you are facing. To bring these issues into focus, I searched through our recent archives and pulled out some key points that are worth noting again. These slightly edited comments come from previously published conversations and I believe you’ll see, as I did, that these are

important issues in our industry that must continually be addressed: Automation is an ongoing topic of discussion, of course. Industry 4.0 and the development of new “smart factory” capital equipment brings increasing levels of process automation and artificial intelligence (AI) to business operations.

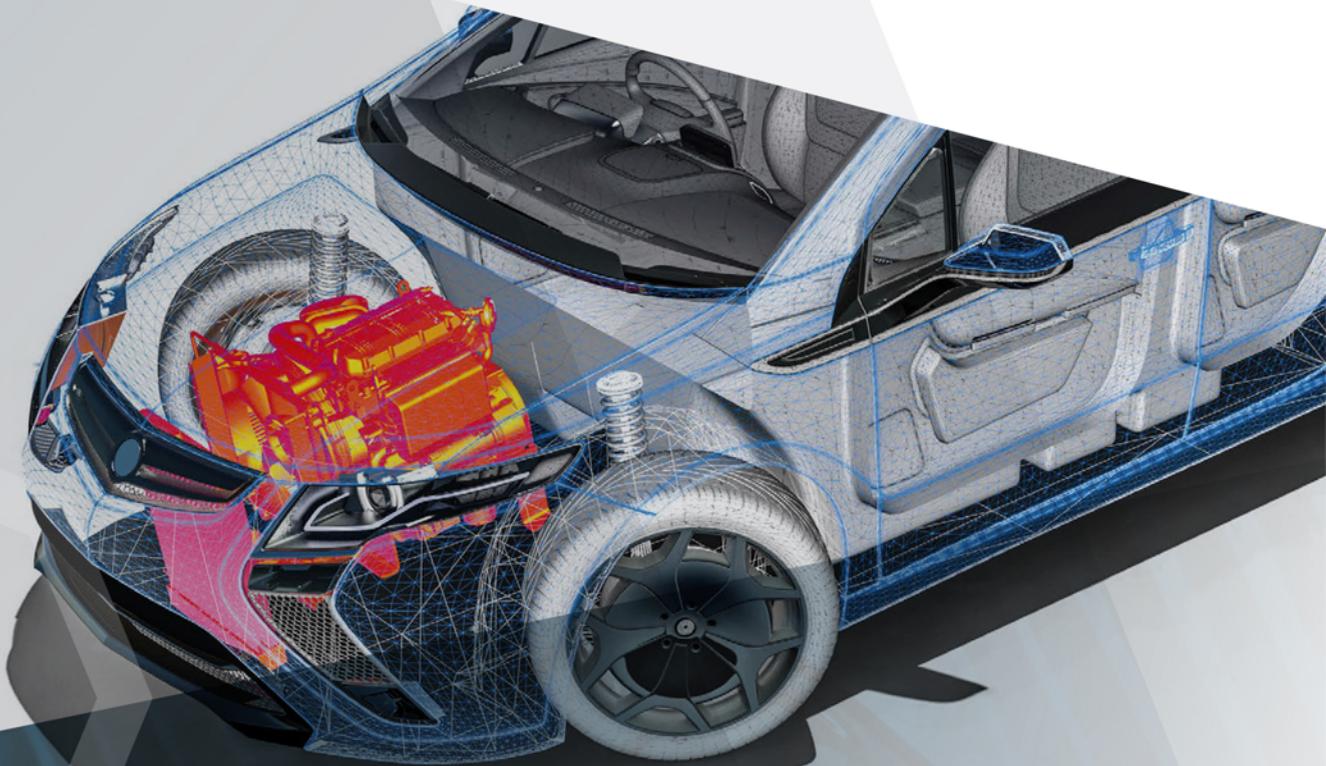
First, I share part of an interview with IPS CEO Mike Brask, who thoroughly understands this trend. In the November 2020 issue of *PCB007 Magazine*, Barry Matties discussed training and staffing with Brask. In this portion of the conversation, Matties is asking about skilled staffing at the company’s Utah location:

Matties: In terms of running a factory like a captive facility, part of it is going to be AI because staffing and finding skilled people is an issue. How are you integrating that (AI) into your equipment? What concerns or actions are you taking?



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Brask: IPS has for years now been interacting with the universities and the trade schools to build up a labor pool that we could hire from. We support Southwest Applied Technology College and Southern Utah University. I'm one of the mentors for the curriculum, and we've introduced a plastic welding program there. We hire their industrial maintenance electricians, welders, and fabricators. And the same with the university, you will see when we go through and look at my engineering department, everyone in that department is a graduate of Southern Utah University, except for one from Boise State.



Mike Brask

Close working relationships with educational institutions come up again and again with companies successfully hiring skilled workers. A more surprising revelation is what Brask shares next:

Brask: For us, a big move was going from AutoCAD to SolidWorks. Once we decided to transition in 2014 to SolidWorks, suddenly, our hiring opportunities opened because of all the students coming in with this skill. Our ability to make them productive is quick because once they know how to draw within SolidWorks, they can draw stuff and do sketches and designs with direction, and we start spoon-feeding them from there.

Next, Matties asks about IPS's customers and their experiences in finding skilled labor, and Brask what his company is doing:

Brask: They're doing similar things. TTM is a good example, as well as others, with their internship programs. They're actively involved in bringing chemical engineers and new blood into our industry, and we're working with customers like that to support their projects. Our new and senior engineers work on projects

with these interns. Hopefully, they bond so that the percentage that stays in our industry can grow together—but we must retrain. We must get these new engineers familiar with all the processes so the software and tooling can advance with the technology.

The shift at IPS from one CAD tool to another is telling. Normally, CAD tools are replaced with new platforms to introduce new design features critical to the design team, or so the thinking goes. What if the critical feature is a competent human operator for the CAD tool? Brask's team has picked up on this realization.

Brask wasn't the only one to share insights about his hiring criteria. In the November 2019 issue of *PCB007 Magazine*, I caught up with Sunstone Circuits' Sheri Kuretich, HR manager, and Nancy Viter, vice president of operations. In that conversation, we dove deep into how hiring and staffing have changed for a quick-turn board house over the past few years. They note that while walk-ins have significantly diminished, finding talent through local community colleges has been a gold mine.

Kuretich: The biggest change over the past five years is how we hire. We used to have a lot of walk-ins. People would drop off their applications often enough that we had a full folder, but now, we're lucky if we get two or three walk-ins each month. Today, the internet allows for online recruitment opportunities, and we receive a lot of responses that way from diverse candidates. We're currently hiring for a position where we're talking to people in completely different areas, but they have relevant experience to the circuit board industry, so it's pretty exciting when those individuals become a part of our selection pool. There aren't many circuit board shops left in the Pacific Northwest, so it's not that often that we have an applicant with direct circuit board experience unless we're open to looking into people in other geographical areas.

If we can get people with a manufacturing and production background who have an aptitude for learning the technology to build

boards, that's great; we have been fortunate in that regard and gotten a lot of great referrals and excellent hires.

It has been interesting in the mechanical operations department. A couple of our newest hires were CNC operators, and rather than targeting just the PCB industry, we looked for some of the specific skill sets that may not necessarily be specifically PCB-related.

Johnson: How is that working out?

Kuretich: Very well. We had two new individuals start in our mechanical operations area that had finished up a CNC course at Clackamas Community College in Oregon City and sought us out. There was a referral by an employee, who sent them our way, and we felt good about it. They had the aptitude and passed the certifications. It's good to see that the local community colleges have those types of programs available; it's not all white-collar education. The students are ready to join the workforce, and they turn out to be great employees too. It's pretty exciting that the college is right in our backyard.



Sheri Kuretich

Viter: I'm on an advisory board there now to help reshape the curriculum for the electronics classes. I attended one meeting recently, and I'll attend another one soon to review the revised offerings. They (Clackamas Community College) are very interested in tailoring the classes to be relevant to today's electronics industry needs and are seeking input from the local businesses that would benefit from well-trained new hires.



Nancy Viter

Connecting with a local community college seems to be a common strategy. Sunstone's work with Clackamas Community College echoes the experiences shared in the interview, published in the December 2020 issue of *SMT007 Magazine*, with Johnny Vanderford and Courtney Tenhover at Lorain County Community College in Ohio. We asked Vanderford and Tenhover about the job market in their immediate vicinity:

Vanderford: LCCC is located in Elyria, Ohio. Around 90% of these companies [we work with] are within a 40-mile radius around the center of Cleveland. We've had companies in the surrounding area, including as far as Indiana and Pennsylvania, that need a similar skill set. If students were interested in moving to another place, they would have careers there as well. We tell the students the same thing. It's nice to have opportunities and options available for you.



Johnny Vanderford

Tenhover: Predominantly, students land assembler, hand soldering, electromechanical, and SMT operator, technician, and engineering positions as they near more of the end of their bachelor's degree. Those are the most common titles. Some are hired as electrical interns, and other smaller employers just don't have a job description with the title, so they hire them in and use them in a wide range of areas.



Courtney Tenhover

Kuretich and Viter also are working through the question of how to entice a candidate from another industry to jump over to printed circuit

fabrication. The idea started to emerge that to find the right aptitudes, we need to make the case that electronics manufacturing is an attractive place to work.

GreenSource Fabrication, based in Charleston, New Hampshire, also works with universities to recruit talent. In the November 2020 issue of *PCB007 Magazine*, Alex Stepinski, vice president and architect of the zero-waste facility, shared the following in our interview with him:

Matties: One of the big concerns is there's not a stream of young engineers coming in with the mindset that you have. What should the industry do to help resolve that? Because we're going to need them, even with all this great equipment.

Stepinski: I don't have a solution for the industry. All I have is our case study, which is data-driven, and we know students coming out of school in the U.S. have a long lead time to get them to function at the level that we need. In Poland, it's a little bit easier, but we don't have a factory in Poland for PCBs; we have a factory for equipment. It seems to work out well. We're trying to leverage that as best we can and partner with schools in the local area. Whelen made a donation of an advanced manufacturing facility to the University of New Hampshire a few years ago in the name of our former CEO.

We had a lot of young grads out of the University of New Hampshire and Keene State. We have a few other schools in the area; again, we're constantly partnering with them to move things forward. We even have a 'little league' of manufacturing. We have school buses locally come in, and kids are learning about manufacturing. We're doing a lot, but it's still quite challenging.



Alex Stepinski

Matties: You keyed in on it. The appeal of manufacturing isn't there compared to technology companies.

Stepinski: We're a service economy now, so it's quite a challenge.

There's something telling in Stepinski's comments. For more specialized talent, he looks overseas in the short term. In the U.S., he's playing the long game to make manufacturing attractive by promoting manufacturing to students as early as high school. It's not hard to imagine that HR departments feel the challenge. We get that sense from Sunstone's Kuretich, as well as IPS's Brask. What's an HR director to do?

In February 2019, we printed a two-part interview with Terry McNabb, a technical recruiter from MRI Network. In this interview, which ran in both *SMT007 Magazine* and *PCB007 Magazine*, McNabb explored how a recruiting specialist can help cast a wider net and find the strongest candidates:

McNabb: Companies are faced with a quandary. One is that they have a succession crisis. They have to find a way to develop the future leadership of the company, and they can't wait on millennials. But at the same time, the average tenure keeps dropping. So, if I'm convinced that you'll be in the C-suite five years from now, you might well be three companies down your career by then. The bigger trend that we see is people are hiring more for a specific need. I might not be able to keep you for several years, but you can solve this million-dollar problem, so even if you only stay for a year, I'm in good shape. It's also a huge trend among millennials to not be hired at all but instead, appear on a contract basis.



Terry McNabb

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Two major forces are driving that. One is a lack of trust that companies have their best interests at heart, such as, ‘You laid off my parents, and I don’t trust that you’re going to keep me.’ That’s a part of it, but I think the larger part of it by far is simply the rate of change in today’s world.

Sometimes, a human resources manager needs to get some expert help and tap into a wider perspective. While Sunstone executives pointed out that walk-in candidates are no longer sufficient to find new hires, McNabb says well-informed talent recruiters also offer market trend guidance:

McNabb: More of the managers and companies around the world are looking to the recruiter for insight into what’s changing in the marketplace, more than anything else.

Johnson: You are in a place to watch a larger sample set.

McNabb: Exactly. Even if you’re brilliant, I’m talking to you and 400 of your peers, so we become aggregators of insight. We bring that insight to our clients, changing their search parameters and goals in many instances. It’s a fascinating process. Then, we approach the top performers who are in that post-accomplishment letdown and make them aware because these are things they don’t think about. You get so busy being competent in your job that it’s easy to become complacent about your career.

The trend is clear: Whether seeking entry-level positions, mid-level experience, or senior-level expertise, hiring needs are migrating to a more technical set of skills. I addressed this question with McNabb:

Johnson: As a recruiter, what would be your suggestion to the HR department at a manufacturing facility? How do they cope? How do they get themselves so that their facility stays viable and they don’t have to close just because they can’t get anybody to run the shop while they wait for the millennials to get there?

McNabb: They need to identify a tier-one talent pool and tier-two talent pool. They need to have a better strategy for engaging those people and attracting them. Let me give you an example. Again, in many roles, there’s an extremely small population that has that skill set that they need. What that hiring manager should do is to identify the entire talent pool. At MRI Network, we do that by identifying which companies would have people with that skill set and how many people they have in each of those companies. If there are 15 companies with an average of three people in each, there are 45 people who have the skill set that we want.

Like McNabb, Brask’s team at IPS is open to playing the long game for continuity, succession, and skill-building, too, as he detailed in Matties’s conversation with him:

Brask: I am trying to get to where I am not the point man on everything and delegate, so I hired a national sales manager. We’ve added the service people, which I’m taking out in the field and training to set the right tone for customer service, meet everybody’s expectations, and set the stage to where the customer confidence is high moving forward that they’re investing in a company that’s going to be around 20 more years.

Brask’s comments showed that he is mindful of employee longevity—a valid concern in a business where a churn-and-burn mentality with employees does the company a disservice. McNabb also talked about the struggle of making a selection. There are so many constraints to balance in this equation, after all:

McNabb: However, most people get a candidate and act on that candidate or not. But in many ways, they’re guessing about the timing of that decision. If they wait, will somebody better come? Or will they lose this one, and then find they were the best? What we recommend instead is to identify that talent pool and exhaust it. Approach each of those 45 people with the most powerful message possible, which is fas-

cinating because high performers get excited about different things than bottom performers. It's one of the ways that we tell. If the person is saying, 'I want more authority, lead the charge, work with this exciting stuff, and have someone help me grow,' then the chances are very good that they're a top performer.

Then, what we do is identify that finite talent pool. We then co-create the most powerful message, leveraging what we understand are the primary motivators for top performers and that hiring manager's insight into their company. When we combine those two things, we end up with a message that's pretty special.

So, how do we attract talent? That is, after all, the burning question. Here's what McNabb had to say:

McNabb: ...there are no passive ways to reach people who are not actively looking. What they're doing is following a selection process, looking at the people who have made themselves the most available, and then selecting the best of those. We start at the other end of the spectrum. We say, 'Forget about who's available. Who are the most valuable people on the planet?' Then, systematically approach each and every one of them with the most powerful message possible.

With my best client—I did a statistical analysis for them at one point—we found that 92% of the people they hired from me not only weren't looking but said there was no way they were going to make a change when I first approached them.

In a talent-starved marketplace, managers should have a dual strategy. One is to identify the finite talent pool. Who are the 20–50 human beings on planet Earth who would bring the greatest value to our team? Then, what level of talent do those people have, and what is it going to take for us to win them over? Another vital consideration for a talent-starved marketplace is that a posting will reach a very small percentage of the people who are actively looking. Those who are actively looking typically only amount to about 20% of the workforce. A proactive approach increases the avail-

able talent pool at least ten- to twenty-fold. A successful recruiting strategy, then, increasingly requires HR to employ three key approaches:

1. Make manufacturing appealing to students entering the workforce.
2. Make the case for why electronics is a more desirable industry than the industry the candidate is already in.
3. Develop a methodology for reaching qualified candidates who might not be actively looking at the moment.

Hiring and staffing, while a constant issue, is becoming acute as manufacturers struggle simultaneously to find enough workers with sufficient talent and training. Additional resources include:

- IPC Educational Foundation (IPCEF), among other IPC initiatives
- Campus-directed IEEE programs, such as IEEE Rising Stars
- Educational programs at SMTA
- Outreach programs at NextFlex, and more

Virtually any industry advocacy organization offers an educational outreach program or two.

It's no surprise, then, that efforts are underway to bring some standardization to the educational programs offered by colleges and universities. The SMTA and FlexTech, in conjunction with a cohort of college and university administrators, are working to craft some standardized curricula.

Marc Carter, a principal with Aeromarc, is helping move the curriculum standardization along. When asked for comment, he shared the following statement:

Carter: In one approach, a local partnership between the electronics manufacturing industry and academia began at Michigan Technological University—now entering its third year of operation, aimed at filling a gap between co-op/apprenticeship programs and the longer lead time STEM K–12 programs—is beginning to expand nationwide. This uses the MTU/Calumet Electronics core partnership in developing a hands-on design through test experi-

ence, backed up by guest lectures from practicing industry subject-matter experts as a prototype. With logistics support from the DoD's Industrial Base Assessment and Sustainment Group—Director Adele Ratcliffe—we are in the early stages of establishing similar 'nodes' around the country.



Marc Carter

A key tenet of this effort is that local industry partners—often the local SMTA chapter acting as a hub—is tasked with defining a consensus on projected near-term, meaning 1–5 years, staffing needs, whether in design, fabrication, assembly, packaging, flex-hybrid, or whatever, and working with local post-secondary educational institutions to develop appropriate curricula and training tools. Our national group serves as a largely voluntary resource pool to help by providing a rough organizational template that has been shown to work and having subject-matter experts available to fill 'gaps' in locally available expertise, especially during the startup phase, as well as a forum to exchange ideas and provide mutual support.

This program is predicated on the belief that the long-term goal of self-sustainability is more likely to be achieved when each local 'node' understands and defines their consensus on local technical staffing needs first, then build

a locally sustainable program to fill that need within the constraints of available resources. A growing nationwide pool of expertise is available to fill in as needed, whether in guest lectures or process set-up when a particular bottleneck is identified.

It is clear that the staffing shortage will not simply take care of itself. This is an inflection point for the industry. Industry leadership—in the form of associations, educational institutions, and forward-thinking manufacturing firms—are not only developing more comprehensive post-secondary training programs to train the next workforce but also taking the next logical steps to provide some educational standardization as well.

To achieve the Million Job Initiative at IPC—not to mention all the other programs and initiatives at SMTA, NextFlex, and others—degree programs will need to provide practical, technical training to back up the outreach and exposure programs. It is, after all, one thing to want to join an industry; it is another thing entirely to have the necessary skill set. When manufacturers take the time and interest to build a relationship with the local community colleges and technical schools and assist the local schools in connecting to the associations, that is when we will see these educational programs truly blossom.

Note: For a little insight, turn to page 27 to see just some of the job openings at TTM Technologies.



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Current Job Postings for a Major PCB Manufacturer

A snapshot of the overall printed circuit board manufacturing industry can be found in the public job postings from just one of the industry's major global suppliers. While this theme plays out across many companies in the industry, the I-Connect007 staff selected TTM as our example of the trend. We think TTM is a good representative of the industry due to their strong U.S. presence, equally strong international presence, and wide range of manufacturing capabilities. If you or anyone you know are seeking employment, start the [job search here](#).

