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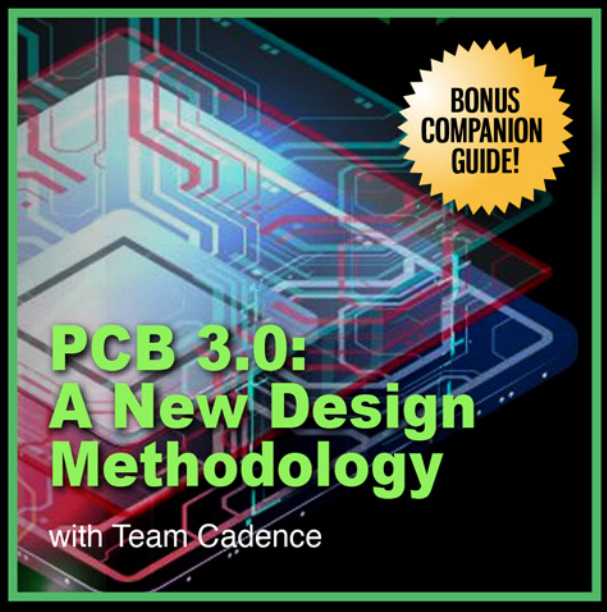
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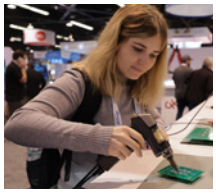
It's Show Time!

It's the 25th anniversary of IPC APEX EXPO, our industry's largest global trade show dedicated to the PCB supply chain. The show begins March 15 in Anaheim with the theme "Reimagine the Possibilities," which feels apt on this 25-year milestone. Join us as we preview all the highlights from this year's show.

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It's Show Time!

Marcy's Musings

by Marcy LaRont, I-CONNECT007



It's hard to believe another year has gone by and it is time, once again, for IPC APEX EXPO. This year marks the 25th anniversary of this iconic show for the electronics industry and, in addition to all the usual suspects, there are some special things in store to celebrate this milestone. Last year, IPC themed the event, "What's Next is Now." This year's theme, "Reimagine the Possibilities," feels like a wholly appropriate follow-on.

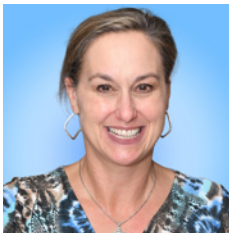
This month's issue of *PCB007 Magazine* kicks off with Dr. John W. Mitchell, IPC President and CEO, taking us through the meaning of the theme and providing a glimpse of what's in store for attendees. Also inside this issue, we share information on this year's impressive keynote speakers, something not to be missed.

In my article, "Breaking Down the IPC APEX EXPO Experience," I look at the show through the lens of its various elements with recommendations on how you can get the most out of your show experience. To help you even further, columnist Dan Beaulieu provides thorough tutelage for exhibitors on maximizing the significant investment of having a booth at a major show. On the lighter side, columnist Don Ball gives us a hilarious recounting of some of his most memorable trade show experiences over the years.

On the program side, Udo Welzel and Stanton (Stan) Rak, chairs of the Technical Program Committee, share insights into this year's Technical Conference, as well as information on the two special sessions on advanced packaging. Teresa Rowe, IPC senior director of assembly and standards technology, talks about why standards committee work is so important and rewarding. Thomas Marktscheffel discusses standards work specifically for Factory of the Future, explaining the various elements from a standards perspective. Kelly Scanlon, IPC's lead sustainability strategist, gives a thorough year-in-review on sustainability, and previews what's next for IPC in this important area. Finally, we highlight the IPC Emerging Engineer program with a spotlight on Hannah Grace and Paige Fiet, two alumni of the program now working in the industry.

Dan Feinberg continues his special series on IPC Hall of Famers, this month acknowledging Denny Fritz. PCBAA chair Shane Whiteside continues his discussion on how our business sector must deal with the current environment in Washington, D.C., staying laser-focused on our goals for U.S. PCB fabricators. And we have some fun infographics this month looking back at 25 years, which I know you will enjoy.

When you say it out loud, 25 years sounds like a long time, but in many ways feels like the blink of an eye. Yet, what has been accomplished, the arc of technology over these past two and a half decades, has had an impact that is nothing less than epic. Look for these trends to continue. So, let's begin to "Reimagine the Possibilities" and learn more about IPC APEX EXPO 2025: What you have to look forward to, and what you don't want to miss. **PCB007**



Marcy LaRont is the editor of *PCB007 Magazine*. Marcy started her career in PCBs in 1993 and brings a wide array of business experience and perspective to I-Connect007. To contact Marcy, click here.

Rice Computer Scientists Develop Solutions for Making AI Models More Efficient and Customizable

Artificial intelligence (AI) is everywhere, from the chatbots we consult for customer support to tools predicting how diseases might spread. But the computing power and energy required to power modern AI models—such as large language models (LLMs)—can make them expensive, inaccessible, and environmentally taxing. A team of researchers at Rice University is working on solutions to change that.

"Generative artificial intelligence is still in its infancy when it comes to broader integration," said Anshumali Shrivastava, associate professor of computer science, electrical and computer engineering and statistics and member of Rice's Ken Kennedy Institute.

Shrivastava and several members of his research group presented three of their most recent advancements in tweaking LLMs to better suit users' needs at the latest convening of the flagship AI conference Neural Information Processing Systems, or NeurIPS, in Vancouver, British Columbia, last December. The three papers develop superior alternatives to popular strategies such as low rank approximations and standard quantizations, showcasing the impact potential and creativity of AI research at Rice.

One of the Rice team's papers presented at NeurIPS explores a concept Shrivastava calls "parameter sharing," introducing Sketch Structured Transforms (SS1) — a method for handling the vast tables of numbers, called weight matrices or working memory, that AI models rely on to make predictions and decisions. For example, when applied to popular LLMs, the SS1 technique sped up processing times by over 11% without requiring additional fine-tuning. Shrivastava's team has developed an algorithm that allows LLMs to run efficiently on standard computer processors (CPUs) instead of GPUs.

In a third paper, the team introduced "coupled quantization," a method for compressing this memory without losing the quality of the model's responses.

Shrivastava's work reflects a broader vision for the future of AI, one where advanced AI is available to everyone, not just tech giants.
Source: Rice University



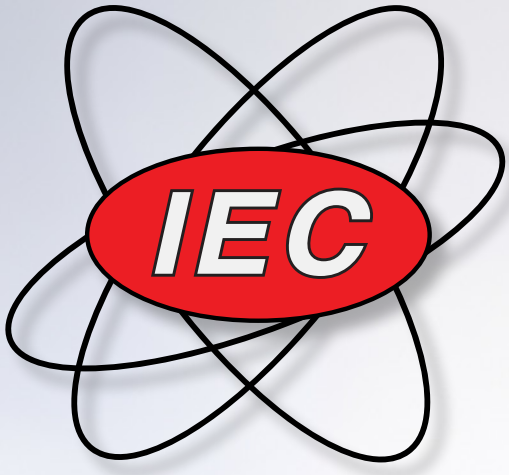
Imagine the Possibilities: Tech Conference 2025

Interview by Marcy LaRont

As we approach the 25th anniversary of IPC APEX EXPO, excitement buzzes around the annual Technical Conference. Coming off a tremendously successful program in 2024—co-hosted with ECWC16 and with a significant global presence—organizers wanted to match that same level of engagement. In this interview, Stan Rak of SF Rak Company and Udo Welzel of Robert Bosch Mobility Electronics, co-chairs of the Technical Program Committee (TPC), highlight efforts of the volunteer committee to bring another quality technical program to life.

Marcy LaRont: We're coming off a highly successful program in 2024. How has the TPC worked together this year and how are submissions of technical papers and posters for this year's conference?

Stan Rak: I am happy to say we are well represented again this year with TPC members from seven countries and across all different industries. We have 25 members on the TPC, including Udo and myself, which nicely corresponds to the 25th anniversary of the conference. We have some additional expertise from the component manufacturing industry, rep-



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resentatives from Intel and NXP in the semiconductor space, and an EMS company, Flextronics, in the mix this year.