LOCATION: USA

Remote

Vice President, HR Operations, Human Resources

Anaheim, CA

Lab Technician, Quality
Process Engineer, Engineering
Production Associate - Final - 2nd Shift, Quality (3 positions)
Production Associate - Solder mask, 1st Shift, Operations
Production Associate, Assembly - 1st Shift, Operations
Waste Water Technician, Facilities

Chippewa Falls, WI

Inside Sales Sales & Marketing
Summer Intern - Electrical Engineer Intern, Engineering
Summer Intern - Manufacturing Engineer Intern, Engineering
Summer Intern - Mechanical Engineer Intern, Engineering
Summer Intern - Chemical Engineer Intern, Engineering
Summer Intern - Operations Intern, Operations
Waste Water Technician - Weekend Night Shift, Facilities

Corporate Office - Santa Ana, CA

Sr. Manager Talent Acquisition, Human Resources

Forest Grove, OR

Business Systems Analyst, IT
Facilities Technician - Nights Compressed, Facilities
Front End Engineering Planner Lead (Swing), Operations
Health and Safety Manager, Operations
Lab Technician- Metlab - (Back Nights), Quality
Process Team Lead - Drill - Night Shift, Operations
Production Operator - Final Audit (Swing), Quality
Production Operator AS9102 - Final Audit (Nights), Quality
Production Operators - Swing & Night Shifts, Operations
Quality Assurance Technician, Quality
Vice President, HR Operations Human, Resources

Littleton, CO

Assembly Final Inspection - 1st shift, Operations
Assembly Test - 2nd Shift, Operations
Driver - 2nd shift, Operations

Electronics Assembly - 1st shift, Operations
Electronics Assembly - 3rd shift, Operations
Electronics Assembly - Soldering - 3rd shift, Operations
Engineering Technician, Operations
Final Inspection OGP - 3rd shift, Operations
Information System Security Manager (ISSM), IT
Microsection Technician - 2nd shift, Operations
Ormet - 1st shift, Operations
Process Engineer - Mechanical, Engineering
Product Engineer, Engineering
Production Associate - AOI - 3rd shift, Operations
Production Associate - AOI, 2nd shift, Operations
Production Associate - Drill - 3rd shift, Operations
Production Associate - Drill - 3rd shift, Operations
Production Associate - Electrical Test - 2nd shift, Operations
Production Associate - Final Inspection - 1st shift, Operations
Production Associate - Hole Fill - 1st shift, Operations
Production Associate - Hole Fill - 2nd shift, Operations
Production Associate - Image - 1st shift, Operations
Production Associate - Lamination - 2nd shift, Operations
Production Associate - Laser Drill - 1st shift, Operations
Production Associate - Ormet - 2nd, Operations
Production Associate - Plating - 1st shift, Operations
Production Associate - Plating - 2nd shift, Operations (2)
Production Associate - Plating - 3rd shift, Operations (2)
Production Associate - Screening - 3rd shift, Operations (2)
Quality Engineer, Quality
Shipping Operator, Operations
Sr. Manager Talent Acquisition, Human Resources
Vice President, HR Operations, Human Resources

Logan, UT

Accounts Payable Coordinator, Finance
CAM Operator -2nd Shift - 3pm - 1130pm M-F, Engineering (2)
Chem Lab Tech. 2nd shift Wed - Sun, Operations
General Ledger Accountant, Finance
Internal Auditor, Finance
IT Security Analyst, IT
Production Associate -I/Llayup material - 2nd shift, Operations
Production Associates - Full Time, Operations
Sr. IT Security Analyst, IT

Current Job Postings for A Major PCB Manufacturer — *Continued*

North Jackson, OH

2021 Engineering Intern & Co-OP, Engineering

Salem, NH

Buyer II, Purchasing

Equipment Operator - 1st, Operations (2)

Equipment Operator - 2nd shift, Operations (4)

Equipment Operator - 3rd shift, Operations (4)

Production Tech - 1st Shift, Operations

Production Tech I - 2nd Shift, Operations

San Diego, CA

Customer Service Representative - 1st Shift, Customer Service

Jr. Process Engineer - Chemical, Engineering

PCB (Printed Circuit Board) Production Planner, Operations

Production Control Manager, Operations

Production Supervisor - 2nd shift, Operations

San Jose, CA

Customer Service Representative, Customer Service

Maintenance/Facilities Assoc. (Janitoria) - 2nd Shift, Facilities

Planner I - 1st shift, Engineering

Planner II - 1st shift, Engineering

Production Associate - AOI/OL - 3rd Shift, Operations (2)

Production Assoc. - Receiving/Material Release - 1st shift, Operations

Production Associate - Shipping Clerk 1st shift, Operations

Production Associate - Soldermask/Sprint - 3rd shift, Operations

Production Associate Drilling 2nd shift, Operations

Production Associate Drilling 3rd shift, Operations

Production Associate Lead - Graphics - 3rd shift, Operations

Production Associate LPI Coater 3rd shift, Administrative

Production Associate Plating 1st shift, Operations

Production Associate Plating 2nd shift, Operations

Production Associate Plating 4th (weekend) shift, Operations

Waste Water Technician - Chemical Handler, Engineering

Santa Ana, CA

HVAC Maintenance Technician - 1st Shift, Facilities

Lab Associate - Wet Lab - 2nd Shift, Administrative

Planner II - 1st Shift, Engineering

Production Associate - Drilling - 2nd Shift, Operations (2)

Production Associate - Fabrication 2nd Shift, Operations

Production Associate - Final Inspection - 2nd Shift, Quality

Production Associate - O/L Graphics 2nd Shift, Operations

Production Associate - Plating - 1st Shift, Operations (2)

Production Associate - Plating - 2nd Shift, Operations (4)

Production Associate - Soldermask - 1st Shift, Operations

Production Associate - Soldermask - 2nd Shift, Operations

Production Associate - Soldermask/Hole Fill - 1st Shift, Operations

Quality Manager, Quality

Santa Clara, CA

Assembly Operator, Administrative

Enig Operator, Operations

Final Inspection LEAD, Quality

Legend/Soldermask Operator, Operations

LPI Operator, Operations

Maintenance Technician, Facilities

Maintenance/Facilities Supervisor, Facilities

Production Associate - Plater I 3rd Shift, Operations

Production Operator - Epoxy Application, Operations

Senior Quality Engineer, Operations

Sr. Facilities/Maintenance Tech., Facilities

Via Fill Operator, Operations

Stafford Springs, CT

B5 Inspector, Quality

Director, Strategic Programs, Sales & Marketing

Expeditor, Administrative

Machine Operator (SMT) - 1st, Operations (2)

Manufacturing Opportunities Available!, Operations

Production Associate - Hand Solder, Operations (2)

Production Associate - Stockroom, Operations

Production Associate - Stockroom - 1st shift, Operations

Production Associate - Sub Assembly - 1st Shift, Operations

Production Associate II - Inspector, Operations

Planner I - 1st shift, Engineering

Production Associate II - Inspector, Operations

Production Associate II - Inspector (Bldg#3 - 1st Shift), Operations

Production Associate - Conformal Coat, Operations

Production Associate - Conformal Coat - 2nd, Operations

QE Tech, Operations

Quality Assurance Assoc. - Supplier Documentation Specialist, Admin.

Quality Engineer, Engineering

Senior Test Engineer, Engineering

Solder - RF, Operations

Sr. Production Associate (NPI 3A SMT), Operations

Sr. Production Associate - Assembly, Operations

Sr. Production Associate - Hand Solder, Operations

Sr. Production Associate NPI (Solder), Operations

Stafford, CT

Building Facilities Tech - 1st Shift, Facilities (2)

Business Analyst, Engineering

CAM/Process Engineering Programmer, Engineering

Chemical Tank Maintenance Tech - 4th Shift, Facilities

Engineering Co-Op, Engineering

Engineering Technician - RF - 1st Shift, Operations

General Production, Operations

Maintenance / Facilities Tech I, Facilities

Maintenance / Facilities Electro Mech Specialist - 1st Shift, Operations

Current Job Postings for A Major PCB Manufacturer — *Continued*

Planning Engineer, Engineering
Process Engineer - DES, Engineering
Production Associate - Cutstock - 1st Shift, Operations
Production Associate - Drill - 1st Shift, Operations
Production Associate - Drill - 2nd Shift, Operations
Production Associate - Drill - 3rd Shift, Operations
Production Associate - Dry Lab - 1st Shift, Quality
Production Associate - Electrical Test - 3rd Shift, Operations
Production Associate - Fillets - 1st Shift, Operations
Production Associate - Final Inspection - 1st Shift, Operations
Production Associate - Lamination - 1st Shift, Operations
Production Associate - Photoprint - 1st Shift, Operations
Production Associate - Photoprint - 3rd Shift (B1), Operations
Production Associate - Soldermask - 2nd Shift, Operations
Production Associate - Special Ops - 1st Shift, Operations
Production Associate - Special Ops - 3rd Shift, Operations
Quote Engineer, Engineering
Virtual Job Fair Two Days!

Sterling, VA

AS9102 Operator, Quality
Chemical Maintenance Technician, Engineering
College Intern, Engineering
Equipment Maintenance Technician, Facilities
Machine Operator I, Operations
NPI Engineering Technician, Engineering
Operations Leadership Program, Operations
Optek Operator, Quality
Production Supervisor, Operations
Quality Analyst I, Quality
Receiving Clerk I, Operations
Waste Water Technician, Operations

Syracuse, NY

2nd Shift Production Supervisor, Operations
Assembler I, Operations (4)
Assembler I - 2nd shift, Operations (2)
Business Analyst, Engineering
Buyer II, Purchasing
Director of Operations, Operations
Electrical Engineer Intern (Summer 2021), Engineering
Engineering Tech. II Process, Engineering
Engineering Technician I, Operations
Equipment Operator I, Operations
Equipment Operator I - 2nd shift, Operations (2)
Equipment Operator III (1st shift - Wireless Division), Operations
Facility Maintenance I - Temp, Facilities
Inspector I, Quality
Inspector I - 2nd shift, Quality (2)
Inspector II, Operations (3)

IT Security Analyst, IT
Master Scheduler, Operations
Master Scheduler (Wireless Division), Engineering
Mechanical Engineer Intern (Spring 2021), Engineering
Process Engineer Intern (Spring and Summer), Administrative
Project Management Engineer I, Engineering
Quality Systems Engineer, Quality
RF Microwave Engineer II, Engineering
RF/Microwave Engineer I, Engineering
RF/Microwave Intern (Summer 2021), Engineering
Senior Financial Analyst, Finance
Sr. IT Security Analyst, IT
Sr. Manager Talent Acquisition, Human Resources
Sr. RF/Microwave Engineer (Wireless Division), Administrative
Supply Chain Engineer Intern, Purchasing
Test II, Operations (2)

LOCATION: CANADA

Toronto, Ontario, Canada

CAM Supervisor - 2nd shift, Engineering
Maintenance Technician, Facilities
PCB NPI Engineer, Engineering

LOCATION: CHINA

Guangzhou, Guangdong

HR Supervisor, Human Resources
Oracle Applications DBA (GZ/HK), IT
Quality System Sr. Engineer, Quality
Sr. Failure Analysis Engineer, Commercial Technology
Sr. Process Technology Development Engineer, Commercial Tech.

Hong Kong

Oracle Applications DBA, IT
Sr. HRD (or Vice President), Commercial AP, Human Resources

Taoyuan, Taiwan

PCB Account Manager (Taiwan Based), Sales & Marketing

The Calumet Files:

Interviews With Young Engineers

Feature by Nolan Johnson
I-CONNECT007

To bring this issue on hiring and training into focus, we reached out to Calumet Electronics and asked them to showcase a few of their young engineers. We wanted to gather a perspective from those who are just entering the workforce, and specifically the printed circuit board industry. Here are their answers in their own words.

Sam Willard, Quality Engineer
1 Year Intern, 6 Months Operator, 2 Months Quality

Had you worked in a different industry prior to this?

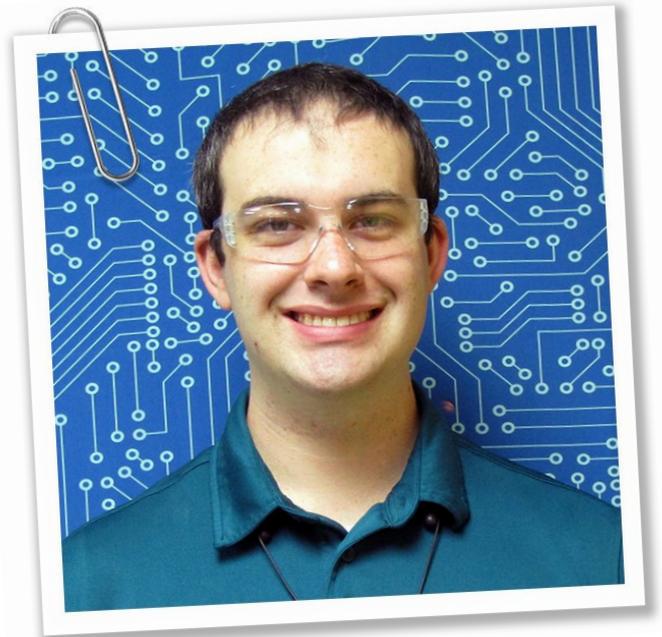
I have had internship experience in the pharmaceutical and personal care industries. I also have experience in academic research.

Was electronics manufacturing something you sought out?

The electronics industry has always been of interest to me (mostly a curiosity) so I approached Calumet at the Michigan Tech career fair with the hope of being able to sell my cheminformatics degree and experience to help with process improvement.

What attracted you to the printed circuit board fabrication industry?

The biggest reason I decided to stay with Calumet Electronics after graduation was that I felt like I could make a bigger impact working here than anywhere else. With electronics penetrating every part of daily life, the ability to make effective circuit boards efficiently and accurately can make huge improvements to daily life. Another major reason is the atmosphere here; everyone is super friendly and always willing to guide me and answer my questions.



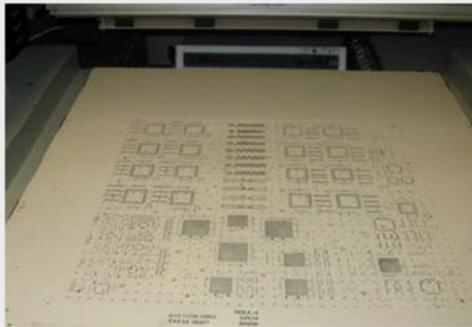
What's your educational background?

I attended Michigan Technological University where I earned bachelor's degrees in Biochemistry and Cheminformatics.

Do you find you use your degree in your job?

I use most of my degrees at Calumet Electronics. While the biology is not the most applicable, chemistry and computer science are a large part of what we do here since much of the manufacturing process uses chemical processes and we generate a surprising amount of data that can be analyzed to im-

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prove our process control. In addition, I've realized that a significant part of a college degree is the thought processes, troubleshooting, and work ethics that you learn in addition to the actual content, all of which are a daily part of my job.

What advice would you give to a fabricator on recruiting and hiring young talent?

I would start with emphasizing how the products we make help people in their dai-

ly lives and that these boards do make a significant difference. I also think that emphasis on the introductory and ongoing learning process is vital since the whole process of building electronic products can be very complicated and potentially overwhelming to someone just entering the industry.

Kyle Hillstead, Process Engineer

**Two summer internships (6 months)
and 7 months as full-time**

Had you worked in a different industry prior?

My goal throughout my undergrad education was to gain working experience in three sectors that environmental engineers can make careers in: consulting, research, and manufacturing. Prior to moving into the electronics manufacturing industry, I had internships in the consulting and research industries. My first internship was with a civil engineering and wetlands management consulting firm. My second internship was with the Western Upper Peninsula Health Department, where I was the Surface Water Quality Technician.

Was electronics manufacturing something you sought out?

I wanted to gain experience in the manufacturing sector to be well-rounded and learn if I was interested in that field. I wasn't directly singling out the electronics industry. With Career Fair at Michigan Tech, I researched several manufacturers and stumbled upon Calumet Electronics. At the time, I had no idea an industry like this was in the Keweenaw (Peninsula).

Do you see a career path in this industry?

I definitely do see a career path for me or else I wouldn't have invested myself as heavily into the industry. Currently, I'm a process engineer for our metallization and copper plating



processes. I'm still quite new to this position but have been immersing myself every day on the manufacturing floor and utilizing the knowledge my senior process engineers have to grow. As our company expands, I will continue my personal growth and aim to be a lead process engineer and mentor to young engineers. I covet the opportunity to help advance this company forward and excite young engineers into the PCB industry.

What attracted you to the printed circuit board fabrication industry?

My experiences during my internships at Calumet Electronics sealed my fate in the industry. I thoroughly enjoy the fluidity of my work.

I am not a desk jockey and my work keeps me in a constant cycle of working at my desktop and being on the manufacturing floor. There's boundless enjoyment in solving issues, sifting through production data, and using your own hands.

What are the things that are better at Calumet than where you were before?

I did not fully enjoy my consulting experience and although I enjoyed my research experience, it was incredibly repetitive and there wasn't a career path for me. At Calumet Electronics, I am never bored and although situations can be stressful, I don't imagine there will be a time I throw my hands up and leave frustrated.

What is your educational background?

I earned my Bachelor of Science degree in Environmental Engineering from Michigan Technological University in 2018 and my Master of Science degree in Environmental Engineering from Michigan State University in 2020.

Samuel Traynoff, Process Engineer

11 months

Had you worked in a different industry prior? Which one(s)?

No I have not worked in a different industry.

Was electronics manufacturing something you sought out?

I had not actively sought out a career in electronics manufacturing, I was applying to multiple locations that were accepting chemical engineers. My introduction to the PCB industry was when I came in for my interview and I went on a tour of CEC's facilities. This is when I found out that PCB manufacturing met my criteria of a fulfilling career—a hands-on process that produced a meaningful product.

Do you see a career path for yourself?

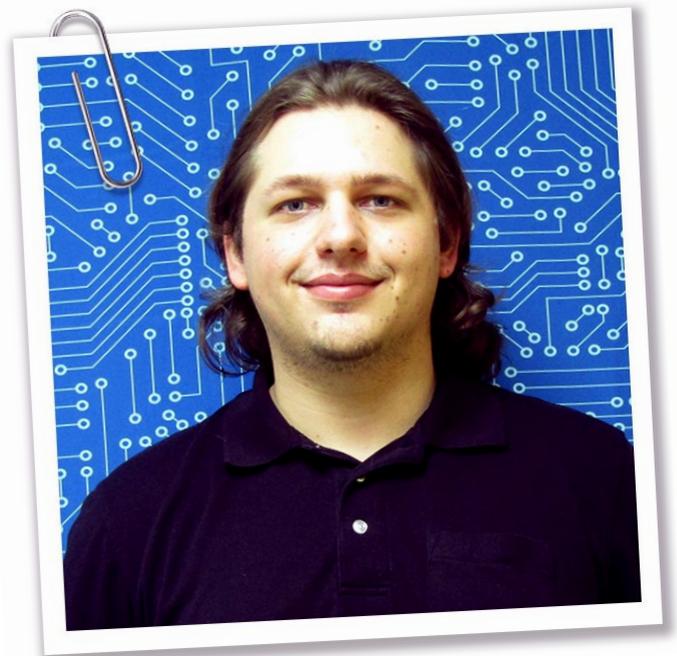
I see a career path at Calumet where I con-

Do you find you use your degree in your job?

Yes, I do. I have to utilize my chemistry and fluid dynamics background daily. I've dabbled in permitting as well.

What advice would you give to a fabricator on recruiting and hiring young talent?

Continue/initiate the intensity with career outreach and internship programs. The addition of a well-rounded introduction into the PCB industry, like MacDermid's PCB 101 Webinar series, would provide excellent detail for people interested in the PCB industry and for interns to hit the ground running. With the continuation/addition of intern programs, they need engineering mentors. Although they may be intelligent, newcomers/interns typically lack intuition of process flow and some struggle with the fluctuating workloads. To avoid interns stalling, a solid program structure and accessible communication to senior engineers must be established. It is ideal to have self-driven interns, but they need the necessary information and tools to flourish.



tinue contributing to the company, while also learning new PCB manufacturing processes and growing as an engineer.

What is your educational background?

I attended Michigan Technological University, where I received a B.S. in Chemical Engineering and a Minor in Mineral Processing.

Do you find you use your degree in your job?

My degree has been useful in two ways. The main use is the academic knowledge it required to earn my degree. While learning this information, it also led me to learn how to creatively problem solve. This ability to solve problems is the skill that has been

most useful day to day since I began working at CEC.

What advice would you give to a fabricator on recruiting and hiring young talent?

My advice would be to follow what CEC already excels at: Fabricators should present a welcoming atmosphere to the young talent, and work with them to find where they fit best. Along with utilizing a new hire's existing strengths, it's essential to maintain a continued focus on their growth.

Brian Torola, Process Engineer

1 year

Had you worked in a different industry prior?

I had not. I began working at CEC the month after I graduated from college.

Was electronics manufacturing something you sought out?

I definitely happened into electronics manufacturing. What I sought at the time was a strong, reputable company close to home. I liked that the job was not a wheels-and-gears application of mechanical engineering.

Do you see a career path for yourself?

I see huge potential for my career path here. I am excited about the prospect of taking on new roles and maybe creating new positions within the company as we grow and branch our capabilities into new parts of the market.

What attracted you to the printed circuit board fabrication industry?

I have had jobs at places for the last 15 years throughout school and everything, and I have never had so many people tell me, "I know so-and-so who works there and they really like it!"

What is your educational background?

I went to Gogebic Community College for one year to complete some generals, then I transferred to Northern Michigan University



for a couple years working toward a degree in Elementary Education. Just before I began student teaching, I transferred to Michigan Technological University and got my degree in mechanical engineering.

Do you find you use your degree in your job?

I do find that I use my degree in my job. Mechanical engineering is a broad study. I use the variable-isolating, test-running and -reporting, and root-cause-analyzing aspects of my training more than the motion-describing, equation-theorizing, and number crunching aspects. I work with the presses and CNC ma-

chines primarily, along with some measurement equipment, so there is also a smattering of CAD and coding skills at play, which I like.

What advice would you give to a fabricator on recruiting and hiring young talent?

If I were to step into the role of trying to recruit and hire “young talent” into the industry, I would speak to the company’s role in the industry, their goals for growth or outreach or improvement, and how young talent fits into those roles and goals. It does not hurt to ad-

vertise ways in which young talent is affecting the industry currently, and to hear from them about the work they do from a high-level perspective as well as how they see themselves in the industry and their take on how the work relates to their training.

I also liked hearing about how the industry is changing/advancing and how the company wants to adjust its stance and their plans for adaptation.

Cole Van Camp, CAM Engineer

7 months

Had you worked in a different industry prior?

This is the first industry I have worked in since graduating college.

Was electronics manufacturing something you sought out?

I did not seek out the PCB field specifically but was interested in working with Calumet and I was interested in learning more about PCBs.

Do you see a career path for yourself?

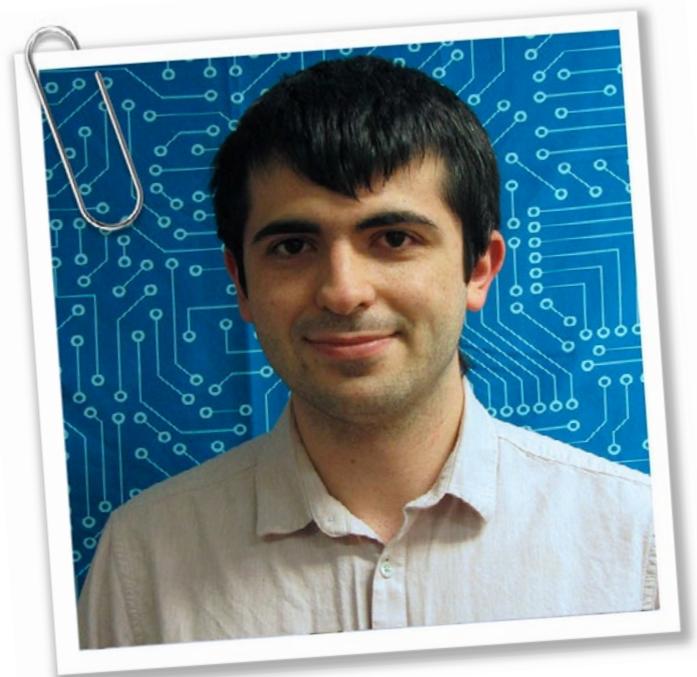
I see a career to help more with the automation and incorporating more software inside the CAM department. I studied and created machine learning algorithms and would like to integrate that going forward as I believe that could make the CAM department more accurate and faster.

What is your educational background?

I studied computer engineering and graduated with a B.S. in Computer Engineering and a master’s degree in Computer Engineering from Michigan Tech University.

Do you find you use your degree in your job?

I do use my degree often since I have become more involved with the automation side of the CAM department and have created/updated old scripts to increase throughput.



What advice would you give to a fabricator on recruiting and hiring young talent?

I would advise Calumet to look for students that are motivated, passionate, and critical thinkers above all. Expanding that outreach to include encouraging promising First Robotics High School participants to attend MTU and co-op may provide additional qualified applicants. The PCB field is continuously advancing and those who can problem solve and quickly adapt will be the most successful.

Audra Thurston, R&D Engineering Manager 2 years full time, 1 year internship

Had you worked in a different industry prior?

I had a semester-long internship my junior year in the phosphate mining industry. The next summer I started at Calumet Electronics as an intern. Calumet Electronics was my first full time job after I graduated university.

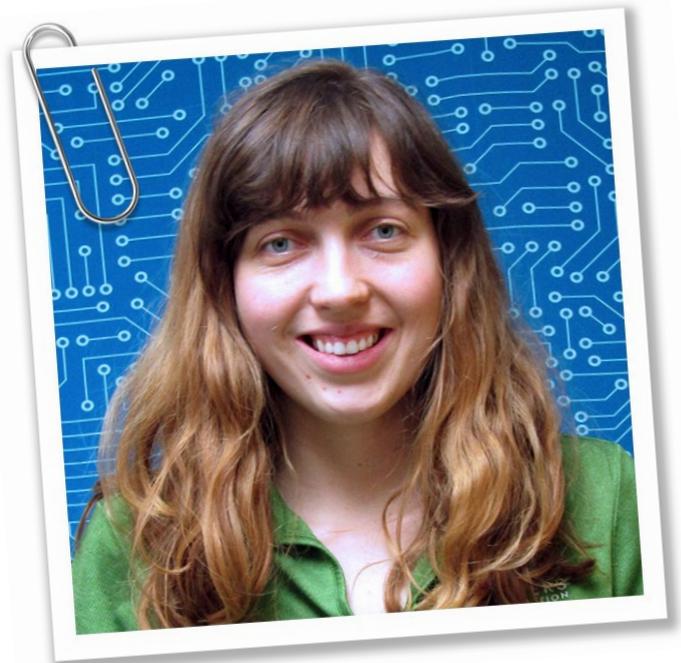
Was electronics manufacturing something you sought out? Or did you happen into it?

I happened into it. I started out looking for an internship in the Calumet area to spend a summer in the Upper Peninsula of Michigan and ended up at Calumet Electronics. I wasn't sure what a chemical engineer could do in the printed circuit board manufacturing process, but it was an internship. After a summer of getting my hands dirty in plating tanks and spending entire days on the manufacturing floor, I knew this was an industry I wanted to stay in because it gave me a chance to be hands on.

Do you see a career path for yourself?

One of the reasons I was attracted to starting as a freshly graduated engineer in this industry over others is because electronics are constantly evolving to meet the demands of miniaturization and improvements to SWAP (size, weight, and power). I realized that there were going to be many advancements in the electronics industry in my lifetime and I could be a part of them at Calumet Electronics. This made me excited because I could have a long career and always be learning something new with all the changes to technology.

Because of this attraction to advanced technology, I pictured myself eventually going on the R&D path after many years of learning the ins and outs of the various manufacturing processes as a process engineer which is where I started. However, due to the opportunity created by the lack of capability in volume in the domestic industry and Calumet Electronics' goal of filling this gap, my career path to R&D was expediated tenfold and I am



now the R&D engineering manager of Calumet's first official R&D team, which is focused on manufacturing the next generation of technology at the market demand for volume, lead time, and price.

Through this experience I realized you can't plan your career path, especially in this ever-changing industry, which to me is exciting. You have to go where your talents are needed to capture the current moment in the industry and figure out how to rise to the challenge. Instead of planning my career path, I am planning my short- and long-term career goals. My long-term career goal is to always feel challenged and to make meaningful contributions to my company, my industry, and my community by creating systematic improvements over time. If I start to feel comfortable in a position, I'll know it is time to reassess my current path.

What is your educational background?

I went to Michigan Technological University where I graduated with my B.A. in Chemical Engineering in 2018. When I started in chemical engineering, I assumed that I would go into toilet paper and consumer product manufacturing since that is such a large industry in the Midwest. I never planned to be in electronics!

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Do you find you use your degree in your job?

To me an engineering degree teaches you how to problem solve and how to quickly learn what you don't know. At Calumet, we refer to this ability as just-in-time learning and this is the part of my degree I use every day. Do I balance organic chemistry equations like I learned how to when earning my degree? No, but I'm glad because I'd much rather use my knowledge for practical, hands-on problems where systems are not performing perfectly rather than thinking about theoretical situations where everything works out like it should. It's more fun! I think that any type of engineering degree can succeed in the electronics industry if you are interested in the material, because your brain has been programmed to approach problems systematically, no matter the subject.

What advice would you give to a fabricator on recruiting and hiring young talent?

I think internships are a great place to start as that is the best way to get a young engineer excited about your company through hands-on experience. I also think that recruitment needs to start in high school and the beginning years of college so that students realize that this industry exists and don't just stumble into it. If I had known about this indus-

try earlier, perhaps I would have tailored my courses to be more applicable to electronics. Reaching out to younger students can be done through information sessions about your company, and presented during classes or extra-curricular clubs.

Another important recruiting tool is your story. That was a large part of what attracted me to Calumet Electronics, specifically, over other PCB manufacturers. The heart of Calumet's business is to revive industry in Calumet, Michigan, by providing good quality manufacturing jobs. Our area was deeply impacted by closure of the copper mines in the 1970s and the decimation of the prominent copper mining industry led to the foundation of Calumet Electronics. That is why everything we do is 100% American engineering and manufacturing. This is a story I wanted to be a part of because I love the Calumet area and have chosen to make it my home. To know that I am helping build a stronger community by the contributions I make to the company every day is incredibly rewarding. I think that people my age want to feel like they are a part of something that is having a positive impact. It is no longer good enough to just receive a paycheck and clock out at the end of the day, we want to be a part of a story we are proud to tell.

Conor Porter, Engineering Services Intern

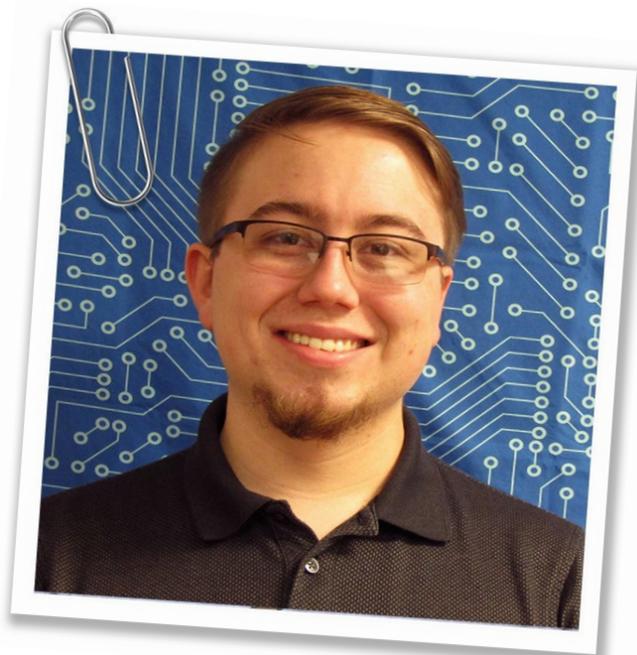
1 year 6 months

Had you worked in a different industry prior?

I have interned for a gold mining company in their Information Technology department.

Was electronics manufacturing something you sought out?

It was a little bit of both for me. I learned about CEC's existence maybe an hour before I met with Rob Cooke at the Michigan Tech career fair. I went there on a whim, as I was thrown off that there were employment opportunities relating to my major (Computer Engi-



neering) basically at the doorstep of where I'm earning my degree. The more I did my research of the PCB industry in the time between my first interview and my employment offer, the more I interested I became in learning about it. Once I received an offer, I took it without much hesitation.

Do you see a career path for yourself?

PCB technology is constantly improving and changing, and I think this field gives me the opportunity to be in the trenches of learning and experimenting with that technology as it is being developed. I see my future-self helping lead the development of new PCB technology or similar technologies relating to electrical and computer systems.

What attracted you to the printed circuit board fabrication industry?

The thing I like most about the PCB industry is the wide range of fields that are involved with it. I have always known what I wanted to get a job doing something related to computer technology in a broad sense. The PCB industry has given me many opportunities to explore topics in my field such as automation development, circuit design, PCB tooling and manufacturing, and many others. I'm still not entirely sure what the best focus for me is, as it is all still very new and interesting, but this industry gives me the time and flexibility to keep exploring those options.

What are the things that are better at Calumet than where you were before?

The biggest difference between CEC and any other job I've had is the potential for personal and company growth. I foresee many opportunities for myself with this company due to the attitude of the people I work with as well as the importance of this industry as a whole.

What's your educational background?

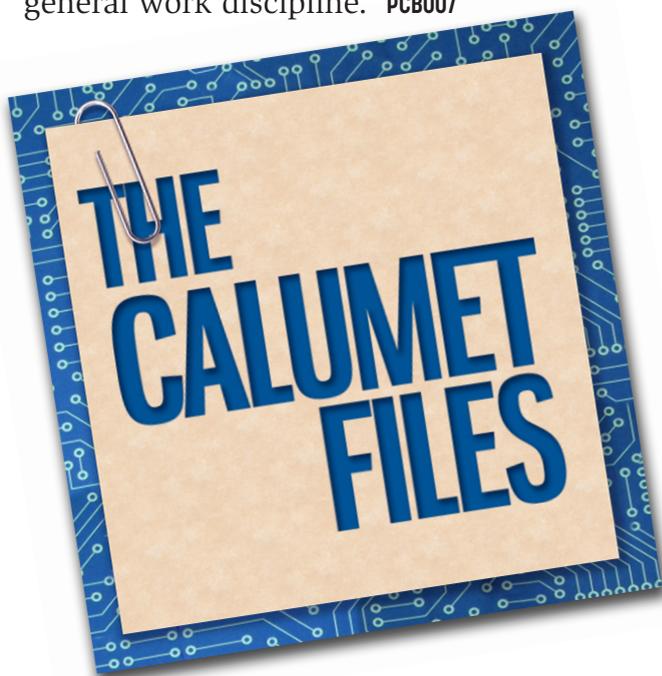
I am currently earning a Bachelor's in Computer Engineering at Michigan Technological University.

Do you find you use your degree in your job?

I use my degree every day I walk into work. CEC has allowed me to hone my programming skills, electrical knowledge, time management, and social skills.

What advice would you give to a fabricator on recruiting and hiring young talent?

Before I answer this, I have a short relatable story. I attempted to get an internship with a different company the fall before I joined CEC. I got all the way to a third interview when I was told they were not interested in me because of my lack of project experience (I was a sophomore at the time). Spring career fair rolled around, and I figured I would attempt that company again as well as a few others. I managed to get an offer from the same company that denied me not six months prior as well as an offer from CEC. I'm sure it's obvious which offer I took, and according to my employers here, that other company lost out on a competent aspiring engineer. The best piece of advice I could give to a recruiter is to give interviewees a second thought when you're considering turning them down due to a lack of technical skills or project experience. Those things can be taught much quicker and easier than certain other skills such as social, writing, and general work discipline. **PCB007**





Hiring Is an Investment in Your Business

Feature by Barry Matties
I-CONNECT007

Hiring is one of the most difficult processes in business. If you don't get it right, you pay a heavy price. To get it right requires a well-defined process beyond just understanding the job description. It's also important to understand the most important soft skill set you are looking for. For example, some of the most important skills may be the ability to solve problems, communicate well, organize tasks, and work with others.

This may all seem obvious, but how do you validate these skills in an interview? Short of any special education required for the job, such as software or a degree, which can easily be verified in an interview, these soft skills may not be so apparent.

There are limitless questions you can ask a candidate, so it's really important to understand what you are trying to discover. In the case of soft skills, asking questions that require the candidate to provide detailed, specific examples of how they used these skills is useful. Develop a set of questions that will help you determine the applicant's soft skills that are most important to you, such as:

- Can you share an example of a difficult problem you had to solve at work?
- When you have multiple tasks that are important, how do you prioritize them?
- When you are faced with a difficult coworker, how do you handle that?
- When do you feel it is the appropriate time to ask for help?

We know hiring is a real investment in your business, and if you don't get it right, the cost can be enormous. The list includes wasted time, lost opportunity, additional management time, reduced productivity, and it could even put some customers at risk, along with the overall company morale. The problem is once you do make a hire, a lot of time is spent getting the new hire acclimated and evaluated. It can take months to really get a read on a new employee, and if you get four, five, or six months down the road and realize you've hired the wrong person, then you have to start this arduous task over again.

Of course, the second time around adds another hiring and training period that will cost many more months of time and lost opportunity. The best way to avoid this is to get it right the first time, and even in the best of circum-

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stances, you never really know if it's right until the new hire starts and you get months down the road. At best, you can be clear on exactly who you are looking for to develop a robust hiring process and help you get it right.

Like a documented manufacturing process, hiring needs a documented process, as well. There are many resources available to develop such a process. Whatever your process is, it's better to invest an extra month or two to get it right because, in the long run, your return on investment will be much greater. The cost of failure is too costly.

Jim Collins' book *Good to Great*, published by Harper Business, has some solid hiring advice. He makes the point that who you hire is more important than what you hire. Here is an excerpt from his book:

“The good-to-great leaders understood three simple truths. First, if you begin with ‘who,’ rather than ‘what,’ you can more easily adapt to a changing world. If people join the bus primarily because of where it is going, what happens if you get 10 miles down the road, and you need to change di-

rection? You’ve got a problem. But if people are on the bus because of who else is on the bus, then it’s much easier to change direction: ‘Hey, I got on this bus because of who else is on it; if we need to change direction to be more successful, fine with me.’ Second, if you have the right people on the bus, the problem of how to motivate and manage people largely goes away. The right people don’t need to be tightly managed or fired up; they will be self-motivated by the inner drive to produce the best results and to be part of creating something great. Third, if you have the wrong people, it doesn’t matter whether you discover the right direction; you still won’t have a great company.”

By the way, *Good to Great* is Amazon's best seller in strategic business planning. If you haven't read this book lately, it's worth the time. It reminds us that the greatest enemy of being great is being good. And when it comes to hiring, being great is something to strive for—your business depends on it. **PCB007**

An Underwater Navigation System Powered by Sound

GPS isn't waterproof. The navigation system depends on radio waves, which break down rapidly in liquids, including seawater. To track undersea objects like drones or whales, researchers rely on acoustic signaling. But devices that generate and send sound usually require batteries—bulky, short-lived batteries that need regular changing. Could we do without them?

MIT researchers think so. They've built a battery-free pinpointing system dubbed Underwater Backscatter Localization (UBL). Rather than emitting its own acoustic signals, UBL reflects modulated signals from its environment. That provides researchers with positioning information, at net-zero energy. Though the technology is still developing, UBL could someday be-



come a key tool for marine conservationists, climate scientists, and the U.S. Navy.

Because radio waves quickly deteriorate as they move through water, subsea communications often depend on acoustic signals instead. Sound waves travel faster and further underwater than through air, making them an efficient way to send data. But there's a drawback.

“Sound is power-hungry,” says Adib. For tracking devices that produce acoustic signals, “their batteries can drain very quickly.” That makes it hard to precisely track objects or animals for a long time-span – changing a battery is no simple task when it's attached to a migrating whale. So, the team sought a battery-free way to use sound.

(MIT News)

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Testing Todd

Feature Column by Todd Kolmodin, GARDIEN SERVICES USA

As with any business, the quality of goods and/or services is of the utmost importance. Company reputations are gauged by the success or failure of maintaining high-quality outputs. Maintaining high-quality and on-time delivery depends on multiple factors: first, equipment and tools to produce the product or service, and second, the power of the workforce behind the product.

Machines and tools support the manufacturing of products, but they are built with the assistance of other machines and, most importantly, people—the human component. Machines do what they are told, and those instructions come from humans. Manual tasks are performed by humans to the point they

may be deemed too repetitive, and the task is then given to robots. However, these robots are given instructions by humans. Companies that maintain superior on-time delivery and quality rely on a key factor within their organization: competence and training of their core workforce.

In the ISO9001:2015 standard, companies are required to demonstrate a system of competence measurement within the organization. This shall be demonstrated with documented information. However, how a company embraces this requirement is totally up to them. Tasks are usually documented by work instructions, which define how any given task is to be performed. Ideally, a stranger can walk up to



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a task, read the work instruction, and perform the task under supervision. In time, the new operator becomes more proficient in that task and no longer requires supervision. The training matrix should define when that time is, when the operator should be reviewed again, and at which point proficiency should be re-scored. A strong training matrix will encompass these disciplines.

Operator Task-Specific Training vs. Cross-Training

There are different camps when it comes down to task-specific training vs. cross-training. It really comes down to the size of the operation and management philosophies. In a ginormous operation, it may be prudent to train specific employees for specific tasks. If the depth of the workforce supports this, it may be the optimal solution.

If the department has but one function and many employees, it makes sense. New employees may start as a trainee and progress to a general operator, and this may work perfectly. Some general operators may elevate to a lead or supervisor. However, they still remain within the same department and perform the same tasks. Other departments within the facility will have the same matrix. If an employee calls in sick or quits, the depth of the workforce can handle the disruption, and although they may be one person shy, the void is filled by a new trainee.

What about the small “mom and pop” type operations? The depth of the workforce is hardly the magnitude of the ginormous example. This can also be the same in a large parent company with small divisional offices. Each of these operations may have small workforces that are required to perform multiple tasks. Is the single task training matrix feasible in this case? Perhaps. However, with these smaller operations, the loss of an employee, even for a day, can be stressful and cause disruption to delivery and perhaps quality.

This is where cross-training becomes an advantage. Employees are trained on multiple tasks; some, they do every day, while oth-

ers may be performed on an as-needed basis. Even though the employee count is smaller, the depth of knowledge in the small workforce is strong. This allows the smaller operations to roll with the occasional employee illness, vacation, or other unforeseen circumstances.

How a training matrix is developed is solely up to the organization. However, it should provide the instructions for any given tasks to be performed, a way to gauge competency, and a time frame to review the competencies. Levels of competency are recommended so that an employee may perform a task without having mastered the task. Examples would be work with supervision, work unsupervised, and work unsupervised and train others. These could be outlined by proficiency percentages or levels, such as Trainee, Operator I, Operator II, and so on. Perhaps equipment may need attention, or other technical aspects are necessary. This may require higher levels of expertise. The matrix can encompass this as well.

Strong training systems may incorporate synergies between the training system and actual equipment or tasks. An example would be an operator who is disallowed the operation of a machine when they sign on because the machine consults the training matrix to validate the employee competence. The system has a self-check mechanism to guarantee employee competence is achieved and maintained.