We added Palash Vyas, a recent PhD graduate from Auburn University who co-authored the Best Poster in the 2024 Technical Conference. He works in the automotive electronics industry now. We know he has a good connection with academia, and he was excited to be involved. We also have a returning member, Dr. Laura Cohen of Continental, who has valuable expertise in automotive, aerospace, and energy systems.

Have you been receiving a steady flow of papers?

Welzel: It is a similar situation to most years: There is always a period of concern because most contributions tend to come in toward the end of the deadline, but this time, we were very positively surprised. We had anticipated some negative headwinds due to the overall slowing economy in several different countries and that it would cause submissions to be low, but we had about 100 abstract submissions, which is very good. Not all of them made it through, which is part of the normal reviewing process. Julia Flynn, Stan, and myself, as well as our IPC colleagues, were positively surprised when we had the final count.

Are you doing peer review right now?

Welzel: Yes, the ball is now back with the authors of the technical papers and with the IPC office. From my perspective, the process has been very smooth. I appreciate the collaboration with the TPC members and their quick reactions and adherence to the deadlines. It is a well-organized process. I want to specifically thank the IPC staff. Julia Flynn did a great job.

This success comes in part from an online tool we are using. It's part of our continuous improvement activity. We would like to improve from year to year, not only in terms of technical content but also in organizational structure and processes. I really appreciate the tool's availability and ease of use, and I think that this positive sentiment is shared by the entire TPC.

The review process is made easy and streamlined with drop-down menus, facilitating the review process to be done very efficiently.

When do you expect to have the final outline for the technical sessions?

Welzel: Our target is to have the proceedings available at the time of the conference rather than 30 days later, which has been typical in previous cycles. Adopting this target has resulted in some compression of the timeline, putting rather short cycles on the different stakeholders. But the goal is to have the proceedings ready at show time because we all agree that it has the highest value for attendees.

Rak: Also, the cycle is compressed because IPC APEX EXPO 2025 is a month earlier this

year. We went from having about a 13-month cycle to about 11 months. We were challenged by Matt Kelly, IPC CTO and VP of technology solutions, to have the proceedings ready in time for the conference, so we've really been driving toward that milestone. Papers were finalized on January 8, with slide presentations done by February 17. All the tracks, sessions, and posters were finalized and back to IPC by the end of January.

Are the posters mostly from students?

Rak: Not particularly, but we did have a number of students who contributed posters this year. Of the 21 that were received, 11 were from students, and we're very excited about that. We have four students who submitted to the full paper conference as well.

What is the primary difference between papers and posters? Is it just in the presentation?

Rak: Papers are typically six to 20 pages, and are expected to be a very technical description of work, complete with data analysis and citations. They are peer-reviewed very closely by the TPC. Papers that make it through will be in the proceedings, and are a permanent record that can be referred to by standards committees that need to use published work as a good foundation for introducing new requirements into standards.

Posters are more like an "announcement of potential," where we have some exciting new results but we don't have a complete story yet. It's not a complete body of work that could influence a standard or the direction of the industry, but it's still worth passing along and potentially building on later.

What are the categories of the technical topics?

Rak: They are divided into 14 categories: Additively Manufactured Electronics and Plastronics; Assembly Processes and Testing; Design for High Speed, High Bandwidth and Reliability; Factory of the Future; High-Density Substrates; High-Frequency 5G and 6G Applications; Novel Thermal Interface Materials; PCB Fabrication and Materials; Power Electronics; Protective Coatings; Quality and Reliability;



Udo Welzel (center) at IPC APEX EXPO 2024 judging a technical poster.

Solder Processes and Reliability; Soldering Materials and Process Technologies; and Sustainability for Electronics. There are also Special Sessions focusing on Advanced Packaging for High-Performance Computing and AI/Data Center Applications and Advanced Packaging for EV Power Electronics.

Are the submissions well divided among these topics, or are they bunched up in a particular focus area?

Rak: Traditionally, the IPC APEX EXPO conference has been very strong in PCB fabrication and materials, quality and reliability, and test processes in assembly. They are the legacy areas for IPC APEX EXPO. In recent years, we've added Factory the Future and have received, I believe, 99 contributions. We also have seven contributions in the category of Emerging Technologies. Advanced Packaging is actually a new category and, as you mentioned, it is a very important focus and an IPC core initiative. We specifically added that this year.

> "The traditional, strong focus of IPC APEX EXPO on PCBs and materials has provided a strong foundation for where we are now: focusing on HDI, ultra HDI, and substrates."

Did you get many submissions for advanced packaging?

Rak: It is our first year in this area, so we did not get very many—only two directly about advanced packaging and some others related to that category, but their primary focus was in one of the other technology focus areas. We weren't surprised, and it's one of the reasons for scheduling special sessions related to advanced packaging. This is where we can introduce IPC membership and the conference attendees to these newer technology focus areas. We are laying the groundwork to grow those areas.

Welzel: We also addressed this by adding new members to the TPC. Our colleagues from Intel and NXP offer the expertise we need to cover these topics, which are somewhat new to both the TPC and the greater IPC APEX EXPO community. Though there were only a few technical contributions, they will build a bridge to the special sessions, and are quite in line with IPC's philosophy that we must build a bridge from silicon to systems.

IPC APEX EXPO is the biggest electronics show and conference for our industry in the United States. What is available for the PCB fabricator attending the conference?

Welzel: The traditional, strong focus of IPC APEX EXPO on PCBs and materials has provided a strong foundation for where we are now: focusing on HDI, ultra HDI, and substrates. The High-Density Substrates track has received a considerable number of contributions. It is the logical extension of the well-established PCB fabrication and materials track. To some degree, the boundary is not always so well defined. It's a bit debatable whether a particular technical paper falls into one or the other category, and whether it's material-related.

Let's talk about power, which is a big discussion point for PCB designers. Given AI, big data processing, and EV, the increasing need for power while simultaneously managing heat dissipation and meeting signal integrity needs presents challenges for today's PCB and system designer, as well as the fabricator.

Welzel: The HDI substrates track will link nicely to the first Advanced Packaging special sessions addressing high-performance computing and AI data center applications. The Power Electronics technical session nicely links to the second Advanced Packaging special session focused on EV power electronics,

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which is one prime use case in the power electronics segment.

We are driving this extension, building on what Stan called the legacy, established conference topics. They are on the agenda, but we are also expanding them into these new fields. That's the way I see it.

Rak: With power electronics and automotive-related harsh environments, we were originally thinking we would just have two sessions in the regular conference, not special sessions. However, the submissions we received for the regular conference were clearly related to power electronics and automotive electronics in harsh environments. Seeing the interest, the TPC responded by putting more emphasis on that area with one of the special sessions.

Speaking to that decision, what stands out in this year's conference for attendees around automotive and EV?

Rak: Advanced packaging and power electronics are not specific just to EV. There are other industries, too, but we will highlight EV, and we're planning four subject matter expert panelists to cover key areas like design, materials and assembly processes, reliability in failure modes, and high voltage testing at the module and subsystem level. This is a key highlight that we are bringing to the conference as far as automotive is concerned.

How about submissions related to sustainability?

Welzel: We have two avenues for sustainability. There are papers with a prime focus on sustainability, which are placed in the Sustainability for Electronics track, and then there are papers that will not end up in this track but are somewhat sustainability-related. For example, a submission on electronic assembly materials may contain a sustainability aspect in the discussion. This will also be highlighted in the conference program. So, there are two ways of looking at sustainability in that sense. It is definitely an area that will see much future growth.

Rak: It was somewhat surprising that about 30% of the submissions had some tie into sustainability. We will flag those contributions in the proceedings that impact sustainability, even if not directly.

When talking about sustainability, keep in mind that by enhancing the durability or reliability of your product and making it last longer, you are also enhancing sustainability by preventing the need to discard and replace parts. Attendees must look at all these topics more holistically to get the most from what the technical conference can offer them.

How can registrants get the most out of attending the technical conference and special sessions?

Welzel: Embrace the many different topics being covered so that you can get a real snapshot of the newest technical developments in the industry and different fields in just a couple of days. It is time very well spent, and that's what I'm always excited about.

Rak: Don't forget about the professional development courses as well. We have 31 courses planned that track to the same focus areas, which track largely to many of the paper presentations. Though IPC is making the decisions on which courses to provide, they ask us to weigh in based on what we are seeing in the paper abstracts. So, if you're just registering for the technical conference, I would strongly encourage you to also look at what professional development courses are being offered. Attendees get maximum benefit from this conference when they take advantage of multiple offerings, not just one thing.

Usually, the timing of the courses is not in direct conflict with the paper presentations. The courses begin on Sunday and the technical conference is Tuesday through Thursday, with the special sessions being on Thursday. That is by design so people can optimize their opportunities at the conference.



Welzel: When you have a break, I encourage you to visit one of the task group meetings for standards development. That's also an activity that you should not ignore. It's a good chance to broaden your professional network and contact other subject matter experts.

LaRont: Udo, why do you encourage attendees to visit a committee meeting?

Welzel: You have a powerful network of subject matter experts, and you can contribute to the industry's overall advancement. It's a very rewarding activity.

So, I absolutely encourage everyone to become active in standards development. Standards are crucial for improving quality, fostering innovation, and reducing time to market. I've been involved in this for many years, and you can be, too. I'm always looking forward to these meetings because there's a lot to learn during them.

Rak: It is valuable for your professional growth and your company. These volunteers are helping to shape future standards that we will all live by. The company may want to play a role in that or at least know what's heading their way.

Welzel: Don't see standards as constraints or things that hinder innovation. It is the opposite; they foster innovation. They make innovation accessible to the wider market.

To conclude, I want to mention the outstanding commitment of the entire Technical Program Committee and the IPC staff. They are very efficient teams, easy to work with, organized, and the TPC is all volunteer.

Thank you so much for your service to the industry and your involvement in IPC. It's always a pleasure talking to you both.

Welzel: Indeed, thanks for spreading the word.

Rak: Thank you. **PCB007**

IPC APEX EXPO 2025 Marks a Special Anniversary Year for the Show

One World, One Industry

Feature Column by Dr. John Mitchell, IPC PRESIDENT AND CEO



This year marks the 25th anniversary of IPC APEX EXPO and IPC is thrilled to celebrate this event milestone with attendees, exhibitors, and presenters. Their dedication to and involvement in IPC APEX EXPO is directly responsible for its success and their efforts clearly illustrate how the entire electronics manufacturing industry comes together to "Reimagine the Possibilities of Electronics" (our theme for this year). This is the place to be to create new business relationships and opportunities and to enjoy this vibrant, ever-evolving industry.

Not only are we celebrating 25 years of a successful trade show, but for the past two decades, the Trade Show News Network (TSNN) has recognized IPC APEX EXPO as a top U.S. trade show. It's a tremendous accomplishment for IPC, and we are very proud of the recognition. For the past several years, IPC APEX EXPO has experienced both attendance and net-square-footage growth. Last year, the show welcomed more than 7,200 professionals from 57 countries. We're looking forward to an even larger crowd this year.

Here's what's new in 2025:

- **Learning Lounge:** The Learning Lounge is a new area on the show floor and is geared toward adding value to the attendee experience. These free sessions provide curated content covering the many facets

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of the electronics industry. Sessions will include topics presented by subject matter industry experts: developing effective training; building regional workforce ecosystems; the reliability and limitations of using vintage IPC test methods (such as ROSE) in the context of new and emerging technologies; PCB design, fabrication, assembly, and manufacturing; and mathematical calculations and considerations necessary to achieve a 75% hole fill in electronic components.

- **Special conference sessions:** Two special conference sessions will be offered on Thursday, March 20. "Advanced Packaging for High Performance Computing and AI/Data Center Applications" will be offered in the morning and will include insights into next-generation packaging solutions for high performance computing. In the afternoon, "Advanced Packaging for EV Power Electronics" will explore innovative design methodologies that enhance reliability under extreme conditions, alongside advancements in materials science that improve durability and performance.
- **Three keynotes to educate and entertain:** From AI, automation, digital transformation and the impact of 3D integration on system performance and assembly to electronics as a resource transforming the global economy, our keynote presentations will inspire their audiences to think deeply and leave with fresh insights ready to implement.

Here are just a few additional highlights of the IPC APEX EXPO 2025 experience:

- View cutting-edge products and services in the **New Products Corridor** and get a sneak preview of tomorrow's equipment, materials, and services that are breaking new ground in our industry.
- Find out what more than 400 of the industry's top innovators and suppliers have to offer on the **show floor.**
- Participate in our **Technical Conference** to discover the latest research and studies in the areas of design, board fabrication, and electronics assembly.
- Attend **standards development committee meetings**: Your input is critical to the development of IPC standards.
- Offering something for everyone, from informative classes for engineers ready to level up in their careers to advanced classes, this year's **Professional Development Courses** will help you build your knowledge and enrich your career.
- Take in a multitude of **networking activities**, from the newcomer's reception and ribbon-cutting ceremony to the ice cream social on the show floor.

This year, you'll be inspired to take the ideas and innovations you encounter onsite and turn them into real-world solutions and business opportunities. Your attendance is an investment in your company's future success. We're looking forward to seeing you at IPC APEX EXPO 2025. **PCB007**



Dr. John W. Mitchell is president and CEO of IPC. To read past columns, click here.

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Breaking Down the IPC APEX EXPO Experience

Feature Article by Marcy LaRont
I-CONNECT007

Attending IPC APEX EXPO is a fantastic opportunity to enhance your knowledge and network within the electronics manufacturing industry. To maximize your trade show experience, it's essential to approach the event with a clear plan and purpose. Here are some tips for how you can maximize your experience this year, navigate APEX EXPO effectively, select informative technical and professional development sessions, and engage with exhibitors to make meaningful connections and get the information you need. Whether you're a first-timer or a seasoned visitor, these tips will help you make the most of your experience.

Exhibitors

For many of us, the exhibitors on the show floor are likely the single most important aspect of this show, but this is a big show, so make the most of your time and energy. Make a plan. Study the exhibitor list. Make appointments in advance. Check for scheduled special events and product demos in vendor booths. If you are planning drinks or dinner with a customer, get reservations early.

Technical Program, Special Sessions, and Professional Development

Though the show floor may be the "main event" of IPC APEX EXPO, my favorite place to be is in the technical and special sessions and professional development courses. I happen to be a philomath (Greek term that means "lover of learning"). But my personal inclination toward continuing education notwithstanding, there is no better way to supercharge your career than through the technical learning opportunities offered at the show.



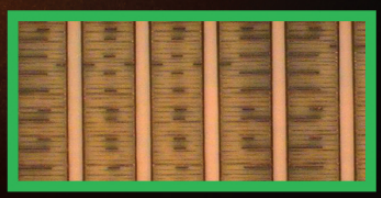
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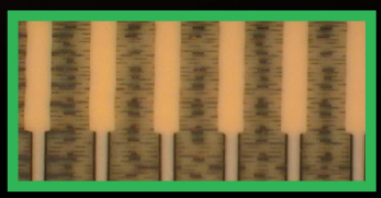
- Excellent Filling Characteristics for Large Holes
- 100% Solids, Low Shrinkage



THP-100 DX1 VF (HV)

THP-100 DX1 HTG

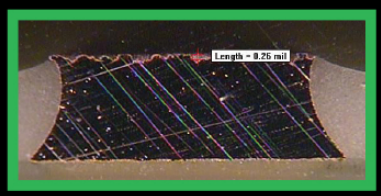
- Highest TG (173°C) Available on the Market
- Low CTE (19/55)



THP-100 DX1 (HTG)

THP-100 DX1 (GF) GAP FILLING MATERIAL

- Low Warpage
- Easy to Process



THP-100 DX1 (GF)

THP-100 (NEW VERSION)

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- Low CTE for Better Back Drilling

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The technical topics are divided into 11 categories:

- Advanced packaging components
- Assembly and test
- Design
- Electronic assembly materials
- Emerging technologies
- Factory of the Future
- HDI, UHDI, and substrates
- PCB fabrication and materials
- Power electronics
- Quality and reliability
- Sustainability for electronics

The professional development courses are coordinated with these tracks either as a main or subsidiary topic, and the Special Sessions are focused on advanced packaging for high computing and AI data center applications and for electric vehicles (EV).