Simply put, you cannot perform tasks for which you are not trained. This satisfies the competence and training requirement and also keeps a thumb on the pulse of the system. This type of system also maintains traceability in case there is a problem found. The training system can be consulted along with machine records to find out who, what, when, where, and finally, why.

Happy holidays! Be safe. **PCB007**



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

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MilAero007 Highlights



Defense Speak Interpreted: Intel Is Now Making a 'SHIP' ▶

Perhaps you recently saw that Intel was awarded a contract for a SHIP by the U.S. Department of Defense. However, this one will not float on the water since SHIP stands for state-of-the-art heterogeneous integration prototype. Denny Fritz explains.

SMTA Europe Webinar: What Is a Good Solder Joint, and How Can Solder Joints Be Tested? ▶

What is a good solder joint? And how can they be tested not only for purposes of process characterisation, optimisation, monitoring, and control but also for ensuring their long-term reliability? Pete Starkey details a webinar organised by the Europe Chapter of SMTA that was presented by Bob Willis, an expert in soldering, assembly technologies, and failure analysis.

The Aerospace and Defense Chapter of the HIR ▶

Nolan Johnson and Andy Shaughnessy recently spoke with Jeff Demmin of Keysight Technologies, who breaks down the work his team has done on the Aerospace and Defense Chapter of the Heterogeneous Integration Roadmap (HIR).

The Heterogeneous Integration Roadmap for Aerospace and Defense ▶

Most people in the semiconductor industry are familiar with the International Technology Roadmap for Semiconductors (ITRS), which provided guidance for the industry starting in 1991 (as the National Technology Roadmap for Semiconductors). The baton was handed to the Heterogeneous Integration Roadmap (HIR),

with the realization that heterogeneous integration—assembling different types of devices rather than monolithic fabrication—is an important enabler for continued progress in the semiconductor industry.

SpaceX, NASA, ESA Launch Sentinel-6 Michael Freilich Mission ▶

Fresh off their second crewed launch for NASA, SpaceX temporarily shifted focus on launches to the U.S. West Coast, where a Falcon 9 rocket launched the Sentinel-6 Michael Freilich oceanography satellite in cooperation with NASA, the National Oceanic and Atmospheric Administration, the European Space Agency, and various other partners.

BAE Systems to Develop Capabilities for Future Vertical Lift Initiative ▶

BAE Systems has been awarded multiple contracts from the U.S. Army to develop key technologies for the Advanced Teaming Demonstration Program (A-Team).

Understanding MIL-PRF-31032, Part 5 ▶

Continuing with Part 5 of the discussion on understanding the military PCB performance standard MIL-PRF-31032, Anaya Vardya discusses the remaining three new procedures to address the unique requirements of the military.

Airbus Wins ESA TRUTHS Study for Metrological Traceability of Earth Observation Data ▶

Airbus has been awarded the lead in the European Space Agency (ESA) contract for the TRUTHS A/B1 (System Feasibility Studies and Pre-Developments) as part of ESA's Earth Observation Earth Watch Programme.

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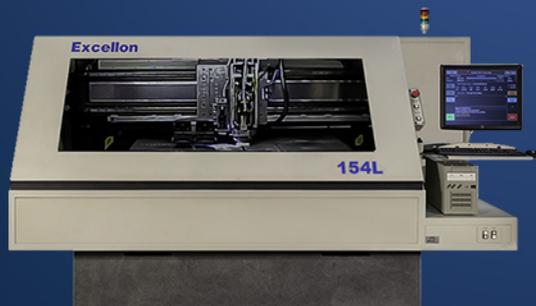
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Training for **Plating Processes** in the Electronics Industry

The Plating Forum
Feature Column by George Milad, UYEMURA

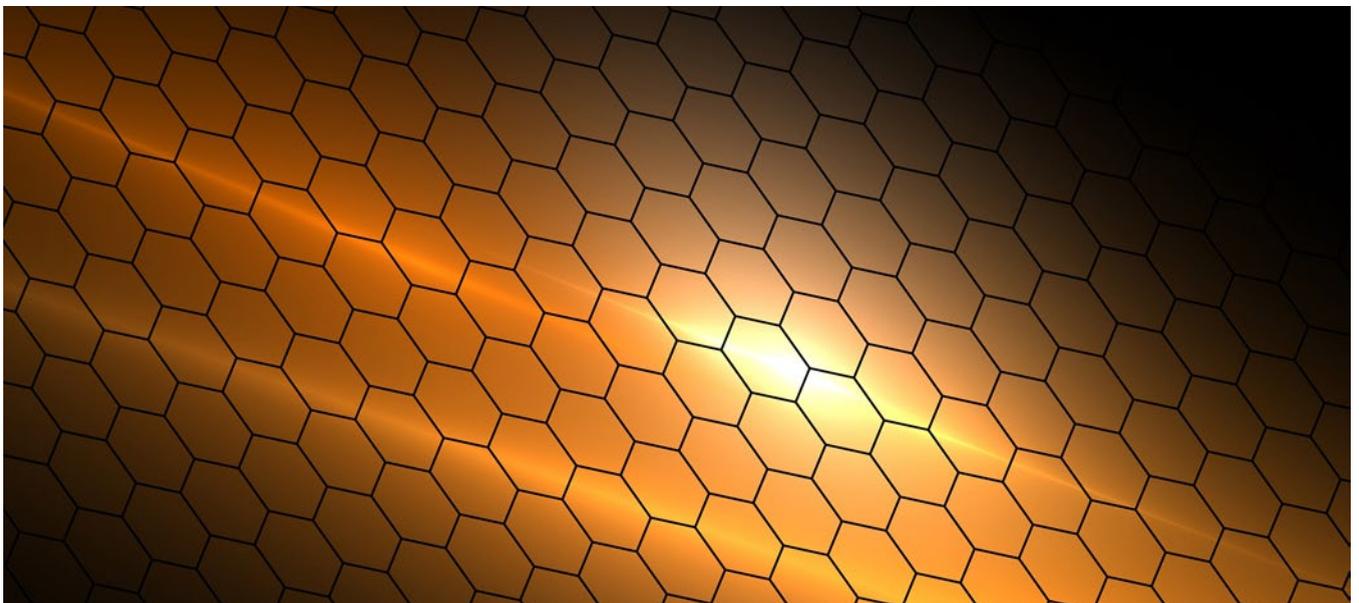
Wikipedia defines training as follows: “Training is teaching, or developing in oneself or others, any skills and knowledge or fitness that relate to specific useful competencies. Training has specific goals of improving one’s capability, capacity, productivity, and performance. It forms the core of apprenticeships and provides the backbone of content at institutes of technology. In addition to the basic training required for a trade, occupation, or profession, training may continue beyond initial competence to maintain, upgrade, and update skills throughout working life.”

In the electronics industry, the role of the supplier in training their prospective customer on the ins and outs of a plating process is paramount to the success of any new installation. This is particularly important, as there are very few curriculums in formal educational institutions that directly address the specific skill set needed by our industry.

Plating is a very old industry and has been studied for many generations. Its basic principles are well understood and documented. However, when it comes to the intricate details of plating a circuit board, there is so much to learn and apply.

Most of the plating chemistries in use today in printed circuit shops are proprietary to the specialty chemical supplier. Supplier R&D departments specialize in finding solutions to meet the ever-changing requirements of new circuit board designs. The net result is a series of products that, when used in a specific way, would give the desired outcome. Suppliers do not divulge their trade secrets to their buyers—the circuit shops.

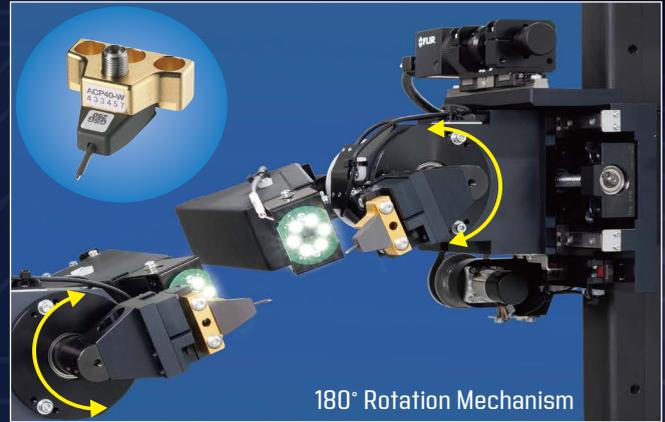
Instead, they describe the product and explain its capabilities to the buyer and supply a detailed data sheet that contains instructions for use, which includes makeup procedures for the electrolyte or the bath, as well as its



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operating ranges and the expected outcome. They also supply procedures to analyze and replenish the electrolyte during its use, as well as schedules for dump and remake of electrolytes. Electrolyte or bath life is mainly determined by the buildup of by-products that will eventually interfere with the functionality of the chemistry.

The supplier also specifies the type of equipment and any specific controllers or dosing peripherals that are needed for their proprietary system to work. With all this complexity, a well-trained user is a must for success and for achieving the desired end result.

Suppliers have training experts available to their customers. This begins with sales, and eventually, the burden of training falls on the shoulders of the technical service engineer in the lab (in-house) or in the field or at the site.

In-House Training

Most suppliers have laboratories and demonstrate chemical processes set up in their facility. In most cases, a lead person (plater, engineer, or manager) from the buyer would spend a day or two being trained by the application engineer. Training involves a hands-on demonstration of the process and may also entail training on the analytical methods used to control the chemistry of the electrolyte for replenishment and continuous successful operation. The trainer becomes an important resource to the user as different situations arise that may include product evolution, increased capacity, or the addition of new equipment or personnel.

Onsite Training

Onsite training is the other side of the coin. Here, the regional sales and technical service engineer conduct the training. In this setup, there is ample opportunity to train different individuals as needed. Onsite training involves adapting the user's equipment and personnel to the process being installed.

Onsite training covers different individuals or groups in the shop. It starts with the process engineer who assumes the primary responsi-

bility of overseeing the successful running of the process. In some of the smaller operations, the position of process engineer is absent. The duties of the process engineer are performed by the production manager, who is assisted by lab personnel, as well as the supplier tech service engineer.

Special training is also needed for the production floor personnel, like the platers, who run the process during their shifts. Training on inspection techniques is paramount to ensure that the parts meet in-house QC requirements. A competent, well-trained plater is the gatekeeper for the product coming off the line. They are always the first to recognize any deviation in product quality.

Training of lab personnel on specific analytical techniques is needed to ensure proper analysis and replenishment of the different components of the bath. This is particularly critical if a new analytical tool is introduced into the lab. Setting up the new tool becomes the responsibility of the supplier technical service team. Lab personnel are trained on the setup and maintenance of controllers that are installed on the line. The lab personnel are also trained in setting up dosing systems that may be needed to maintain a steady-state operation. The lab usually has the responsibility for determining the end of life of a bath and scheduling a dump and remake. The lab also oversees the makeup of the new bath.

Communicating the proper operation of any chemical process is critical to the success of the operation. This is achieved by the successful training of different personnel in the production shop by the supplier team. Continuous monitoring of the setup is equally important, and retraining is always needed as changes in equipment, product requirements, or personnel occur. **PCB007**



George Milad is the national accounts manager for technology at Uyemura. To read past columns or contact Milad, [click here](#).

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Shane Whiteside

Whiteside's View From the Summit: An Industry Perspective

Interview by Nolan Johnson I-CONNECT007

I spoke with Shane Whiteside to get his unique perspective on the industry as president and CEO of Summit Interconnect, as well as his position on the board of directors for the IPC. Whiteside discusses the business challenges he sees overall.

Nolan Johnson: Shane, you have two high-profile roles in the industry right now. First, can you introduce yourself?

Shane Whiteside: I'm currently serving as president and CEO of Summit Interconnect. I'm proud to be a part of that. It's a great team here in the PCB industry. Also, it's my honor to serve on the IPC board of directors. For the next two years, I'm serving as the chairman of the board.

Johnson: That's a very influential position. Summit certainly seems to be growing. How would you characterize that?

Whiteside: Since we formed the company in April of 2016, through the acquisition and merger of the two companies in Southern California (MEI and KCA), we've grown organically. We also made an acquisition in December 2018 of Streamline Circuits, and then we just finished an acquisition in July of ITL Circuits in Toronto, Canada. Each of the companies has grown significantly since we bought them. By putting them together on one platform, we have developed a very large and best-in-class sales force. Again, the two main elements of growth have been organic and acquisitions.

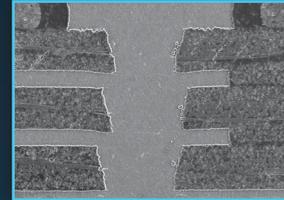
Johnson: With your perspective in putting together a company like Summit, as well as your position on the board of directors for IPC, what are some of the business challenges that you see for the industry overall?

Whiteside: There are quite a number of challenges. In 2020, in particular, everybody's facing a challenge with COVID-19 and coping with it not only in our businesses but also in

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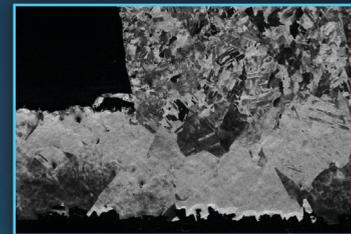


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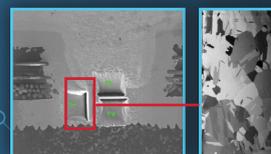
Via Dep 4550 low stress electroless copper can run in many types of equipment with excellent properties.



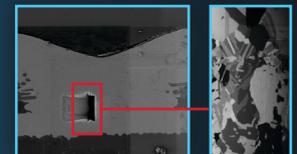
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Summit's Santa Clara, California office.

our personal lives and in society. We continue to have challenges in our business that we've faced over the last few years, including investing in our growth for the future, deciding where to invest in our business, and trying to anticipate what technologies are going to grow faster than others.

We've been fortunate in the last three years to have a growing market in North American PCBs. Before that, it had been a declining market for 15+ years. That presented its own set of challenges as well. But with some confidence, and with a growing market ahead, we continue to invest in our businesses.

There's also a continuing increase in compliance requirements, particularly with the markets that we serve. And while we're pleased to demonstrate the compliance of the products that we build to all the specifications and expectations of our customers, that demonstration of compliance is increasingly stringent. And not only does this involve documentation of compliance to requirements but also additional laboratory testing, such as reliability testing and things of that nature. It has proliferated from the sample level to every board and panel.

With this continuing expansion of compliance requirements, there's a significant cost associated with that. It requires us to invest in additional people, test systems, lab equipment, and similar items to continue to ship

at the same level. If I were to buy a drill machine or a lamination press or invest in plating, I could drive incremental dollars for that investment. When investing in meeting additional requirements that is not the case. It's investing just to continue to operate at the same level.

Johnson: What's driving the increase in compliance? Sure, compliance is often a cost of doing business; it's a requirement if you're going to land some of those deals, and it becomes a factor in organic growth. What's

happening on the customer side to drive that increased need in compliance?

Whiteside: In the markets that we serve, including the military market, there's an ever-greater emphasis on mission assurance, which is laudable, and that's what we want. And on the medical side of the business, there's an emphasis on zero defects, which is the same in automotive and aerospace as well. It's all about safety and mission assurance, which are all things we care about.

There are times when we have to ask ourselves from a business standpoint, and I encourage customers to ask themselves, "Are we well past the point of diminishing marginal returns here at some point?" Continuing to ask for more verification, demonstration, inspection, and record keeping—at some point, you have a reasonable assurance that the product is good and compliant, and it's going to be very reliable. Sometimes, I wonder if what's being asked for is over the top.

Johnson: When I was listening to one of the IPC automotive executive forums a couple of years back, it became clear that automotive was going to need at least an order of magnitude, if not two, in the volume of production. Plus, at least in order of magnitude, if not two, in better reliability and reduction in field failures. Those two numbers going in opposite di-

rections create a need for something fundamentally different than just incrementally documenting yourself into a higher yield. At some point, something needs to change with regard to the approach to production if you're going to get those kinds of results.

Whiteside: I completely agree. And all the while, we have very good quality systems and very good quality metrics in each of our plants. The emphasis is always to improve that, and that's always there. Documentation, validation, demonstration, and all that doesn't necessarily help us improve our product quality; it just helps us convince our customers that we continue to make good products.

Johnson: Where are you focusing your attention for capital equipment and improving processes?

Whiteside: We've invested for growth along the way. We've invested in enhancing our technology. As I mentioned earlier, we've invested in our ability to be efficient at meeting these higher levels of compliance requirements. Looking ahead, we're going to continue on that same path.

We're expanding in one of our locations and taking on some additional floor space that will enable us to significantly expand our HDI capacity. We also recently closed on our acquisition in Toronto at ITL Circuits, and we are working with them on defining strategic growth initiatives and investment required.

Johnson: Do you have issues or concerns right now with things like cybersecurity? We talked already earlier in the conversation about tracking and compliance issues. What about cybersecurity and protection issues?

Whiteside: That's a good question. Cybersecurity is a real focus for all of us, both in our professional and personal lives, and it's certainly



Summit's Anaheim, California office.

a concern on the part of the U.S. government. Many of the commercial OEMs that are continuously innovating want to protect their intellectual property. We all understand the need for cybersecurity. It's something that we're complying with, and we have a plan to continue that. We're currently NIST 800-171 compliant from a cybersecurity standpoint.

The new CMMC standards supplementing the NIST requirements are something that we are working on very diligently. I can tell you for a company our size, we're going to be spending a significant amount of money on this effort to further improve our cybersecurity and meet the defined standards. I'm concerned, on behalf of the industry, that companies that aren't our size may choose not to make that investment—particularly a company that doesn't do a lot of defense work but still services some critical requirements. If they can otherwise replace that business with commercial business and not have to make that investment, a company may choose to stop supporting defense business.

I'm also concerned that the cost of complying with CMMC across the defense industrial base is going to be excessively burdensome to smaller companies. I read an estimate today that between the DoD and the defense industrial base, the aggregate investment is going to be north of \$90 billion total. It's an evolving topic right now because the requirements are



Summit's Orange, California office.

just finalizing, but it's something that I'm concerned about.

Johnson: The National Defense Authorization Act (NDAA) legislation, currently in the Senate and the House, contains provisions requiring an increase in U.S. PCB manufacturing. But to do that DoD work, fabricators will have to invest in cybersecurity.

Whiteside: That's correct. There are some initiatives in the proposed NDAA that will benefit the domestic PCB industry. It's in reconciliation as we speak, so we'll have to wait to see what the final language is. When it does come out, it is expected to be favorable to future business conditions in the North American and allied countries' PCB markets. From that standpoint, it will be favorable, but I acknowledge your point that investing in cybersecurity will be required.

Johnson: Putting on your IPC board hat for a moment, what's the role that IPC can play in helping these smaller or less well-capitalized PCB companies stay in business through this transition? How do you encourage them and help them?

Whiteside: IPC has done a great job in advocacy here, especially in recent years, represent-

ing the whole of industry on Capitol Hill. They are very responsive to their membership. They represent us well, and the voice of the industry is very well articulated by IPC on Capitol Hill.

Johnson: One of the things that IPC is working on is workforce development, which is a critical issue for us in manufacturing in general and the electronics industry in particular. From your perspective, how are the workforce development initiatives through IPC proceeding?

Whiteside: They're going well. As you said, it's a much-needed initiative. And IPC is very proactive in trying to address the need to develop the next generation of 21st-century workers for all of the segments of the electronics supply chain that they represent, and IPC's Board of Directors has been very supportive in their efforts. Summit is engaged in several areas of this initiative. We have donated to the IPC Education Foundation, we participate in the emerging engineer program, and we have committed to sponsor two student chapters at universities in California.

I think that while we appreciate the vast knowledge and experience that resides in this industry, we also see that much of this knowledge is going to retire over the next few years. And it's really incumbent on all of us not to

just support what IPC is doing here but to look inside our own companies, adopt similar initiatives, enhance our training programs, support internships where we can inspire students toward a career in electronics manufacturing and hopefully hire them when they graduate.

These are initiatives that a lot of us who have been just so busy building circuit boards and contending with the declining market up until the last few years, it's just not something we were putting front and center, and now we really need to do that not only to ensure our own business continuity but also to continue the continuity of the mind share and the brainpower in this industry.

Johnson: Can you measure a return on investment for being involved in these programs?

Whiteside: It's early, but I'm convinced that there will be a return on that investment.

I'd like to highlight the expansion of online training that IPC is doing through its EDGE platform. That's something that they found to be beneficial and more highly adopted during COVID-19 because of the nature of what we're going through to keep our industry operating. Part of workforce development here is to streamline the efficiency of training and to determine how to engage with the new younger generation workforce. A lot of it is about making knowledge available online and on-demand and adapting training delivery that is suited for the younger workers in our industry. IPC has put a lot of effort into developing that.

Johnson: That tells me that we can expect this to not be a temporary thing. This is going to be a new way of doing business.

Whiteside: Absolutely. As businesses, we've all learned so much about how to operate differently during COVID-19 and rationalize things that we used to not think much about, like a lot of the travel and meetings that we were doing. The nature of the restrictions forced us to think differently. And now that we've learned how to do things differently, we're assessing

how we're going to do business differently in the future. I think we're all doing that.