On first view, the PCB fabricator may feel a little left out. But fear not, as never have the technical lines been more blurred than they are today. I promise that PCB fabricators will find relevant information in many of these presentations. This is the exciting stuff; it's the what and the how of electronics manufacturing today and in the future. Do yourself a favor and take some time to see what's here for you and your organization and plan accordingly.

Keynote Speakers

The keynote speaker presentations are available to all attendees. Make sure to take advantage of this benefit and get some inspiration and encouragement during your trade show experience. There are three keynote speakers this year. The event kicks off with Kevin Surace, a futurist, visionary, and inventor of disruptive innovation and generative AI. His presentation is titled, "AI, Automation, and the Digital Transformation." This will be followed up on Wednesday with Dr. Ahmad Bahai, senior VP and CTO of Texas Instruments, and a luncheon presentation by IPC CEO Dr. John W. Mitchell. I highly recommend. You won't be disappointed. *Turn to page 76 for an overview of the keynote presentations.*

Networking Opportunities

Meeting other professionals is part of every good trade show experience. I want to highlight two specific events: the Newcomers Welcome Reception and the Women in Electronics Reception. While the Newcomers Welcome Reception is specifically for first-timers, the Women in Electronics Reception is for all attendees. The keynote speaker is Jody Urquhart.

In addition, there are several show floor events, including a ribbon cutting, show floor reception, networking with poster presenters, and an ice cream social.

Standards Development Committee Meetings

Last but definitely not least, IPC's amazing work on industry manufacturing standards drives innovation and progress. As technology becomes more challenging to build, standards become even more essential to industry success. Volunteer work on committees allows you to give back to the industry in an impactful way. There is nothing like the camaraderie and sense of accomplishment from committee work. This is your opportunity to visit a standards committee meeting to see if it might be the right opportunity for you. All are welcome to visit and there is no obligation other than to observe. We highly recommend it. **PCB007**

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- Get ideas for improving efficiencies back at the office
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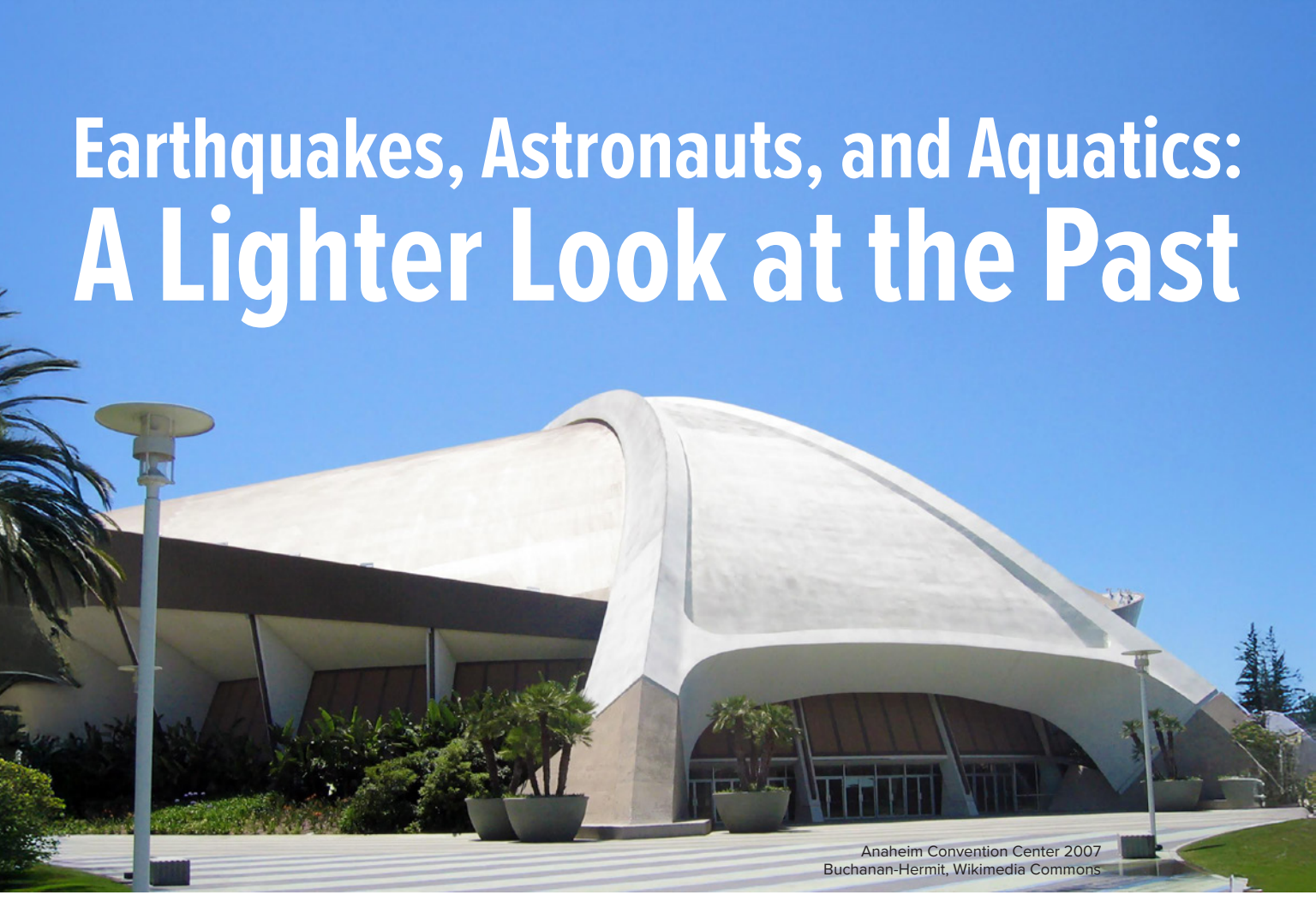
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Earthquakes, Astronauts, and Aquatics: A Lighter Look at the Past



Anaheim Convention Center 2007
Buchanan-Hermit, Wikimedia Commons

The Chemical Connection

Feature Column by Don Ball, CHEMCUT

IPC will host its 25th IPC APEX EXPO with the theme "Reimagine the Possibilities," in Anaheim, California, next month. It will also mark the 68th anniversary of IPC's founding. This year's event brings up many memories of IPC APEX EXPO's past and former National Electronics Packaging Conferences (NEPCONs). In this column, I would like to share some of the lighter moments from my almost 50 years of exposition experiences—especially those in Anaheim.

The first thing that always comes to mind when reminiscing on past show experiences is an earthquake that occurred in the late 1980s at NEPCON West. There was a low rumbling sound, and the sets, lights, and hanging displays swayed alarmingly. I wondered if I could squeeze under the sturdy, titanium black oxide module we had on display in our booth. This certainly doesn't qualify as a lighter moment but some of the reactions to it were. When the shaking stopped, our West Coast salesperson pointed to the northeast and declared it was a magnitude 2.8 quake with the epicenter near Barstow. He turned out to be almost spot on. I thought if earthquakes were so frequent that people could develop the ability to pinpoint their epicenters, there was no way I would ever live in California. Our Italian rep was so traumatized he spent the next two nights sleeping in his rental car in the open parking lot.