Johnson: Two years out, as you're wrapping up your position as the chairman of IPC's board of directors, what do you want your legacy to be?

Whiteside: That's an interesting question, I really haven't given that much thought. I guess I would say that I would like my legacy to be that I was an instrumental part of building and growing very top-notch and high-quality companies in the PCB industry, both Summit and TTM. With IPC, I'd like my legacy to be, hopefully, one of serving the organization well as a board member during a period of significant growth, globalization, and expansion of value to members. Our company is involved with IPC at so many levels, and we're involved in many of the standards committees. I like to joke with my team, "Being on the board is how I serve IPC because I'm not smart enough to be on a standards committee."

I've been on the IPC board of directors since 2005, and it's so gratifying to be there and watch the organization grow from where it was when I joined to where it is right now. The initiatives and the value that IPC provides its memberships now has taken on many additional dimensions, particularly under the leadership of John Mitchell and the rest of IPC's management team. They've developed a fine association that strives to deliver more value to the members every year.

The association has expanded to be a truly global organization. And by doing that, it's able to represent all segments of its membership across the globe. It has been very gratifying to be able to witness that and have sort of an inside-the-boardroom view of that progression through all these years. I'm honored to be part of it.

Johnson: That's an awesome answer. Shane, thanks for taking the time to talk with me.

Whiteside: Thank you Nolan, it's great to speak with you. **PCB007**

ein Electronics Industry News and Market Highlights



2020 IEEE International Electron Devices Meeting (IEDM) Announces Virtual Events Schedule ▶

The 66th annual edition of the IEEE International Electron Devices Meeting (IEDM), the world's premier forum for the presentation of applied research in transistors and related devices, announced the details of its virtual schedule.

Rohm Reducing Size of Automotive Designs With Ultra-Compact MOSFETs ▶

ROHM has released the ultra-compact AEC-Q101 qualified MOSFETs, RV8C010UN, RV8L-002SN, and BSS84X, best-in-class 1mm² size that deliver automotive-grade reliability. The products are suitable for high-density applications such as ADAS and automotive ECUs.

Medical Devices to Revolutionize With Integration of Cloud, IoT, and AI ▶

Frost & Sullivan's recent analysis, "Pipeline Analysis of Phase III Medical Therapeutic Devices: The Potential Game Changers and Growth Enablers," finds that the technology developmental trend for pipeline therapeutic medical devices in the late stage (Phase-III) of clinical development or clinical trial is shifting towards manufacturing portable, lightweight, and easy-to-use devices for patients, allowing their use in home settings.

Artificial Intelligence Technology Solutions Receives Wally HSO Order ▶

Artificial Intelligence Technology Solutions Inc. announced that its wholly owned subsidiary Robotic Assistance Devices (RAD) received an order from a global top 20 medical devices company with over 50,000 employees for what RAD expects as the first of several Wally HSO (Health Screening Option) units to be deployed at one of the client's manufacturing facilities.

NVIDIA A100 Marks Dawn of Next Decade in Accelerated Cloud Computing ▶

Amazon Web Services' first GPU instance debuted 10 years ago with the NVIDIA M2050. At that time, CUDA-based applications were focused primarily on accelerating scientific simulations, with the rise of AI and deep learning still away off.

Tuscan Holdings Corp. Announces Intent to Combine With Microvast Inc. ▶

Tuscan Holdings Corp. confirmed that it signed a letter of intent related to a business combination with Microvast Inc., a provider of next-generation battery technologies for commercial and specialty use electric vehicles.

Archer's A1 Biochip Development Commences ▶

Archer Materials Limited is pleased to announce the company commenced building a lab-on-a-chip device ("biochip") named A1 Biochip™.

Foresight Integrates NVIDIA Platforms for Use in Autonomous Machines ▶

Foresight Autonomous Holdings Ltd., an innovator in automotive vision systems, announced that it has completed the integration of its QuadSight® software on the NVIDIA® Jetson AGX Xavier™ platform, suitable for shuttles, agriculture, heavy equipment machines, and more.

Mitsubishi Shipbuilding Exploring the Future of Marine Vessels With ROBOSHIP ▶

Mitsubishi Shipbuilding Co. Ltd., a part of Mitsubishi Heavy Industries (MHI) Group, is participating in an inter-business project to explore the potential of the "ROBOSHIP" as the marine vessel of the future.

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Leading by Going the **Extra Mile**

The PCB Norsemen
by **Didrik Bech**, ELMATICA

When I first started contemplating this column—sharing my experience of how to attract new colleagues, welcome them, train them, and include them in the company’s culture and style/methodology of leadership—it hit me hard. This year has been far from normal, and it has taught me a lot about myself, the colleagues I am honored to represent, and our company during unprecedented times. Here, I’ll share how “doing a little extra” often can change a lot.



Figure 1: Didrik Bech dressed as a monkey on Halloween to visit colleagues working from home and deliver cupcakes.

Have You Identified the Correct Core and Soul of the Company?

Previously, one might have thought of the entity “the company” as the core and soul of the organization; however, these last few months have reminded me that this is not the case. It’s the team of colleagues which is “the company,” and only together will individual contributions result in a larger output than separate efforts. One can have big thoughts, ideas, perspectives, and visions, but bringing these to life requires the devoted attention of many colleagues and a wide array of experiences. Simply put, the team that cooperates best will win, and the only competitor a company really has is itself.

Why am I writing this when the topic is staffing? Without the correct staffing, your company will not flourish. To succeed, one requires a team of colleagues with a high degree of responsibility, pride, and dedication toward the company. The fanciest leadership strategies will lead to failure and dissociated colleagues.

How to Welcome Newbies and Engage Employees During a Pandemic

Since January 2020, we have welcomed four new colleagues to Elmatica; some started just before the pandemic erupted, and others began during the first and second waves. How could we ensure that they felt welcome and included when there were distancing guidelines?

Transparency and clear goals and expectations are a good first start. Allowing and actively supporting your colleagues to welcome, include, and train your new colleagues is a

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Figure 2: Didrik Bech giving John Steinar, one of [The PCB Norsemen](#), a surprise visit.

good second step. What may be most important is giving the new colleague the freedom and encouragement to fail, learn, and ask any question of anybody. Remember, training during the circumstances we have experienced this year has no precedence.

Keeping and developing the company culture during a pandemic and including new members at the same time has demanded extra internal focus. Imagine starting a new position just weeks before the world shut down. The emotion of being abandoned is not hard to imagine. With openness and transparency, we have tried to avoid this through training online, setting no limit for reaching out to colleagues asking for help, and ensuring extra room for failure.

We developed online social events for employees, provided breakfast delivery, and I even [dressed like a monkey on Halloween](#), handing out cupcakes to every colleague at their doorsteps. When times are challenging, lead by going that extra mile, and do not ask from others what you are not willing to do yourself.

During my career, I have had the pleasure of hiring many great colleagues. Here are the

key learning points. First, the hiring process is something one should take very seriously; the cost of failure is severe for both the company and the candidate. As with most things in life, it takes two to tango, and the same goes when hiring.

Second, it's not just about finding the right candidate for you; it's equally important for the candidate to find their match with the company. This is something I strongly emphasize during an interview process. It needs to be a good fit, which is a two-way street. This is when values, goals, and company culture enter the arena.

The Most Important Thing Any CEO Can Bring to the Table

Recently, we planned for a motivational speech by a psychologist to talk about similarities, differences, and strengths among colleagues. After talking with them, we concluded that the most important thing any CEO can bring to a company is culture. This is why it is vital to incorporate new colleagues with the company's culture as quickly and diligently as possible, as it represents the heart and soul of the organization.

When I took over the helm after Elmatica's former CEO Arild Bakke, one thing he asked was, "What are your thoughts about company culture? Our people and I have worked together for a long time, and it is vital that you maintain and further strengthen our family culture." Luckily, the aspect of family culture represents the type of culture I was already connected with. Education is a foundation, and experience is important, but what the company culture represents is key. Ask, "What culture do you represent?"

Staffing Challenges

Staffing, or the process of finding the right candidate for the right position, involves ensuring that the individual has the necessary skills or the ability to be trained to acquire those skills and qualifications. We are indisputably addressing one of the key elements to allow your company to develop on a business and, more importantly, a cultural level. Which

processes and safeguards have you implemented to protect your future development?

The process of staffing encompasses a wide array of different challenges one can be confronted with. A few of these challenges might be a lack of experience, time pressure to hire or fill a position, an unclear position, overpromising, or a conflicting culture. If these challenges are not addressed during the staffing process, the probability of a sub-optimal recruitment process will significantly increase.

Another common challenge is treating the process of hiring as a left-hand job or delegating it to someone without the proper experience or understanding of the requirements of the position. There may also be time pressure if the company lost an existing colleague or hires after a demand is evident. Unfortunately, this is quite normal, as one does not wish to add costs before they have the financial predispositions for the position.

In general, staffing should be according to fulfilling the company-approved strategy and future direction. This aspect is often forgotten due to a lack of an overall strategy.



Figure 4: Didrik Bech visiting a colleague curbside.

Do Not Jump Into the 'Friend Mistake' When Staffing

Challenges during the staffing process may include the “friend mistake,” where one is subject to employ individuals who have many traits in common with the interviewer. This can result in a company composed of individuals with homogenous traits and reduce diversity in the company.

This challenge can be remedied by having clear instructions regarding what one is actually seeking with regard to both personal and professional traits. One should not emphasize personality tests too much during staffing; however, they can provide the interviewer with valuable information regarding how to build the right team with different personality traits.

When the optimal candidate has been identified, one should ensure that the candidate truly understands the requirements of the position. The employer must also provide the candidate with the training and information they communicated to the candidate in the interview. Unfortunately, there are many examples

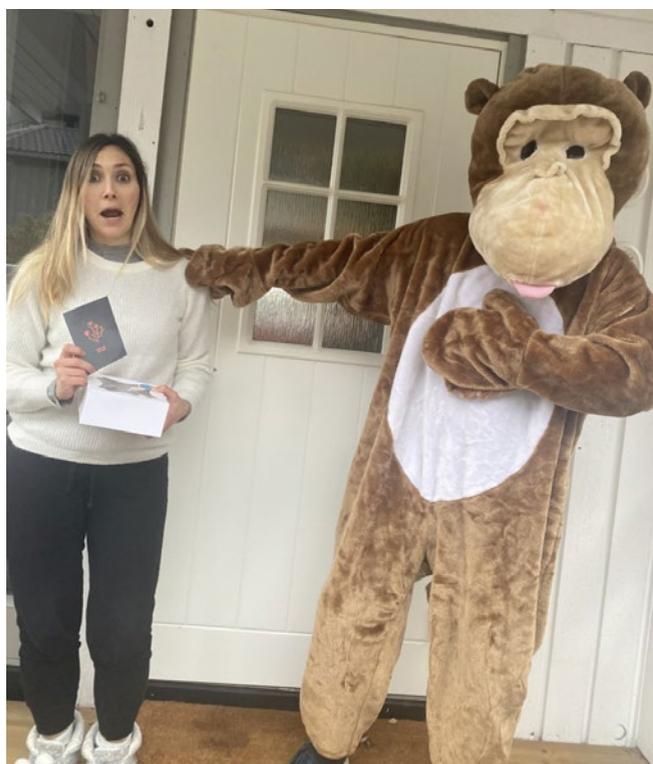


Figure 3: Didrik Bech visiting colleagues while Elmatica's headquarters are closed.

where the employer does not fulfill promises, and the now-employee overexaggerated their experience.

Training Is Not Only Valid for New Colleagues

Regardless of the reason why training is required, the act of educating human capital is essential for any company to remain competitive. As a leader, one is responsible for understanding the competence matrix for current and future demands of the company and the training required by existing and new colleagues to fulfill those demands. This theoretical approach might sound simple, but it is quite challenging and requires constant monitoring of the entire business flow of the company on an internal and external level.

Once the competence matrix has been established, it is a case of addressing the correct resources and implementing the training. As long as it is analyzed and linked to the company as described previously, the implementation should be the lesser challenge.

Leadership Strategies: Buzzwords or Business?

The company should have a continuous focus on aligning the competence matrix with the strategic development of the company and consequently securing the process from staffing to training. There are numerous leadership strategies in the corporate world. Most contain fancy buzzwords and sound impressive, but in the end, it's all about being a good human being, showing respect, focusing on including people, leading by example, and creating a good atmosphere with clear mandates, goals, and objectives. That is what we aim for and what we want all our new and existing colleagues to feel. **PCB007**



Didrik Bech is the CEO of Elmatica. To read past columns or contact The PCB Norsemen, [click here](#).

New Green Materials Could Power Smart Devices Using Ambient Light

Researchers from the University of Cambridge, Imperial College London and Soochow University in China have discovered that new green materials currently being developed for next-generation solar panels could be useful for indoor light harvesting. They report their findings in *Advanced Energy Materials*.

The team investigated perovskite-inspired materials. Although perovskites are cheaper to make than traditional silicon-based solar panels and deliver similar efficiency, perovskites contain toxic lead substances. This drove

the development of perovskite-inspired materials, which are instead based on safer elements like bismuth and antimony.

"The materials can turn light into electricity with an efficiency already in the range of commercial technologies," said co-author Dr Robert Hoyer from Imperial College London. "We have also already identified several possible improvements, which would allow these materials to surpass the performance of current indoor photovoltaic technologies."

Though more environmentally friendly, these perovskite-inspired materials are not as efficient at absorbing sunlight. However, the team found that the materials are much more effective at absorbing indoor light, with efficiencies that are promising for commercial applications. The power provided by these materials under indoor illumination is already sufficient to operate electronic circuits.

This research was funded by EPSRC and National Natural Science Foundation of China.

(University of Cambridge)



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**Use of IMS Thermal Materials
in Multilayer Stackups**

IPC-2581 Rev C Accelerates NPI

Article by Terry Hoffman

TECHNICAL LEADER, ELECTRICAL ENGINEERING
AT CISCO SYSTEMS

Detailing the Problem

Printed circuit board fabrication and assembly have been around since the 1950s. Since that time, major advancements have been made in materials, processing, and CAD tools. With the ease of creating PCB layouts today, anyone can get a PCB made. However, the manufacturing processes limit what can be built by PCB vendors and assembly manufacturers and we have to be concerned with PCB and PCA DFX (design for manufacturability, test, assembly, etc.).

Unfortunately, since the 1950s, not much has been done to help with communicating DFX issues between the designers and their manufacturing partners. Those original DFX issues were likely communicated using redline drawings and other written documents and drawings. With the internet came text-based emails. Today, we use modern office tools like spreadsheets and word processors, sometimes saved as PDF files, attached to emails. These tools

commonly require human entry or translation of data which can lead to mistakes and miscommunication.

We continue to use emails with attachments today to communicate DFX waivers and approvals.

The Ideal Solution

It would be great if the electronics industry could not only automate the collection of the DFX data, but also put the data into a format that could be easily read and processed by design and project management tools. This would remove the need for a human to translate the data, eliminating human errors during entry and translation. An automated process would allow for a database to be created with tasks automatically assigned to different job functions. This would also ease the approval of, rejection of, and commenting on individual waivers.

IPC-2581 Rev C Solution

IPC-2581 Rev C enables the industry to improve the DFX processing and communication by creating an open standardized format us-

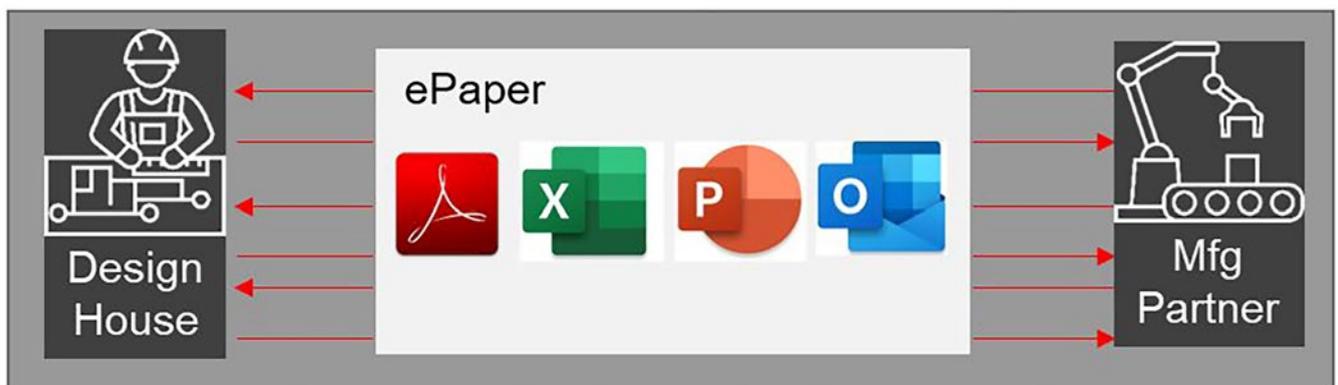


Figure 1: An illustration of the communication process.

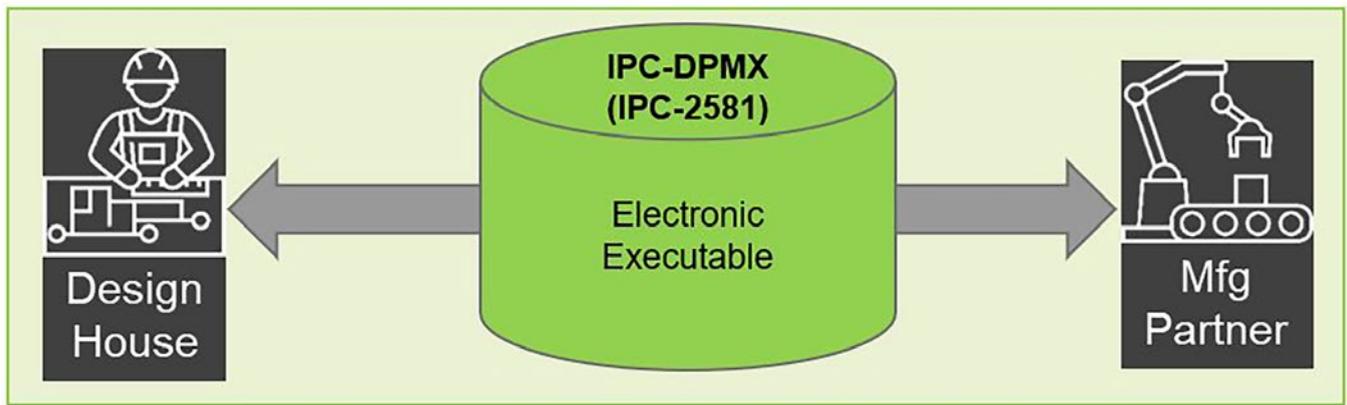


Figure 2: IPC-2581 Rev C Solution improves the DFX processing and communication by creating an open standardized format using XML with tags.

ing XML with tags. By using XML with tags for DFX, any tool vendor can document DFX issues and any other vendor can read the issues automatically by creating tools that look for and process the data associated with the tags.

The DFX part of IPC-2581 Rev C is very robust and allows for any kind of DFX issues related to components, board fabrication, board assembly, PCB stackup, PCA testing, and data quality. The standard allows for inclusion of pictures, binary images, and external references, as well as references to internal data.

Looking at the Benefits

With IPC-2581 Rev C, OEMs and vendors can now use the same open and intelligent data format to exchange complete DFX information to report build and assembly issues, ask for waivers, and get approvals or rejections for waivers. Due to the standard being open to everyone, the format of the DFX data allows all tool vendors to have a common format for exchanging all this data.

Now that IPC-2581 Rev C enables automated tools to manage DFX data, there are new opportunities for the PCB software industry to flourish with new and innovative DFX software. Such software could be used to automatically collect the incoming DFX data into a database and distribute tasks to certain job functions. Tools such as this could speed up responses to DFX issues which in turn allow

the PCBs and PCAs to be built with minimal delay.

Summary

The IPC-2581 consortium members and the IPC 2-16 committee members spent a lot of time and discussions adding a more comprehensive set of DFX capabilities in the IPC-2581 Rev C standard. The end product is a robust format that allows the PCB and PCA industry to report all DFX issues using automated tools that will benefit both OEMs and vendors. Software vendors can finally create new and innovative tools to obsolete the decades-old process of attaching spreadsheets to emails to report DFX issues and get waiver approvals. **PCB007**

IPC-2581 is a standard by the industry for the industry. To learn more about IPC-2581 revision C, follow the IPC-2581 Consortium page on LinkedIn. To get regular updates, join the IPC-2581 Consortium mailing list at www.ipc2581.com. You can join the IPC-2581 Consortium to influence the future direction of this standard.



Terry Hoffman is a technical leader in electrical engineering at Cisco Systems.

Simplify Your QMS Documentation Through **KISS**, Part 2

The Right Approach

by Steve Williams, THE RIGHT APPROACH CONSULTING

Editor's note: Read [Part 1](#), which originally appeared in the November 2020 issue of PCB007 Magazine.

Introduction

While documentation is often viewed as a necessary evil, it is a very important aspect of any quality system but needs to be functional. Part 2 details more tips and techniques to simplify and streamline your QMS documentation.