At IPC APEX EXPO 2007, where we celebrated IPC's 50th anniversary, our booth was directly across from IPC, where they were

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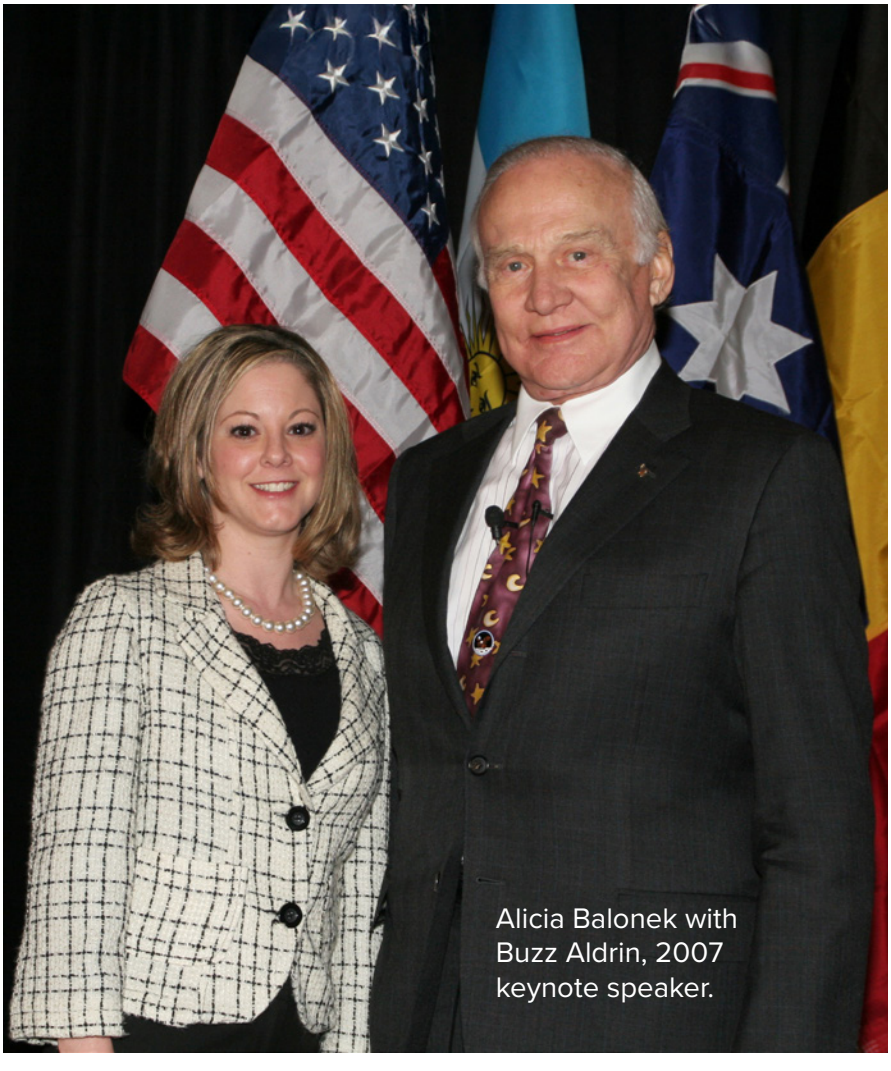
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taping interviews with industry pioneers. We watched for two days as a constant stream of elderly people came up on the the IP stage and added their wisdom and founding stories to the record. On the third day, as another elderly man came to the IPC booth, I overheard two of my colleagues wondering who this old fogey was and what he could say that was new and interesting. I soon recognized the man and told them the "old fogey" was Buzz Aldrin, the second man to walk on the moon. Complete silence followed. At least they had the grace to look embarrassed.

Occasionally, someone brings up the idea of having a live display of running water in the equipment brought to the show instead of just a static display. Usually, we reject this idea, but one year in the 1990s, we let a company debut a new liquid etch resist. They planned to demonstrate how easy it was to use to resolve very fine lines and spaces. I was somewhat apprehensive, as I was among those responsible for making sure everything ran smoothly at the show. However, this was a mild sodium carbonate solution, so even if there were minor leaks, it would be harmless. What could go wrong?

Well, on the first day of the show, someone stepped on the drain valve and broke it off, which soaked several nearby booths with 80 gallons of warm, slightly alkaline water. It wasn't a light moment at the time, but we've looked back on it with amusement. However, since then, there has never again been talk of running another live water demo in our booth.

As is part of the trade show experience, many characters have come through our booth over the years, but one has remained stuck in my mind. It was soon after the first EXPO, sometime in the early 2000s. A potential customer came into the booth and started asking questions, but it was soon apparent that he knew absolutely nothing about wet processing or the electronics business. Our sales rep asked why he was at an electronics packaging exhibition. "Oh, I own several bakeries around the country," he replied, "but I'd like to expand my investments, and I'm looking for something less complicated than the baking business to get into." For several seconds, there was a stunned silence before everyone in earshot drifted away as unobtrusively as possible while our sales rep tried to acquaint our potential customer with reality.



Alicia Balonek with Buzz Aldrin, 2007 keynote speaker.

Finally, while these shows are fantastic venues to meet old customers and potential new ones, they also offer opportunities to spy on your competitors,

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not only to see what they have that's new and different but also to try and pick up any potentially classified or secret information.

One year, our sales manager was determined to get an etcher operating manual from one of our major competitors. He came up with an elaborate plan, including false name badges, company fronts, and agents, which he would take to the competitor's booth and pose as customers. However, on the first day, when we went to our booth to prepare for the day, my fellow process engineer, Joe, was sitting with his feet on the table reading one of that competitor's etcher operating manuals.

"Where did you get that?" our sales manager asked. "From their booth." "How?" "One of their field service guys gave it to me." "Why would he just give you one of their etcher manuals?" "Because I gave him one of ours," Joe replied.

Several minutes of pandemonium ensued, but no harm was done, except perhaps to our sales manager's blood pressure. Joe knew that no company would put anything classified in a customer operating manual or bring one to a trade show. It was fun, though, for us technical types to watch our sales guys have hissy fits for several minutes.

I considered sharing the story of the time I got kicked out of Disneyland—an event I've quietly been proud of ever since—but I'm running out of space, so it will have to wait.

Enjoy the show. **PCB007**



Don Ball is a process engineer at Chemcut. To read past columns or contact Ball, click here.

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Empowering Women in Electronics:
An Evening of Connection and Inspiration

Feature Article by Alicia Balonek
IPC

The Women in Electronics Reception at IPC APEX EXPO on Tuesday, March 19, from 6–7:30 p.m., promises to be an evening of inspiration, camaraderie, and empowerment. With the theme "Eagerly Empowering Worn-Out Professionals with Humor, Hindsight, and Hallelujahs," the event aims to rejuvenate and energize professionals in the electronics industry, a sector where women are underrepresented yet make invaluable contributions.

Keynote speaker Jody Urquhart will lead an interactive and uplifting presentation, offering meaningful insights designed to cultivate a positive, "can-do" attitude in the workplace. Her talk will blend humor with practical wisdom, encouraging attendees to reimagine their approach to work and life. Through humor and hindsight, Jody aims to ignite a sense of purpose and joy in attendees, helping them envision and create the fulfilling work-life balance they've always desired.

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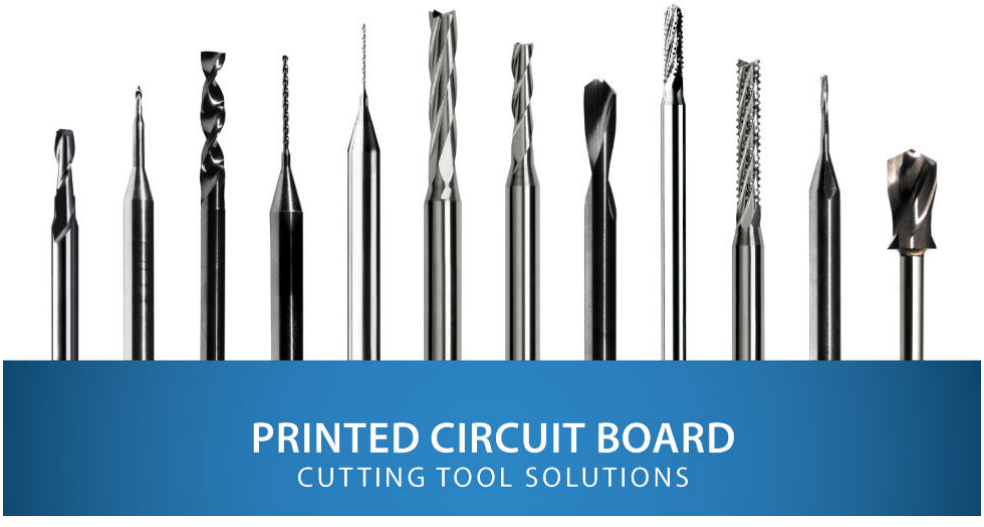


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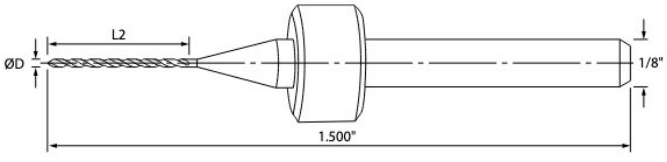
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Kyocera's renowned array of drills, routers, end mills, and specialty tools offer many benefits and advantages to customers for all their drilling and routing needs. Kyocera's tool reliability and design flexibility are key strengths of their products, along with a complete R&D facility in the US, new tool manufacturing capability, and local technical resources, all available to support customer needs.





4 Facet Point Geometry

REPOINTING will be a new service offered by Insulectro through Kyocera. The company has recently invested in automated, state-of-the-art equipment and all repointing will be done in Southern California.

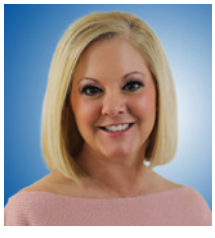


The reception also serves as a reminder of the critical importance of supporting women in STEM (science, technology, engineering, and mathematics) fields. Women currently comprise about 28% of the STEM workforce, with even smaller percentages in specialized areas like engineering and electronics. Events like this play a pivotal role in addressing the gender gap by providing women with a platform to connect, share experiences, and find mentors and allies.

By fostering a supportive community, the Women in Electronics Reception contributes to the larger goal of increasing female representation in STEM. Representation matters because diverse perspectives lead to more innovative solutions and equitable workplace practices. Empowering women in electronics isn't just about fairness—it's about strengthening the entire industry by drawing on the talents and insights of all its members.

Attendees will leave the reception with practical tools, renewed motivation, and a deeper appreciation for the vital role women play in electronics. As Jody's presentation emphasizes, success is not just about what you do but how you feel about doing it. For women in electronics, cultivating that sense of fulfillment is key to breaking barriers and thriving in this dynamic field.

The evening promises not only to uplift spirits but also to reaffirm the commitment to championing women in STEM. This event is a steppingstone toward a future where the electronics industry reflects the full spectrum of talent and potential. **PCB007**



Alicia Balonek is senior director of trade shows and events at IPC.



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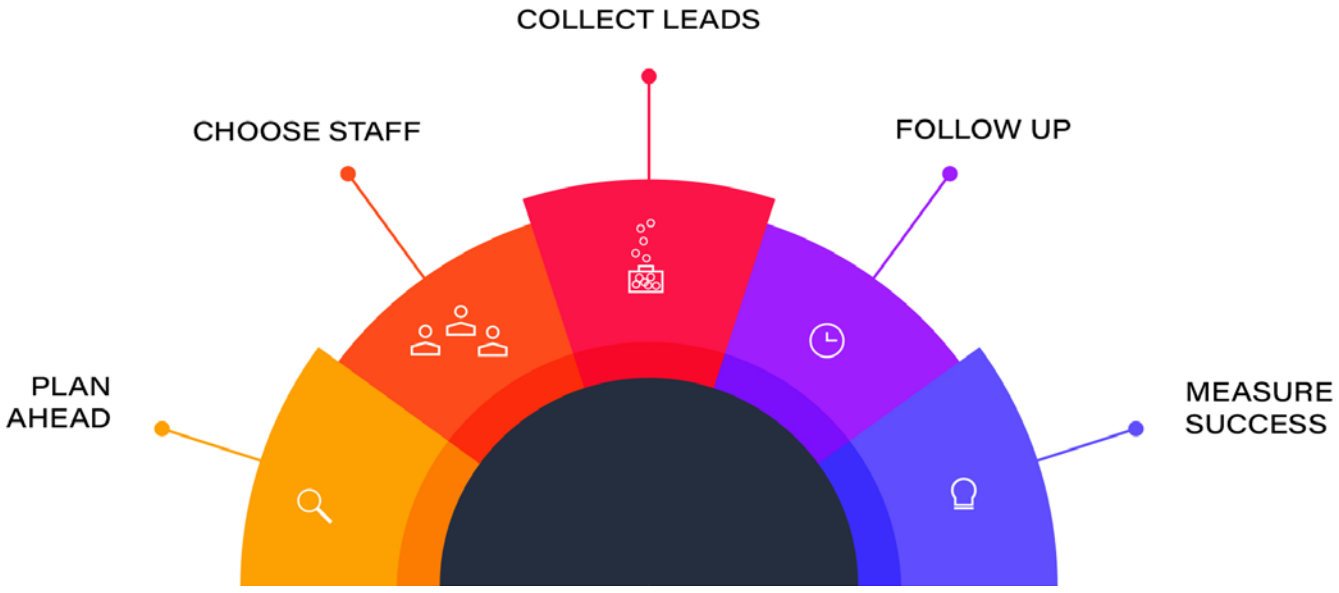
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MAXIMIZING the Five Stages of Your Trade Show Exhibit



It's Only Common Sense

Feature Column by Dan Beaulieu, D.B. MANAGEMENT GROUP

I have been advocating for trade shows for years. I know they're not cheap. Booth space, travel, hotels, promotional materials, and time away from the office can add up quickly. But they are one of the most significant investments your company will make in marketing and sales. If done right, trade shows can be a gold mine of opportunity to gain leads, build relationships, and showcase your business to the world.

So, how do you ensure you're getting the most bang for your buck? Like everything else in business, it starts with a plan. Let's break it down step by step.

1. Preplanning is the Foundation of Success

Fail to plan, and you're planning to fail. The success of your trade show presence is determined long before you set foot on the exhibition floor. Here's what you need to do.

- **Define your goals:** Why are you going to this trade show? Are you launching a new product? Looking to generate leads? Strengthening relationships with current customers? If you aren't sure, then don't go. Whatever your goals, make them specific, measurable, and actionable. For example, "generate 50 qualified leads" or "schedule 10 follow-up meetings with existing clients."

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- **Choose the right show:** Not all trade shows are created equal. Do your research. Research the audience, the industries represented, and past attendance. Focus on events where your ideal customers and partners will be. I highly recommend finding a show you're interested in and then walking the show floor prior to deciding whether you should exhibit there.
- **Design your booth for impact:** Your booth is your storefront. It needs to grab attention and communicate your value instantly. Invest in clear, professional graphics that highlight your unique selling points. Ensure it is welcoming and functional with space for demos and discussions.
- **Build buzz before the show:** Don't wait until the show to start promoting. Announce your attendance in advertisements, a press release, social media, your website, and email newsletters. Offer incentives for visiting your booth, such as giveaways, product demos, or a chance to win a prize.



2. Operating the Booth With Your Front Line Team

The people in your booth are the face of your company. Their attitude, knowledge, and professionalism make or break your success. Make sure they are active. There is nothing that looks worse than seeing people sitting in the back of the booth looking at their phones or having so many of your own people in your booth that it looks like a party. Your potential customers will not be interested or comfortable in crashing your party.

- **Choose the right people:** Your booth team should be friendly, outgoing, and knowledgeable. They must understand your products and services inside and out and, just as importantly, know how to listen and engage with potential customers.
- **Train your team:** This one is very important. Don't assume everyone knows how to work a trade show booth effectively. They don't. Provide training on how to greet visitors, qualify leads, and deliver concise, impactful elevator pitches. Role-play scenarios to prepare them for different types of interactions.
- **Keep energy levels high:** Standing in a booth for hours can be exhausting. Schedule regular breaks for your team so they stay fresh and enthusiastic. Encourage them to walk the floor on breaks, if they can. Keep water and snacks on hand to prevent fatigue.
- **Engage, don't just sell:** Visitors don't want a hard sales pitch; they want solutions to their problems. Train your team to ask open-ended questions so they can understand a visitor's needs and tailor their responses accordingly. This is an important skill that makes good salespeople great. There is no better time to hone this skill than at a trade show.

3. Getting Leads

This is the lifeblood of trade show success. Leads are the reason you're there, and remem-

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ber that not all leads are created equal. You want quality over quantity.