Document Control

Now called documented information, this is another area that is prone to an auditor's finding, and in most cases, results from a lack of discipline. The key concept of document control is that any document related to product

quality needs to be under document control. Examples include documents such as procedures, forms, logs, checklists, etc.

I would argue that every document in any organization is related to product quality and needs to be controlled. It is a far superior strategy to include every form, log, etc., in the document control system than to defend to a customer or auditor why the uncontrolled form they just found is not related to product quality in some way.

There are a number of key elements that need to be thoroughly understood and considered within any document control system. These elements are briefly discussed here and need to be defined in the document control procedure.

Centralized Control

Document control by committee does not work; every effort should be made to design a system in which all documentation flows through a single person/position, such as a quality analyst or QMS coordinator. Flowing down responsibility to functional departments is a disaster waiting to happen and makes the "control" part of document control very difficult to maintain. Cen-



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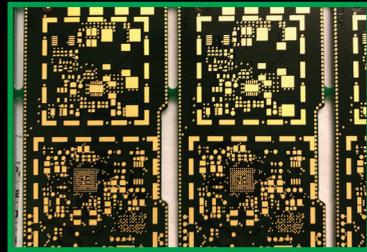


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IJR-4000 MW300



IJR-4000 FW100



tralized control also assures all documentation follows the standard format(s) that have been established and provides a control mechanism for any proposed documentation revisions.

Master File

Whether electronic or paper-based, there needs to be a master list of all documents under control along with the document name, revision, and date. A master set of current revision original documents needs to be kept in a secure, restricted location (both paper and electronic).

Controlled Document

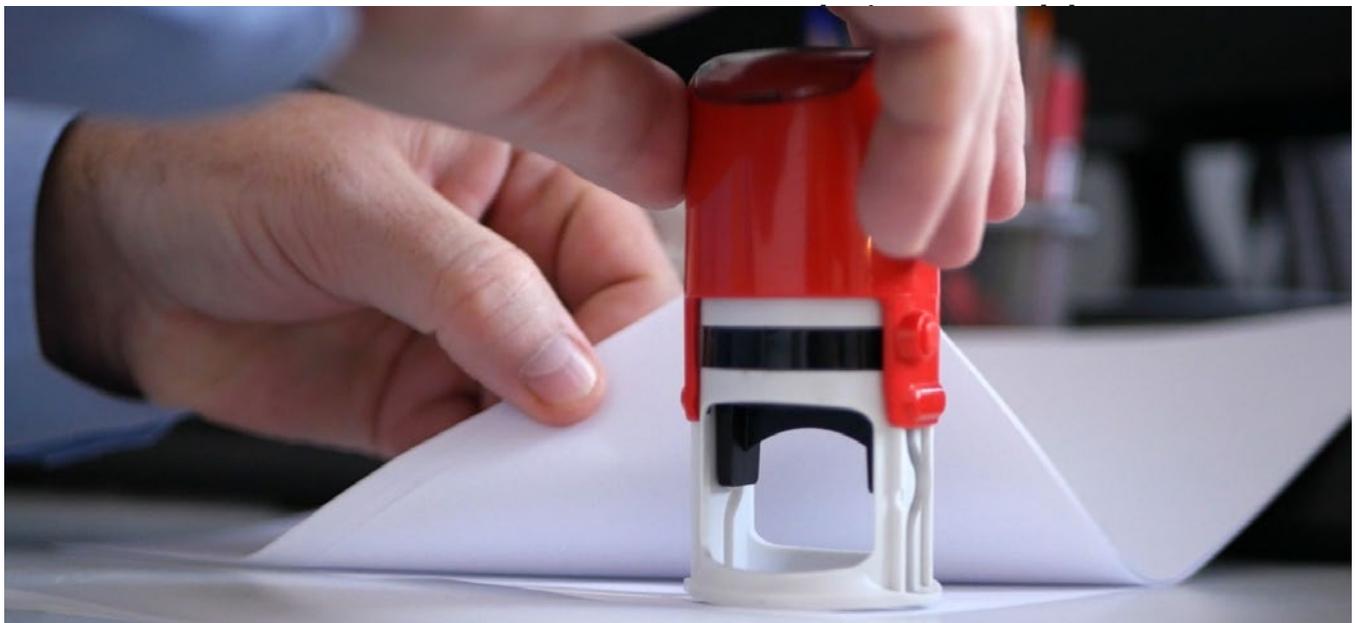
Whether paper or electronic, there needs to be a method for identifying and supplying the current revision document to the workforce that needs them. For paper systems, a colored stamp (red works well) and the words “controlled document” should be used to physically stamp the title page of all procedures when issued. The controlled documents should be posted in the area where the work is being done, and a record needs to be made noting the physical location of each controlled document that has been issued. This traceability will be needed to effectively recall all issued controlled documents when revisions change. For electronic systems, control is typically easier to manage through user read-only access

to job-specific controlled documents as long as employee terminals are available wherever the documents are needed. High-level documents, such as the quality manual and ISO specifications, need to be included in the document control system, serialized, and have limited distribution.

Uncontrolled Document

An uncontrolled copy of procedures and work instructions often needs to be printed for training or reference purposes. These will not be recalled when there is a new revision. In a paper system, these are unofficial copies that are photocopied from the masters and still need to be issued from document control and stamped “uncontrolled document” in green ink (or any contrasting color to the controlled choice) because they are primarily created for distribution outside the control of the facility.

Example verbiage that can be used to address this in the document control procedure may include: “Any customer or employee desiring a procedure to take home for review will be issued an uncontrolled copy. Uncontrolled copies are for reference only, and shall not dictate procedure.” In an electronic system, a very good way to handle this is to add a timestamp to the document footer. A date and time will print on the document with an expiration date (e.g., 24 hours), after which the document becomes obsolete.



Data Backup

The document control procedure needs to address electronic data (quality system files, customer data files, CAD files, business files, etc.) and specify not only a backup plan but also provide for redundant copies to be stored off-site for protection against a facility disaster. On-site copies should be securely stored,



such as in a locked fire-proof safe. Cloud services have become the new standard for data backup, but it is good business practices (and cheap insurance) to still have a physical copy stored offsite.

Conclusion

While documentation is often viewed as a necessary evil, it is a very important aspect of any quality system. By adopting the “if you can’t prove it, it didn’t happen” mentality and applying the practical KISS principles discussed in this two-part series, a world-class, auditor-friendly documentation system can be developed with minimum pain and suffering. **PCB007**



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

Leveraging a 3D Printer ‘Defect’ to Create a New Quasi-textile

Sometimes 3D printers mess up. They extrude too much material, or too little, or deposit material in the wrong spot. But what if this bug could be turned into a (fashionable) feature?

Introducing **DefeXtiles**, a tulle-like textile that MIT Media Lab graduate student Jack Forman developed by controlling a common 3D printing defect—the under-extrusion of polymer filament.

Forman used a standard, inexpensive 3D printer to produce sheets and complex 3D geometries with a woven-like structure based on the “glob-stretch” pattern produced by under-extrusion. Forman has printed these flexible and thin sheets into an interactive lampshade, full-sized skirts, a roll of fabric long enough to stretch across a baseball diamond, and intricately patterned lace, among other items.

“No custom software or hardware is needed—just a

relatively cheap \$250 printer, the most common type of printer,” Forman says.

Filaments to fabric

Forman’s experiments were inspired by the work of a friend who used under-extruded filament to produce vases. With his first attempts at under-extruding, “I started playing with it, bending it and even stretching it, I was like, ‘whoa, wait, this is a textile. It looks like it, feels like it, bends like it, and it prints really quickly.’”

The new textile can be sewn, de-pleated, and heat-bonded like an iron-on patch. Forman and his colleagues have printed the textiles with a conductive filament that allows a lamp to be lit and dimmed by touching pleats in the lampshade. The researchers suggest that other base materials or additives could produce textiles with magnetic or optical properties. (MIT Media Lab)





Supplier Highlights



Insulectro to Host OEM Forum 'Accelerate Development With Accurate Design Data' ▶

Insulectro, a distributor of materials for use in the printed circuit board and printed electronics industries, hosted an OEM FORUM on Thursday, November 5, at 11:05 a.m. Pacific. The topic was "Accelerate Development With Accurate Design Data."

New DuPont Kapton Polyimide Film Addresses Impact of Faster Voltage Rise on Motor Insulation ▶

DuPont Interconnect Solutions, a unit of DuPont Electronics & Imaging, announced the results of a recent research study that show Kapton® ECRC polyimide film provides an eight-fold improvement over standard polyimide films for insulating the conductors found in high-performance traction motors designed for the e-mobility market.

MacDermid Alpha Releases CircuEtch 200 Anisotropic Final Etch for SAP, mSAP ▶

MacDermid Alpha Electronics Solutions, a global leader in specialty materials for electronics, announced the release of CircuEtch 200, a high-performance anisotropic final etch for circuit formation in semi-additive and modified-semi-additive processes (SAP/mSAP) utilized in IC substrate and substrate-like HDI manufacturing.

IPS Expanding to Accommodate Growing Market ▶

I-Connect007 Publisher Barry Matties recently had the opportunity to visit IPS in their Cedar City, Utah, facility, where Mike Brask, founder and president of IPS, shared his business strategy and a tour of the expanding manufacturing facility. IPS produces a wide range of PCB

manufacturing equipment, including plating, DES, VCM, VRPs, ventilation, and spare parts for older equipment.

Exception PCB Purchases Ledia Direct Imager From Ucamco ▶

Exception PCB, one of the largest dedicated time and technology PCB manufacturers in the U.K., has purchased a Ledia Direct Imager from Ucamco with great satisfaction of all parties involved.

Elekonta Marek Opts for Solder Resist From Peters ▶

Elekonta Marek has opted for a Peters solder resist. The German manufacturer of high-tech boards counts on the advantages of the two-pack solder resist from series Elpemer 2467. As Elekonta is a prototype manufacturer for the automotive industry, the cooperation is of strategic importance to Peters.

Arlon EMD Honors Veterans ▶

Arlon EMD, a specialty electronics material manufacturer based out of Rancho Cucamonga, California, supports our military community globally and shares a sense of pride and respect for the men and women who serve.

LPKF Showcases New Virtual Showroom ▶

LPKF's new "virtual showroom" offers a fast and informative alternative to face-to-face trade shows or a visit to the company's own demo laboratory for questions related to PCB prototyping.

GETECH Launches Largest Fixtureless PCB Router Available Today ▶

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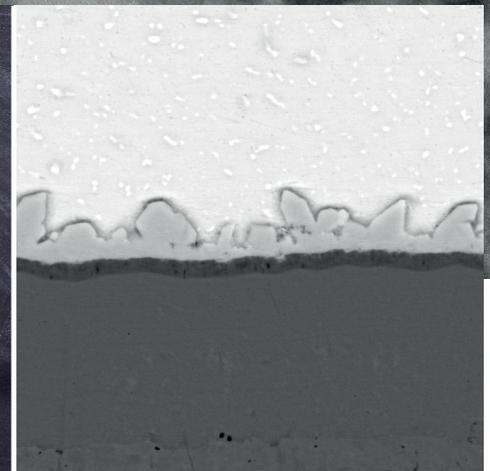
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A Process Engineer's Guide to Final Etching, Part 2

Trouble in Your Tank

by Michael Carano, RBP CHEMICAL TECHNOLOGY

Introduction

In last month's column, I presented various etching defect causes related to equipment parameters. In this month's column, I will discuss various other causes that lead to etching defects.

Surface Preparation and Photoresist Adhesion

Final etching is often one of the least understood processes where downstream root-cause defects are concerned. While it is easy to point the finger at the etching process itself, skilled troubleshooters must be wary of downstream processes and materials. Case in point is surface preparation before photoresist lamination, as well as the condition of the copper foil. Figure 1 is a schematic showing a deep depression in the copper foil.

Now, while indentations and scratches in the foil and the glass weave can negatively im-

pact resist adhesion, in a previous column I discussed the importance of surface preparation and overall cleanliness of the copper surface. If there are issues with neck downs, resist lifting, blistering, etc., it is easy to understand how etching solutions (even when under optimum process control) can seep under the lifted resist and etch the copper, creating an open. One can easily see how the depression in the copper foil surface can act as a conduit permitting etching solution to etch away copper (Figures 2 and 3).

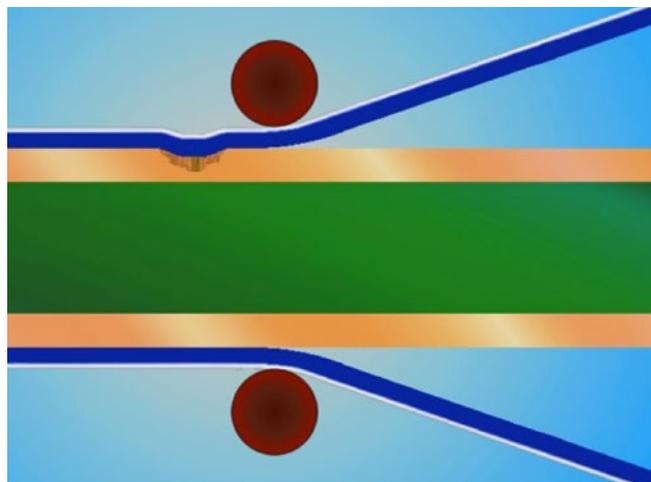


Figure 1: Hot roll lamination; depression in foil may prevent resist adhesion.

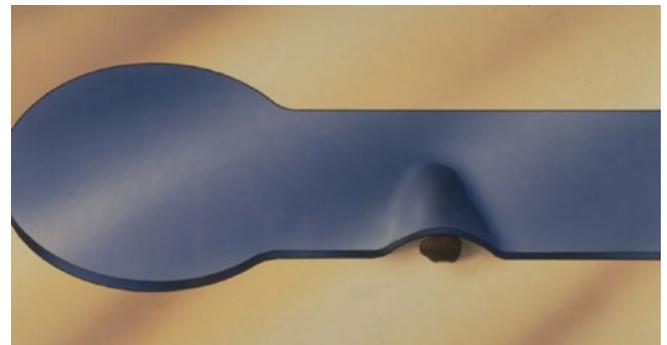


Figure 2: Depression in foil surface with possible resist adhesion issue.

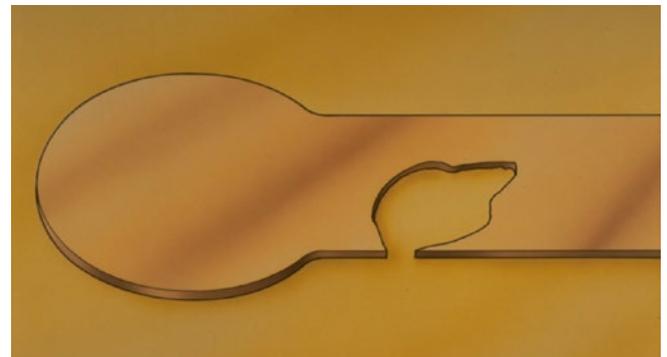
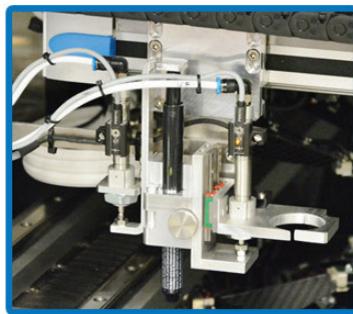


Figure 3: After etching and resist stripping, copper etched away where the resist did not adhere. (Source: IPC)

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While frustrating as this situation is, a process engineer and skilled troubleshooter can look downstream to find the root cause and take corrective actions. Case in point is the resist lamination process. Assuming one has achieved a clean copper foil surface with a reasonable degree of surface roughness, the mechanics of the resist lamination process takes center stage.

There are several critical variables in the resist lamination process that are keys to success. In hot roll lamination, heat is applied to the rolls and transferred through the polyester film coversheet and the resist to the resist/copper interface to achieve good resist-to-copper conformation and adhesion [1-2]. The rolls are heated by a variety of methods. Check with the equipment supplier in this case.

While temperature is important, pressure, as supplied by the rollers, is a significantly more important variable with respect to resist conformity. Regardless, temperature plays an important role in reducing the resist viscosity for improved flow. For the hot roll laminator, Table 1 shows what these values are.

While these parameters are critical to quality, one must not ignore the condition of the rollers that make the contact between the copper layers and resist. For optimum resist conformity, the rollers must be properly main-

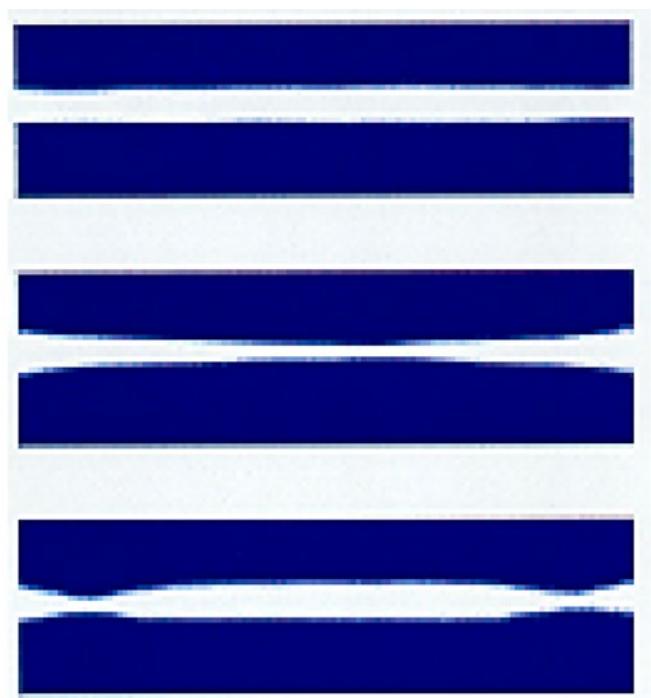


Figure 4: A schematic of the rolls (top and bottom). The top shows good condition. The middle and bottom pairs show bow and other deterioration. (Source: Tim Blair)

Automatic Cut Sheet Laminator	
Roll temperature	100–130°C (212–266°F)
Lamination speed	1.0–3.0 m/min (3.3–9.8 ft/min)
Lamination pressure	2.0–7.0 Bar (equipment dependent)
Manual Hot Roll Laminator	
Roll temperature	100–130°C (212–266°F)
Lamination speed	1.0–3.0 m/min (3.3–9.8 ft/min)
Lamination pressure	2.5–3.0 Bar

Table 1: Automatic cut sheet laminator and manual hot roll laminator.

tained and changed after so many uses. These rollers eventually can bow and receive scratches and gouges after repeated use. These conditions are deleterious and negatively impact resist adhesion (Figure 4).

As shown in Figure 4, the condition of the latter two sets of rollers requires attention. Otherwise, resist conformity and adhesion is compromised, including sporadic resist lifting, neckdowns, line width reduction, ragged traces, and opens caused by etch-outs. Note that the rollers are made of rubber. The pliability of the rubber helps to make intimate contact with the resist-to-board interface. Increased usage, time, and temperature will increase the hardness of the rubber coating, thus reducing the ability of the rolls to make intimate contact.

Finally, the actual temperature at the resist/copper interface is the key deliverable with respect to resist adhesion and conformity. This temperature depends on the contact time of the resist with the heat as supplied by the rollers, the temperature of the heat source, and the thermal mass and temperature of the board. The contact time, in turn, is a function of the lami-

nation speed and of the roll/film “footprint” in the lamination roll nip. The lamination speed is set by the hot roll rpm and diameter of the rolls, while the “footprint” (i.e., the width of the hot roll/board contact zone in the nip) is determined by the durometer and thickness of the roll material, as well as the roll pressure and the “foot” that the rollers create. **PCB007**

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1. Karl H. Dietz, “Fine Lines in High Yields, (Part XXVIII): Advances in Hot Roll Lamination of Dry Film Photoresist (Part A),” *CircuiTree Magazine*, December 1997, p. 60.

2. Karl H. Dietz, Fine Lines in High Yields, (Part XXIX): Advances in Hot Roll Lamination of Dry Film Photoresist (Part B),” *CircuiTree Magazine*, January 1998, p. 18.



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

‘What to Expect When You’re Expecting Robots’

As COVID-19 has made it necessary for people to keep their distance from each other, robots are stepping in to fill essential roles. People may be increasingly receptive to robotic help to reduce their risk of catching the virus.

As more intelligent, independent machines make their way into the public sphere, engineers Julie Shah and Laura Major are urging designers to rethink how robots fit in with society.

Shah and Major have written “What to Expect When You’re Expecting Robots: The Future of Human-Robot Collaboration,” published by Basic Books.

What we can expect, they write, is that robots of the future will no longer work for us, but with us. Shah and Major say that robots and humans will have to establish a mutual understanding.

“Part of the book is about designing robotic systems to understand the very subtle social signals that we provide to each other,” Shah says. “But equal emphasis in the book is on how we have to structure the way we live our lives, from our crosswalks to our social norms, so that robots can more effectively live in our world.”