- **Use lead capture technology:** Gone are the days of scribbling notes on business cards. Use digital lead capture tools to quickly record contact details and key information about each interaction. Many trade shows offer badge scanning systems. Take advantage of them.
- **Qualify your leads:** Train your team to ask questions that determine whether a visitor is a potential buyer or just window shopping. Focus on gathering information about their role, needs, budget, and timeline.
- **Don't overlook note-taking:** After each conversation, jot down notes about what was discussed. These details will be invaluable for personalized follow-up after the show.
- **Offer value to visitors:** Give attendees a reason to share their information. Offer free resources like white papers, industry reports, or exclusive post-show webinars. Ensure the value of the offer aligns with the interests of your target audience.

4. Post-Show Follow-up

This is where the real magic happens. The trade show isn't over when the exhibit hall closes. In fact, the real work begins after the show ends.

- **Follow up promptly:** Don't let leads go cold. Follow up within a week of the show while the interaction is still fresh in their minds. Send a personalized email or make a phone call referencing your conversation at the booth.
- **Segment your leads:** Not all leads are ready to buy immediately. Segment your leads into categories like hot, warm, and long-term prospects. Tailor your follow-up strategy accordingly.
- **Provide value:** Your follow-up shouldn't be a generic sales pitch. Offer something of value, like additional product information, a demo, or a case study. Show how your product or service solves their specific problem.
- **Track your progress:** Use a CRM system to log your follow-ups, track responses, and monitor which leads are converting. This ensures no one falls through the cracks.

5. Tracking ROI

This is the measure of success. If you're not tracking your return on investment, how do you know whether the trade show was worth it? Measuring ROI helps you refine your strategy for future events.

- **Calculate your costs:** Add up all your trade show expenses: booth rental, travel, accommodations, promotional materials, shipping, and staff time.
- **Measure your gains:** Track the revenue generated from leads obtained at the show. This includes direct sales, as well as long-term contracts or repeat business that originated from show interactions.

25 Years of Tech Milestones

1999

WiFi is first introduced for home use; Napster launches first music streaming service.

napster

2000

PayPal officially launches in October 2000 and today remains the world's most valuable FinTech company.

PayPal

2001

Apple releases its first iPod, obsoleting devices such as the Sony Walkman.



2002

SpaceX is founded, bringing private space travel into the mainstream.

SPACEX

2005

Amazon launches Prime membership for shipping benefits.

amazon prime

2006

Facebook opens to anyone over the age of 13 with an email address.

2007

First Apple iPhone; Kindle e-readers enter market; Netflix launches streaming.



2009

First FitBit comes to market, paving the way for sophisticated health tracking bio devices.



2010

iPad introduced to mixed reviews. Venmo comes on the scene.

venmo

2012

Ancestry DNA kits become available to the general public.



2014

Amazon Echo speakers enter market, introducing Alexa as a personal assistant.

alexa

2015

Google launches very first driverless car, soon renamed Waymo. SpaceX introduces a reuseable rocket and Tesla creates PowerWall.



2020

Telehealth medicine explodes overnight due to the COVID-19 pandemic.



2022

First fully electric commuter plane built by Eviation Aircraft, named Alice, makes its maiden voyage.



2024

Significant breakthroughs in quantum computing are made, including quantum modularization and teleportation of quantum information over long distances.



- **Analyze non-monetary benefits:** Not all ROI is financial. Consider the value of increased brand awareness, strengthened customer relationships, and industry insights gained from the show.
- **Learn and adjust:** After the show, conduct a post-mortem with your team. What worked well? What didn't? Use these insights to improve your approach for the next event.

Exhibiting at a trade show is a significant investment, but with the right strategy, it can deliver a tremendous return. Preplanning ensures you're prepared. Staffing the booth with the right team maximizes your interactions. Capturing quality leads sets the stage for future sales and diligent follow-up turns opportunities into results.

Finally, tracking your ROI closes the loop, helping you make informed decisions about future events. Remember, success at a trade show isn't about being the biggest booth on the floor—it's about making the most meaningful connections and turning those connections into long-term business relationships.

So, the next time you're gearing up for a trade show, remember, it's not just about showing up—it's about showing up with purpose, passion, and a plan.

It's only common sense. **PCB007**



Dan Beaulieu is president of D.B. Management Group. To read past columns, click here.

Rice Researchers Unveil 'Surprising' Breakthrough in Carbon Nanotube Recycling

In a significant step toward creating a sustainable and circular economy, Rice University researchers have published a landmark study in the journal Carbon demonstrating that carbon nanotube (CNT) fibers can be fully recycled without any loss in their structure or properties and positions them as a sustainable alternative to traditional materials like metals, polymers and the much larger carbon fibers, which are notoriously difficult to recycle.

The research team used solution-spun CNT fibers created by dissolving fiber-grade commercial CNTs in chlorosulfonic acid. Fibers made from different types of CNTs produced by different manufacturers were initially processed into separate single-source virgin fibers, then recycled by combining them and mixing in chlorosulfonic acid. Surprisingly, mixing the two fibers led to complete redissolution and no sign of separation of the two source materials into different liquid phases. This redissolved material was spun into a mixed-source recycled fiber that retained the same structure and alignment of the virgin fiber.



"Remarkably, the recycled fibers demonstrated equivalent mechanical strength, electrical conductivity, thermal conductivity and alignment, which is unprecedented in the field of engineered materials," said co-first author Michelle Durán-Chaves, a graduate student in chemistry.

The research revealed several significant findings that position CNT fibers as a promising material in the journey toward sustainable practices. Unlike traditional materials, particularly polymers and carbon fibers that degrade in quality during recycling, CNT fibers retained 100% of their original properties after being recycled.

Source: Rice University



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MilAero007 Highlights



NASA's New Deep Space Network Antenna Has Its Crowning Moment ▶

NASA's Deep Space Network, an array of giant radio antennas, allows agency missions to track, send commands to, and receive scientific data from spacecraft venturing to the Moon and beyond. NASA is adding a new antenna, bringing the total to 15, to support increased demand for the world's largest and most sensitive radio frequency telecommunication system.

Solar Powered Aircraft Achieves New Stratospheric Success ▶

During the first flight at Spaceport America® in New Mexico, in recent weeks, the solar powered aircraft flew for 24 hours climbing to more than 66,000 feet and cruising in the stratosphere, before successfully landing in a serviceable condition, meaning it was ready to fly again just two days later.

Cutting-Edge Satellite Tracks Lake Water Levels in Ohio River Basin ▶

Since early 2023, SWOT has been measuring the height of nearly all water on Earth's surface—including oceans, lakes, reservoirs, and rivers—covering nearly the entire globe at least once every 21 days. The SWOT satellite also measures the horizontal extent of water in freshwater bodies. Earlier this year, the mission started making validated data publicly available.

NASA's Kennedy Marks New Chapter for Florida Space Industry ▶

The future of research and technology at NASA's Kennedy Space Center in Florida is expanding Wednesday, as Kennedy's center director and charter members in the Florida University Space Research Consortium signed a memorandum of understanding in research and development to assist with missions and contribute to NASA's Moon to Mars exploration approach.

L3Harris Showcases Robotic Drone Detection Capability for US Army ▶

L3Harris Technologies has successfully demonstrated a new drone detection and defeat capability for its T7 robot system at Vanguard 24, an annual capstone experiment the U.S. Army hosts at Fort Huachuca, Arizona. The T7 is a large robotic system that gives operators precision control for Explosive Ordnance Disposal (EOD) and other complex tasks.

Northrop Grumman to Deliver US Navy's E-130J Nuclear Command, Control and Communications Aircraft ▶

Northrop Grumman Corporation has been selected as the prime contractor to deliver nuclear command, control and communications (NC3) aircraft for the U.S. Navy's Take Charge And Move Out (TACAMO) mission.

Two Additional Boeing O3b mPOWER Satellites Successfully Communicating in Space ▶

Two more Boeing-built O3b mPOWER satellites are sending and receiving signals in space after launching from the Kennedy Space Center, Florida and will join the first six O3b mPOWER to further enhance SES's ability to deliver high-speed, reliable connectivity to global users.