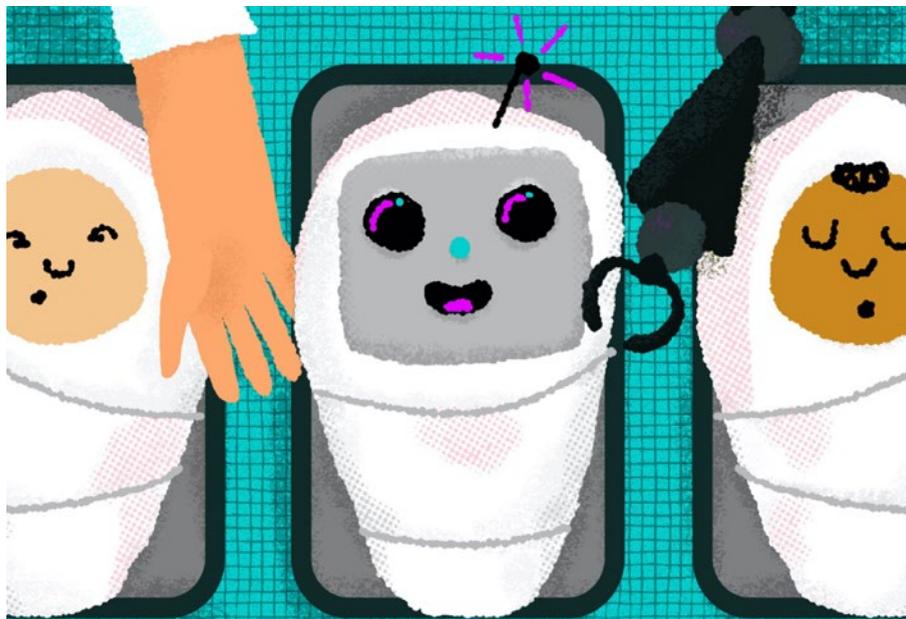
Getting to know you

As robots increasingly enter public spaces, they may do so safely if

they have a better understanding of human and social behavior.

Consider a delivery robot on a busy sidewalk: The robot may be programmed to give a standard berth to obstacles in its path. But what if the robot meets a person wheeling a stroller while balancing a cup of coffee? Could a robot read the social cues and step aside to let the stroller by?

Shah believes the answer is yes. She’s implemented tools in robots that can recognize and collaborate with humans in environments such as the factory floor and the hospital ward. She is hoping that robots trained to read social cues can more safely be deployed in more unstructured public spaces. (MIT News)





Ucamco Webinar Explores Benefits of Front-End Automation Tool

Article by Pete Starkey
I-CONNECT007

I have known the Ucamco people for over 30 years and recognise their company as an industry-leading provider of PCB CAM and pre-CAM software, as well as laser photoplotters and direct imaging systems. The team has always endeavoured to understand customer needs—often to anticipate them—and to respond with innovative solutions.

At the 2019 productronica exhibition in Munich last November, in a conversation with Ucamco managing director [Karel Tavernier](#), I learned about a new concept in front-end software: iamcam, with “iam” standing for intelligence-aided manufacturing. Later, at this year’s IPC APEX EXPO, I had the opportunity to speak with [Luc Maesen](#), director of Ucamco USA, and learn a little more about an automated workflow system using artificial intelligence on top of Ucamco’s automation engine to do the same for CAM as had been done for pre-CAM with Integr8tor software.

In the words of Tavernier, “The main goal is to take the drudgery out of CAM work. For stan-

dard boards, there’s no reason why the CAM process can’t be done completely automatically.” Maesen commented, “We don’t necessarily see it as a replacement of every CAM operator, but the vast majority of the work can be done by this fully-automated programme, which allows your experts to concentrate on the ones where you really need to pay attention because they have special requirements.”

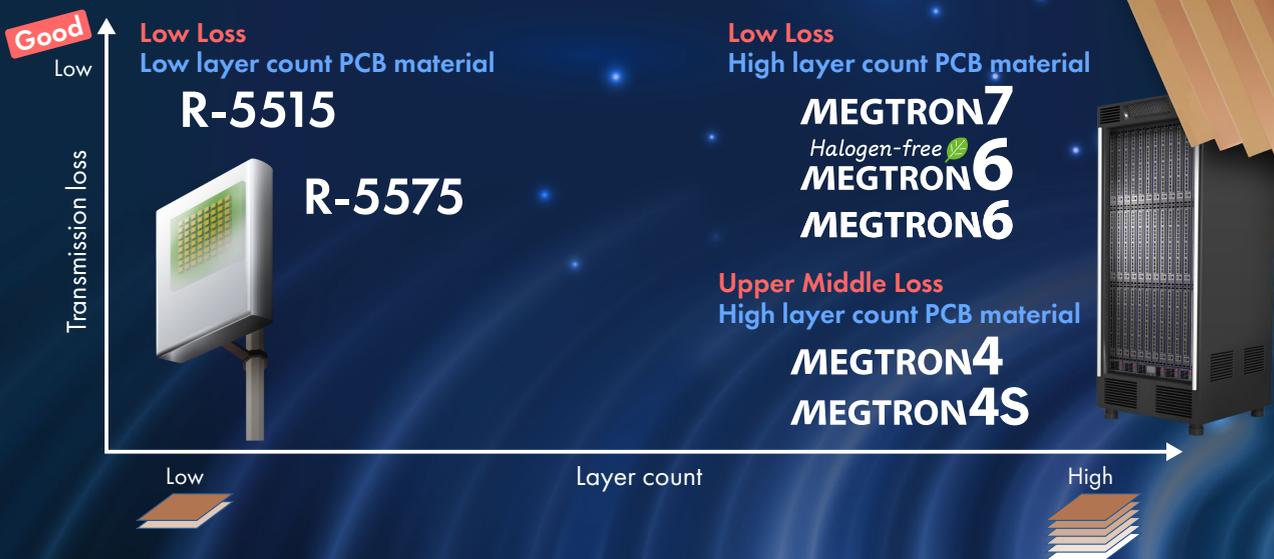
When it was announced that there would be a webinar to describe the details of iamcam, I immediately signed up. The event was professionally presented by Ucamco applications engineers. Adam Newington provided the commentary, Denis Morin drove the live demonstration, and Sylvia Liemer responded to questions from the audience.

Newington introduced iamcam as a new, automated PCB front-end workflow, designed to overcome the challenges faced daily by typical PCB fabricators of tooling-up many low-added-value standard jobs with manual CAM—expensive, time-consuming, and with potentially inconsistent quality. It offers a client/server solution for off-loading routine PCB CAM data preparation, reducing front-end process-

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R-5575	High thermal conductivity Stability under high temperature storage	3.6	0.005	
MEGTRON7	Ultra low loss laminate High layer count	3.4	0.002	12GHz Balanced-type circular disk resonator
<i>Halogen-free</i> MEGTRON6	Halogen-free type Stability under high temperature storage	3.4	0.003	
MEGTRON6	De facto standard material in industry Stability under high temperature storage	3.4	0.004	
MEGTRON4S MEGTRON4	Highly heat resistant at Reflow process Good transmission loss	3.8	0.007	10GHz IPC-TM-650 2.5.5.5

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ing time and costs, avoiding human error, and enabling higher throughput with less manpower. He set out to explain how iamcam fitted in and how it worked.

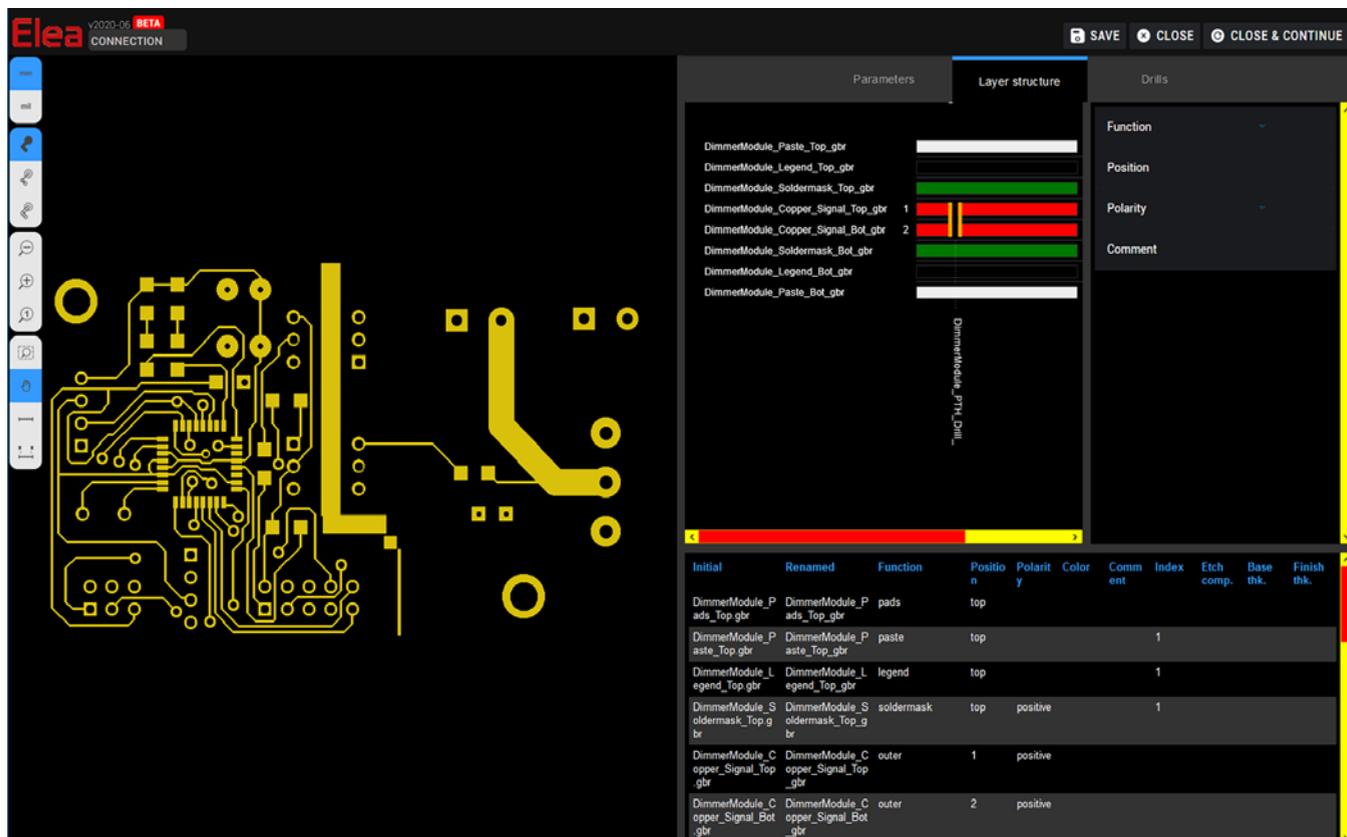
Generally, as-received data is not good enough to go straight into production without a series of checks and setting-up operations, monotonous if performed manually. The primary purpose of iamcam is to help the PCB fabricator to automate the CAM process. In the majority of cases, the iamcam workflow-based solution takes care of all those manual operations necessary to get the job into production as quickly as possible. Combining the workflow system with a web-server allows it to work in the background as an “automation engine.”

The heart of the iamcam system is a suite of artificial intelligence (AI) algorithms that examine and analyse the data, filter out good from bad, and make assessments and judgments that enable the system to output production-ready, single-image data of the required quality. Iamcam has the proven capability to run a large percentage of jobs through the front-end in a fully automatic mode.

Newington explained that the infrastructure is capable of hosting additional business processes; his example showed iamcam working side-by-side with Ucamco’s Integr8tor PCB data entry and design analysis tool within the automation engine. In his words, “We want to drop-in the data, give it a push, and then have 70% of the jobs prepared fully automatically.”

The primary purpose of Integr8tor is to extract the information needed to make an accurate quote quickly. Looking at the two tools next to each other, Integr8tor supports the pre-sales and quotation environment, providing engineering and quotation data. Now it has a working partner in iamcam. Once the order is won, and the job needs to be set up for production, it is no longer necessary to transfer the data to a CAM system; it continues its flow seamlessly within the automation engine and is prepared fully automatically.

In this example, additional information required to enable iamcam to complete its job was supplied in the form of an iamcam “ticket”—a set of instructions from an external source, such as an ERP system. The iam-



Why Choose Fein-Line?

Because there is a Fine Line between winning and the alternative.

Fein-Line Associates is a consulting group serving the global interconnect and EMS industries, as well as those needing contact with/information regarding the manufacture and assembly of Printed Circuit Boards. The principal of Fein-Line Associates, Dan (Baer) Feinberg, formally president of Morton Electronic Materials (Dynachem) is a 50+ year veteran of the printed circuit and electronic materials industries. Dan is a member of the IPC Hall of Fame; has authored over 150 columns, articles, interviews, and features that have appeared in a variety of magazines; and has spoken at numerous industry events. He covers major events, trade shows, and technology introductions and trends.

Mr. Feinberg and his associates specialize in:

- management consulting
- technology transfer
- new product market entry
- merger and acquisition due diligence
- market information and market research
- expert witness assistance and seminars regarding all aspects of printed circuits
- electronic assembly manufacturing and marketing



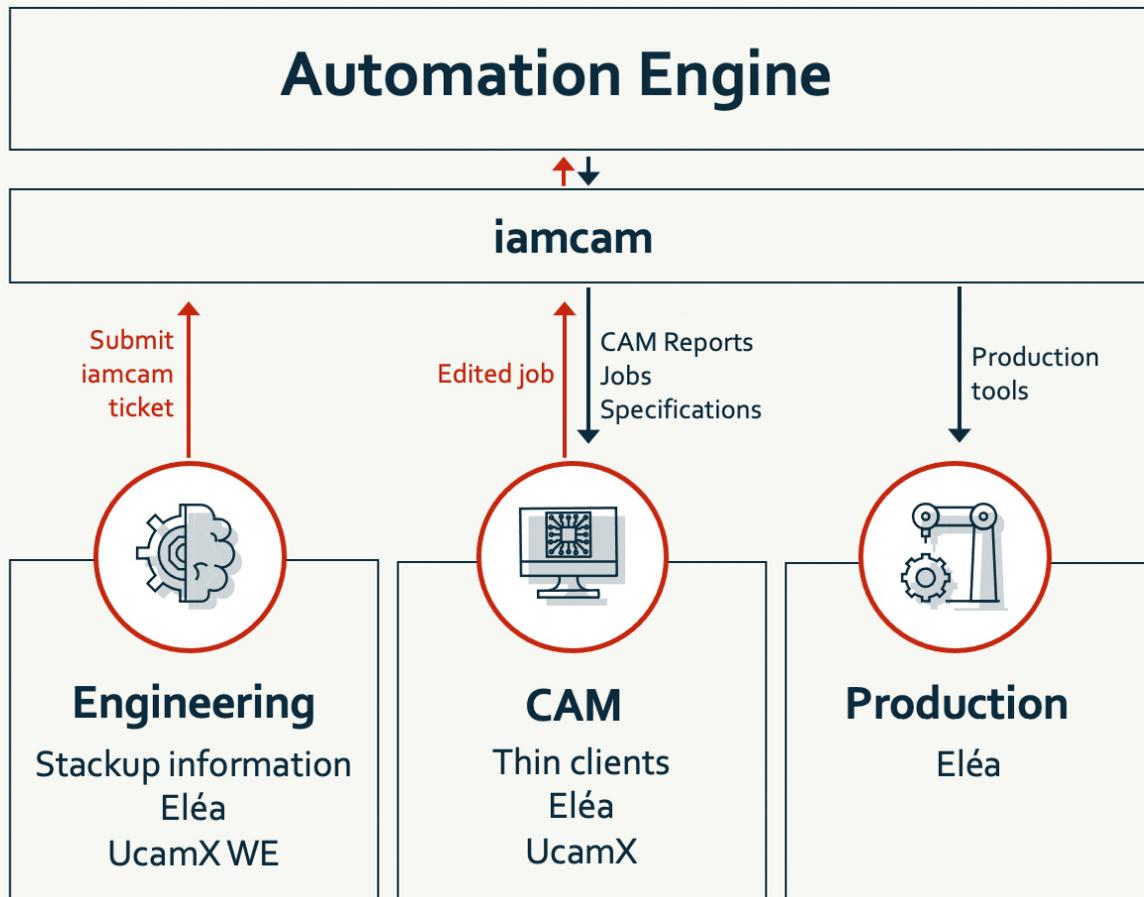
Dan (Baer) Feinberg

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P.O. Box 73355
San Clemente, CA 92673

Telephone: (949) 498-7866
Email: baer@feinonline.com



www.feinonline.com



cam ticket defined specific requirements such as minimum annular rings and clearances, depending on IPC classification, copper weights, layer count, etc. And if all the requirements were not quite reached but close, it listed the type and scale of edits that the system was approved to make without having to refer the job back to the customer.

At the time a job was launched into the iamcam process, there were several options for choosing the ticket: automatically from a library of pre-defined specifications, set by the ERP, scripted using the characteristics of the job, or added manually. Whatever might be found to be wrong or missing in the data, there were tools available to fix it.

Newington likened the situation to the crew of an aircraft carrying out a pre-flight check. The checklist made sure the data was verified and properly met the requirements before being allowed to proceed to any automatic manipulation or CAM processing. Minor problems were put on a to-do list to be fixed man-

ually using simple web-based applications and returned to the input stage of the automated workflow. Jobs shown to require serious intervention were re-routed to the regular CAM system.

Once a job had been through iamcam processing, it was subject to rigorous analysis within the system to verify that everything had been done correctly before being qualified to receive a green light, ready to go into a production panel. Red-light jobs were obviously not candidates for automatic processing. In between were jobs where, although the data had been processed correctly, they were not capable of complying exactly with the definitions on the particular ticket class that had been assigned. In such cases, it was possible to assign a ticket to a higher class and resubmit the job to the system.

All became clear when Morin demonstrated a series of real-time examples with the iamcam user interface live on-screen to illustrate in detail the features that Newington described.

And, in response to questions from the audience, Morin used the system to display the procedure and results of particular editing operations.

It was clear after watching this webinar that automation is the answer. An existing team would be able to complete more jobs on a daily basis by automating recurring, tedious, and non-value-added front-end tasks. It increases quality by reducing errors and increases efficiency and throughput by standardising processes, saving valuable time and money overall.

Considering the price tag of late deliveries, scrap, or production standing idle, iamcam is worth taking a look at. This webinar does a good job of explaining the functions and benefits of this exciting development in front-end automation. If you were unable to attend the live event, you can catch it on demand by contacting presales@ucamco.com. **PCB007**

Sponsored Links

- For more about iamcam, visit ucamco.com/en/software/cam/iamcam
- Recordings of the other webinars are available at ucamco.com/en/webinars

Related Videos

1. Pete Starkey, "Real Time with... productronica 2019: Interview with Karel Tavernier," I-Connect007.
2. Pete Starkey, "Real Time with... IPC APEX EXPO 2020: Interview with Luc Maesen," I-Connect007.



Pete Starkey is an I-Connect007 technical editor based in the U.K. with over 45 years' experience in the PCB industry. He is also a Fellow and Council Member of the ICT, an Honorary Fellow of the EIPC, and a member of the European Technical Committee of the SMTA.

BYU Partnering with NASA to Send a 'Spacecraft Selfie Cam' into Space on Official Mission

November 11, 2020

Brigham Young University students have created a cube satellite that will launch into space on an official NASA mission later this year. The 10-centimeter CubeSat is outfitted with cameras on all six sides and will make it possible to inexpensively detect damage on the exterior of a spacecraft that cannot be seen in other ways.

"It's a satellite that is designed to take pictures of another satellite," said BYU engineering professor David Long. "In other words, it's a spacecraft selfie cam."

Two versions of the BYU CubeSat will join satellites from eight other universities as part of NASA's ELaNa 20 mission

The 10 nanosatellites will be loaded into a variety of tubular dispensers and deployed by a pressurized spring once in space. The moment BYU's CubeSats are deployed, they will boot up in less than a second and start recording video. Later, antennas will be triggered, and the nano satellites will begin sending data

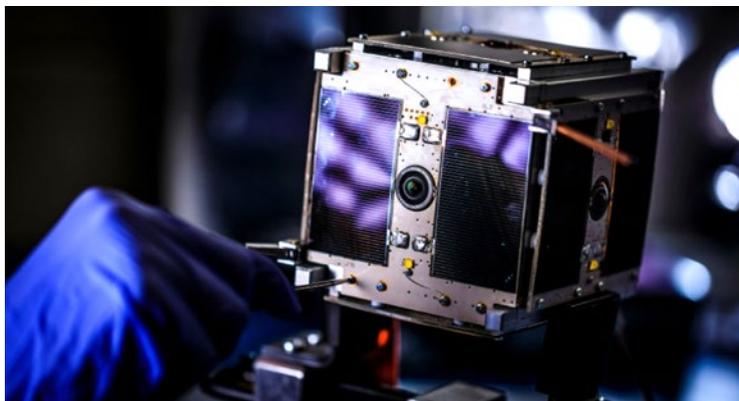
Those images and video will be transmitted back to Earth, where engineers, including those

at BYU, will be listening. It will be an impressive feat for a tiny, but intricate satellite—and a first for BYU's College of Engineering.

There is a lot of tech packed in 144 square centimeters, including six solar panels, four battery circuit boards, a radio circuit board, a computing board, and more than 25 cables. According to engineers, that's four times as many cables as a desktop computer at only a sixth of the size.

"It's pretty small, but even the simplest spacecraft can be quite complex," Long said.

(Brigham Young University)





Editor Picks from PCB007

1 PCB Technologies Focuses on an All-in-One Solution ▶

Recently, PCB Technologies reached out to us with news about their new All-In-One offering. Intrigued, we followed up and spoke with VP of Marketing and Business Development Arik Einhorn to get more details on the All-In-One services. We've included the short article and the interview here.



Arik Einhorn

3 PC Technological Advances in 2020 ▶

With CES quickly approaching, which is perhaps the largest technology event globally that is also going virtual this year, key component and sub-assembly companies are not waiting to announce their next generation of components. Dan Feinberg details new components and performance advances, as well as why you should consider building your own PC.



Dan Feinberg

2 The Government Circuit: As 2021 Nears, What's on IPC's Government Policy Radar? ▶

In the United States, Election Day 2020 has come and gone, and all signs indicate that former Vice President Joe Biden is the presumptive President-elect. It's shaping up to be a busy month here at IPC, heading into a busy new year. Chris Mitchell details some of the top issues we're following this November.



Chris Mitchell

4 Manufacturers Weigh in on Made-in-America Debate ▶

As the U.S. grapples with who will take the helm of the U.S. presidency, electronics manufacturers around the country are grappling with which policies and ideas would promote growth and innovation in the sector. Many agree that a push for "made in America" policies and incentives might be useful. Often, they point to similar initiatives used by other countries, including China and India.

5 Just Ask Joe Fjelstad: The Exclusive Compilation ▶

We asked you to send in your questions for Joe Fjelstad, and you took us up on it! We know you all enjoyed reading these questions and answers, so we've compiled all of them into one article for easy reference. We hope you enjoy having another bite at the apple. And if you'd like to hear more from Joe, view his column series "Flexible Thinking."



Joe Fjelstad

6 Survey Results: 'Are You Currently Hiring?' ▶

The I-Connect007 research team invited readers to share their thoughts on what's happening with staffing and retention to help prepare for an upcoming issue on this important topic. Here, we delve into the first question, "Are you currently hiring?"

8 The PCB Norsemen: So Much More Than Just Through Vias ▶

As most people know, component holes are still highly necessary for components that require them, and clean lead-through-holes (vias) have increased in necessity over the last 30 years. John Steinar Johnsen explains how the challenges with smaller diameter vias, perhaps depth-controlled, have increased and are, in some cases, challenging for those who produce PCBs and have to assemble and handle solder components.



John Steinar Johnsen

7 Cicor Mourns Death of Chairman Heinrich J. Essing ▶

The Board of Directors of Cicor Technologies Ltd. has the painful obligation to inform that the current Chairman Heinrich J. Essing has passed away unexpectedly.



Heinrich J. Essing

9 Advanced Circuits Offers Free PCB Design Software ▶

PCB manufacturer Advanced Circuits created PCB Artist to provide a free design solution that makes the process faster and helps customers find potential mistakes before moving onto prototyping or production.



10 Calumet Electronics Expands Manufacturing Campus ▶

Calumet Electronics Corporation is expanding its manufacturing operation to meet market demand with an addition to its existing manufacturing facility and the purchase of a neighboring historic building.



For the Latest PCB News and Information, Visit: PCB007.com

Career Opportunities



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For just \$750, your 200-word, full-column ad will appear in the "career opportunities" section of all three of our monthly magazines, reaching circuit board designers, fabricators, assemblers, OEMs, and suppliers.

In addition, your ad will be featured in at least one of our newsletters, and your posting will appear on our jobConnect007.com board, which is also promoted in every newsletter.

Potential candidates can click on your ad and submit a resume directly to the email address you provide or be directed to the URL of your choice. If you wish to continue beyond the first month, the price is the same per month.

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To get your ad into the next issue, contact:

Barb Hockaday at barb@iconnect007.com or +1 916.365.1727 (-8 GMT PST)

I-Connect007
GOOD FOR THE INDUSTRY



Career Opportunities

Now Hiring

Director of Process Engineering

A successful and growing printed circuit board manufacturer in Orange County, CA, has an opening for a director of process engineering.

Job Summary:

The director of process engineering leads all engineering activities to produce quality products and meet cost objectives. Responsible for the overall management, direction, and coordination of the engineering processes within the plant.

Duties and Responsibilities:

- Ensures that process engineering meets the business needs of the company as they relate to capabilities, processes, technologies, and capacity.
- Stays current with related manufacturing trends. Develops and enforces a culture of strong engineering discipline, including robust process definition, testing prior to production implementation, change management processes, clear manufacturing instructions, statistical process monitoring and control, proactive error proofing, etc.
- Provides guidance to process engineers in the development of process control plans and the application of advanced quality tools.
- Ensures metrics are in place to monitor performance against the goals and takes appropriate corrective actions as required. Ensures that structured problem-solving techniques are used and that adequate validation is performed for any issues being address or changes being made. Develops and validates new processes prior to incorporating them into the manufacturing operations.
- Strong communication skills to establish priorities, work schedules, allocate resources, complete required information to customers, support quality system, enforce company policies and procedures, and utilize resources to provide the greatest efficiency to meet production objectives.

Education and Experience:

- Master's degree in chemical engineering or engineering is preferred.
- 10+ years process engineering experience in an electronics manufacturing environment, including 5 years in the PCB or similar manufacturing environment.
- 7+ years of process engineering management experience, including 5 years of experience with direct responsibility for meeting production throughput and quality goals.

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Now Hiring

Process Engineering Manager

A successful and growing printed circuit board manufacturer in Orange County, CA, has an opening for a process engineering manager.

Job Summary:

The process engineering manager coordinates all engineering activities to produce quality products and meet cost objectives. Responsible for the overall management, direction, and coordination of the engineering team and leading this team to meet product requirements in support of the production plan.

Duties and Responsibilities:

- Ensures that process engineering meets the business needs of the company as they relate to capabilities, processes, technologies, and capacity.
- Stays current with related manufacturing trends. Develops and enforces a culture of strong engineering discipline, including robust process definition, testing prior to production implementation, change management processes, clear manufacturing instructions, statistical process monitoring and control, proactive error proofing, etc.
- Ensures metrics are in place to monitor performance against the goals and takes appropriate corrective actions as required. Ensures that structured problem-solving techniques are used and that adequate validation is performed for any issues being address or changes being made. Develops and validates new processes prior to incorporating into the manufacturing operations

Education and Experience:

- Bachelor's degree in chemical engineering or engineering is preferred.
- 7+ years process engineering experience in an electronics manufacturing environment, including 3 years in the PCB or similar manufacturing environment.
- 5+ years of process engineering management experience, including 3 years of experience with direct responsibility for meeting production throughput and quality goals.

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Career Opportunities



BLACKFOX

Premier Training & Certification

IPC Instructor

Longmont, CO; Phoenix, AZ;
U.S.-based remote

*Independent contractor,
possible full-time employment*

Job Description

This position is responsible for delivering effective electronics manufacturing training, including IPC Certification, to students from the electronics manufacturing industry. IPC instructors primarily train and certify operators, inspectors, engineers, and other trainers to one of six IPC Certification Programs: IPC-A-600, IPC-A-610, IPC/WHMA-A-620, IPC J-STD-001, IPC 7711/7721, and IPC-6012.

IPC instructors will conduct training at one of our public training centers or will travel directly to the customer's facility. A candidate's close proximity to Longmont, CO, or Phoenix, AZ, is a plus. Several IPC Certification Courses can be taught remotely and require no travel.

Qualifications

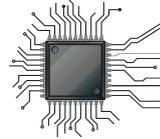
Candidates must have a minimum of five years of electronics manufacturing experience. This experience can include printed circuit board fabrication, circuit board assembly, and/or wire and cable harness assembly. Soldering experience of through-hole and/or surface-mount components is highly preferred.

Candidate must have IPC training experience, either currently or in the past. A current and valid certified IPC trainer certificate holder is highly preferred.

Applicants must have the ability to work with little to no supervision and make appropriate and professional decisions.

Send resumes to Sharon Montana-Beard at
sharonm@blackfox.com.

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MivaTek

Global

MivaTek Global: We Are Growing!

MivaTek Global is adding sales, technical support and application engineers.

Join a team that brings new imaging technologies to circuit fabrication and microelectronics. Applicants should have direct experience in direct imaging applications, complex machine repair and/or customer support for the printed circuit board or microelectronic markets.

Positions typically require regional and/or air travel. Full time and/or contractor positions are available.

Contact HR@MivaTek.Global
for additional information.

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Career Opportunities



Indium Applications Manager

Responsible for identifying market insights and developing strategies, using market intelligence, emerging technologies, and industry feedback to promote an assigned series of products/offerings to a designated market space and will collaborate with other internal functions such as product management, marketing communications, sales, technical support, production, accounting, and quality to realize established goals.

Responsibilities:

- Own Indium Corporation's brand presence in an "identified market" as assigned by the position's supervisor
- Conduct market research to determine market opportunities and to develop competitive knowledge
- Mine customers, co-suppliers, competitors, employees, researchers, trade-shows, patents, publications, etc. for opportunity insights
- Identify preliminary market strategies to develop specific offerings
- Provide training on application technologies and specific products to sales and technical personnel
- Support new product development by determining customer needs and communicating these needs to the proper technical group(s)/product managers
- Network with relevant industry players to obtain market information/facilitate partnerships
- Perform other duties or special projects as assigned

Contact: jobs.indium.com

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Our Summit Anaheim, CA, division currently has multiple open positions for planning engineers.

The planner is responsible for creating and verifying manufacturing documentation, including work instructions and shop floor travelers. Review lay-ups, details, and designs according to engineering and customer specifications through the use of computer and applications software. May specify required manufacturing machinery and test equipment based on manufacturing and/or customer requirements. Guides manufacturing process development for all products.

Responsibilities:

1. Accurately plan jobs and create shop floor travelers.
2. Create documentation packages.
3. Use company software for planning and issuing jobs.
4. Contact customers to resolve open issues.
5. Create TDR calculations.
6. Assist in the training of new planning engineers.
7. Review prints and purchase orders.
8. Create stackups and order materials per print/spec.
9. Plan jobs manufacturing process.
10. Institute new manufacturing processes and or changes.

Education/Experience:

1. High school diploma or equivalent
2. Minimum five (5) years' experience in the printed circuit board industry with three (3) years as a planning engineer.
3. Must be able to cooperate and communicate effectively with customers, management, and supervisory staff.
4. Must be proficient in rigid, flex, rigid/flex, and sequential lam designs.

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Career Opportunities



We're Hiring! Connecticut Locations

Senior Research Chemist: Waterbury, CT, USA

Research, develop, and formulate new surface treatment products for the printed circuit board, molded interconnect, IC substrate, and LED manufacturing industries. Identify, develop, and execute strategic research project activities as delegated to them by the senior research projects manager. Observe, analyze, and interpret the results from these activities and make recommendations for the direction and preferred route forward for research projects.

Quality Engineer: West Haven, CT, USA

Support the West Haven facility in ensuring that the quality management system is properly utilized and maintained while working to fulfill customer-specific requirements and fostering continuous improvement.

For a complete listing of career opportunities or to apply for one of the positions listed above, please visit us here.

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We're Hiring! Illinois / New Jersey

Technical Service Rep: Chicago, IL, USA

The technical service rep will be responsible for day-to-day engineering support for fabricators using our chemical products. The successful candidate will help our customer base take full advantage of the benefits that are available through the proper application of our chemistries.

Applications Engineer: South Plainfield, NJ, USA

As a key member of the Flexible, Formable, and Printed Electronics (FFPE) Team, the applications engineer will be responsible for developing applications know-how for product evaluation, material testing and characterization, and prototyping. In addition, this applications engineer will provide applications and technical support to global customers for the FFPE Segment.

For a complete listing of career opportunities or to apply for one of the positions listed above, please visit us here.

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Career Opportunities



SMT Operator Hatboro, PA

Manncorp, a leader in the electronics assembly industry, is looking for a **surface-mount technology (SMT) operator** to join their growing team in Hatboro, PA!

The **SMT operator** will be part of a collaborative team and operate the latest Manncorp equipment in our brand-new demonstration center.

Duties and Responsibilities:

- Set up and operate automated SMT assembly equipment
- Prepare component kits for manufacturing
- Perform visual inspection of SMT assembly
- Participate in directing the expansion and further development of our SMT capabilities
- Some mechanical assembly of lighting fixtures
- Assist Manncorp sales with customer demos

Requirements and Qualifications:

- Prior experience with SMT equipment or equivalent technical degree preferred; will consider recent graduates or those new to the industry
- Windows computer knowledge required
- Strong mechanical and electrical troubleshooting skills
- Experience programming machinery or demonstrated willingness to learn
- Positive self-starter attitude with a good work ethic
- Ability to work with minimal supervision
- Ability to lift up to 50 lbs. repetitively

We Offer:

- Competitive pay
- Medical and dental insurance
- Retirement fund matching
- Continued training as the industry develops

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SMT Field Technician Hatboro, PA

Manncorp, a leader in the electronics assembly industry, is looking for an additional SMT Field Technician to join our existing East Coast team and install and support our wide array of SMT equipment.

Duties and Responsibilities:

- Manage on-site equipment installation and customer training
- Provide post-installation service and support, including troubleshooting and diagnosing technical problems by phone, email, or on-site visit
- Assist with demonstrations of equipment to potential customers
- Build and maintain positive relationships with customers
- Participate in the ongoing development and improvement of both our machines and the customer experience we offer

Requirements and Qualifications:

- Prior experience with SMT equipment, or equivalent technical degree
- Proven strong mechanical and electrical troubleshooting skills
- Proficiency in reading and verifying electrical, pneumatic, and mechanical schematics/drawings
- Travel and overnight stays
- Ability to arrange and schedule service trips

We Offer:

- Health and dental insurance
- Retirement fund matching
- Continuing training as the industry develops

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Career Opportunities



Sales Account Manager

Sales Account Management at Lenthor Engineering is a direct sales position responsible for creating and growing a base of customers that purchase flexible and rigid flexible printed circuits. The account manager is in charge of finding customers, qualifying the customer to Lenthor Engineering and promoting Lenthor Engineering's capabilities to the customer. Leads are sometimes referred to the account manager from marketing resources including trade shows, advertising, industry referrals and website hits. Experience with military printed circuit boards (PCBs) is a definite plus.

Responsibilities

- Marketing research to identify target customers
- Identifying the person(s) responsible for purchasing flexible circuits
- Exploring the customer's needs that fit our capabilities in terms of:
 - Market and product
 - Circuit types used
 - Competitive influences
 - Philosophies and finance
 - Quoting and closing orders
 - Providing ongoing service to the customer
 - Develop long-term customer strategies to increase business

Qualifications

- 5-10 years of proven work experience
- Excellent technical skills

Salary negotiable and dependent on experience. Full range of benefits.

Lenthor Engineering, Inc. is a leader in flex and rigid-flex PWB design, fabrication and assembly with over 30 years of experience meeting and exceeding our customers' expectations.

Contact Oscar Akbar at: hr@lenthor.com

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Senior Process Engineer

Job Description

Responsible for developing and optimizing Lenthor's manufacturing processes from start up to implementation, reducing cost, improving sustainability and continuous improvement.

Position Duties

- Senior process engineer's role is to monitor process performance through tracking and enhance through continuous improvement initiatives. Process engineer implements continuous improvement programs to drive up yields.
- Participate in the evaluation of processes, new equipment, facility improvements and procedures.
- Improve process capability, yields, costs and production volume while maintaining safety and improving quality standards.
- Work with customers in developing cost-effective production processes.
- Engage suppliers in quality improvements and process control issues as required.
- Generate process control plan for manufacturing processes, and identify opportunities for capability or process improvement.
- Participate in FMEA activities as required.
- Create detailed plans for IQ, OQ, PQ and maintain validated status as required.
- Participate in existing change control mechanisms such as ECOs and PCRs.
- Perform defect reduction analysis and activities.

Qualifications

- BS degree in engineering
- 5-10 years of proven work experience
- Excellent technical skills

Salary negotiable and dependent on experience. Full range of benefits.

Lenthor Engineering, Inc. is the leader in Flex and Rigid-Flex PWB design, fabrication and assembly with over 30 years of experience meeting and exceeding our customers' expectations.

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Career Opportunities



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TRAIN. WORK SMARTER. SUCCEED.

Become a Certified IPC Master Instructor

Opportunities are available in Canada, New England, California, and Chicago. If you love teaching people, choosing the classes and times you want to work, and basically being your own boss, this may be the career for you. EPTAC Corporation is the leading provider of electronics training and IPC certification and we are looking for instructors that have a passion for working with people to develop their skills and knowledge. If you have a background in electronics manufacturing and enthusiasm for education, drop us a line or send us your resume. We would love to chat with you. Ability to travel required. IPC-7711/7721 or IPC-A-620 CIT certification a big plus.

Qualifications and skills

- A love of teaching and enthusiasm to help others learn
- Background in electronics manufacturing
- Soldering and/or electronics/cable assembly experience
- IPC certification a plus, but will certify the right candidate

Benefits

- Ability to operate from home. No required in-office schedule
- Flexible schedule. Control your own schedule
- IRA retirement matching contributions after one year of service
- Training and certifications provided and maintained by EPTAC

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APCT

Passion | Commitment | Trust

APCT, Printed Circuit Board Solutions: Opportunities Await

APCT, a leading manufacturer of printed circuit boards, has experienced rapid growth over the past year and has multiple opportunities for highly skilled individuals looking to join a progressive and growing company. APCT is always eager to speak with professionals who understand the value of hard work, quality craftsmanship, and being part of a culture that not only serves the customer but one another.

APCT currently has opportunities in Santa Clara, CA; Orange County, CA; Anaheim, CA; Wallingford, CT; and Austin, TX. Positions available range from manufacturing to quality control, sales, and finance.

We invite you to read about APCT at APCT.com and encourage you to understand our core values of passion, commitment, and trust. If you can embrace these principles and what they entail, then you may be a great match to join our team! Peruse the opportunities by clicking the link below.

Thank you, and we look forward to hearing from you soon.

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Career Opportunities



U.S. CIRCUIT

Sales Representatives (Specific Territories)

Escondido-based printed circuit fabricator U.S. Circuit is looking to hire sales representatives in the following territories:

- Florida
- Denver
- Washington
- Los Angeles

Experience:

- Candidates must have previous PCB sales experience.

Compensation:

- 7% commission

Contact Mike Fariba for more information.

mfariba@uscircuit.com

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2/3 of electronic industry companies have difficulty finding production workers.¹

VS



Upskill Your Employees with IPC Electronics Workforce Training

IPC Electronics Workforce Training helps you bridge the skills gap. Throughout 2020 IPC will launch a series of training courses curated to the needs of the electronics industry. We're working to make effective training easier for you to deliver.

[See our current course listing on IPC EDGE.](#)

Courses can be offered directly to employees or integrated into your training programs.

¹IPC. (2017). Findings on the Skills Gap in U.S. Electronics Manufacturing.



Webinar: For more information about the iamcam concept, please request the iamcam webinar video via presales@ucamco.com.

REALTIME with... IConnect007

ROUNDTABLE DISCUSSION FEATURING:



Chris Hanson
Ventec International Group



Rax Ribadia
Excello Circuits



Denis McCarthy
Ventec International Group



Pete Starkey
I-Connect007



An IMS Thermal Materials Discussion

Roundtable: "Use of IMS Thermal Materials in Multilayer Stackups for Power Applications" with Ventec International Group and Excello Circuits.

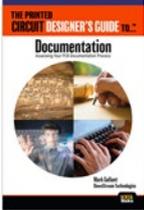
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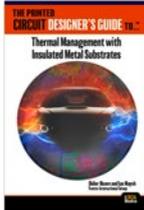
American Standard Circuits

Beat the heat in your designs through thermal management design processes. This book serves as a desk reference on the most current techniques and methods from a PCB fabricator's perspective.



Documentation, by Mark Gallant, Downstream Technologies

When the PCB layout is finished, the designer is still not quite done. The designer's intent must still be communicated to the fabricator through accurate PCB documentation.



Thermal Management with Insulated Metal Substrates, by Didier Mauve and Ian Mayoh,

Ventec International Group

Considering thermal issues in the earliest stages of the design process is critical. This book highlights the need to dissipate heat from electronic devices.



Fundamentals of RF/Microwave PCBs, by John Bushie and Anaya Vardya,

American Standard Circuits

Today's designers are challenged more than ever with the task of finding the optimal balance between cost and performance when designing radio frequency/microwave PCBs. This micro eBook provides information needed to understand the unique challenges of RF PCBs.



Flex and Rigid-Flex Fundamentals, by Anaya Vardya and David Lackey, American Standard Circuits

Flexible circuits are rapidly becoming a preferred interconnection technology for electronic products. By their intrinsic nature, FPCBs require a good deal more understanding and planning than their rigid PCB counterparts to be assured of first-pass success.

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