DESIGN TIPS #124:

ETCH COMPENSATION

What is minimum space and trace? The answer depends on the starting copper weight.

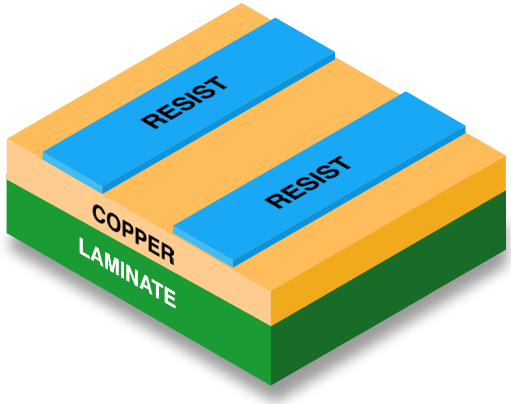
This is because we must do an etch comp on the traces in CAM to compensate for known etch loss. The space between traces after compensation will play a role in whether a board can be manufactured.

The lower the spacing width, the higher the cost. Designers don't always account for the proper starting copper weight after edge compensation.

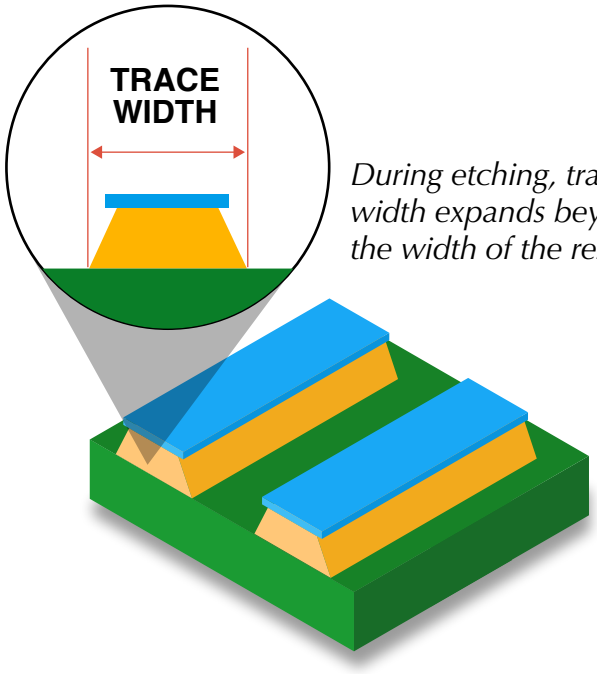
Design tips:

- For accurate starting copper weight, **add a half mil (.0005″) to all copper features**.
- **Start with 3/8 or 1/4 oz. foil**, reducing etch comp and less likely to cause a spacing issue.
- **Boards that call for full body electrolytic gold are not comped** to avoid gold slivers occurring during the etching process.

Before etching



After etching



During etching, trace width expands beyond the width of the resist.

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Long-time Challenges Confront a New Administration

American Made Advocacy

by Shane Whiteside, PCBAA

A new year didn't just mean cold weather across the country, it also meant a change to the political environment facing American manufacturers. Across the entire federal government, there will be changes in personnel, structure, and governing philosophy. This means those of us who care about what happens in Washington will need to adjust our strategies and tactics to match a new reality. Here's how that looks across the federal ecosystem.

At the Pentagon

America's warfighters depend on modern microelectronics to fight, win, and come home safely. DoD investments in recent years have reflected this and we have no reason to believe that will change. The Pentagon's industrial base study identified printed circuit boards (PCBs) as a critical component for which we lack sufficient manufacturing capacity to meet projected needs. Military leaders should continue to use the Defense Production Act to address this issue. Depending on adversarial countries for the components inside the defense technologies that float, fly, and fight is bad policy and dangerous practice. As new Defense Department political appointees arrive, PCBAA will connect with them and continue the great partnership our association has developed with key agencies within the Pentagon over the past four years.

At the Commerce Department

In the last administration, there was unprecedented activity at the Commerce Department. Through the CHIPS and Science Act, they disbursed nearly $52 billion in federal funds to reduce our dependence on foreign semiconductors. That investment in American-made semiconductors is paying off as new fabs come online and expand U.S. market share.

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As anyone knows who follows the microelectronics supply chain, the CHIPS Act missed substrates and PCBs. As you know, "chips don't float." To function, semiconductors need substrates and PCBs.

The new SCALE tool released by the Department in September uses 41 different sensors to detect vulnerabilities in supply chains across industries. They identified low sustainability for printed circuit boards, meaning that few, if any, alternatives are available if the supply chain is disrupted. The new team at Commerce has a tremendous opportunity to address this critical gap in the microelectronics supply chain. Unless America builds out the entire technology stack—chips, substrates, and PCBs—we will remain dependent on brittle supply chains and foreign nations for the technologies that power our economy.

At the White House

The second Trump administration promises to be very different than the first. Indications are that there will be an early focus on policies that affect the global competitive economic environment. American companies have struggled to compete with countries that subsidize their PCB industries. We welcome a focus on American manufacturing coupled with a wait-and-see attitude on tariffs and trade restrictions. We continue to believe that incentives are the most powerful tool to bring back and expand America's PCB capacity. We look forward to working with the Trump administration to make PCBs in America again.

On Capitol Hill

The new Republican majorities in the House and Senate are focused on early victories for President Trump, especially in the tax arena. The Ways & Means Committee, under Chair Jason Smith, is building a massive legislative package to extend individual and corporate tax cuts during the first 100 days of this new administration.

This is an opportunity for American-made PCBs. We have long advocated for a 25% tax credit for those purchasing PCBs made in America. This would create a strong demand signal visible to suppliers, OEMs, and investors. That's why a group of executives from PCBAA and IPC member companies recently gathered in Washington, D.C., to lobby lawmakers and emphasize the opportunity for tax incentives that would transform the domestic PCB market.

In times of major shifts in government focus, it's important for industries like ours to stand united and advocate for policies that will benefit our customers, consumers, and our national security. I'm confident that if our industry is organized and presents a united front to legislators and policymakers, their decisions will move markets. We must stay focused and consistent in our messaging which will ensure that we win the understanding and support of the new administration.

If you are ready to get off the sidelines and join this fight, I'm eager to speak with you. **PCB007**



Shane Whiteside is president and CEO of Summit Interconnect and current chair of the Printed Circuit Board Association of America. To read past columns, click here.

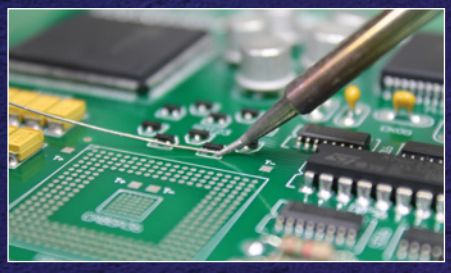
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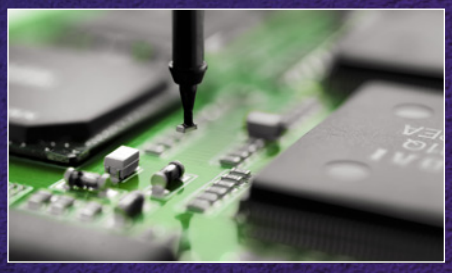
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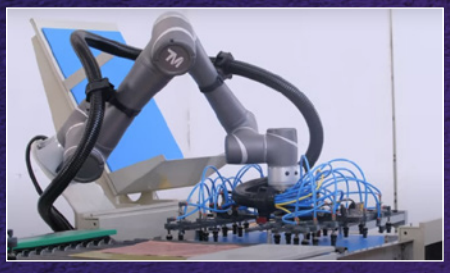
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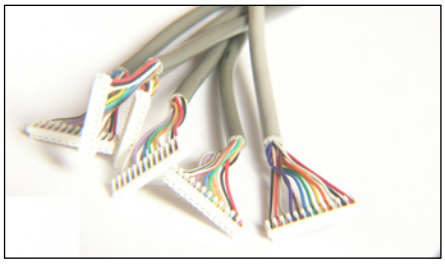
THE TOP 5 THINGS YOU NEED TO KNOW ABOUT MANUFACTURING TRAINING

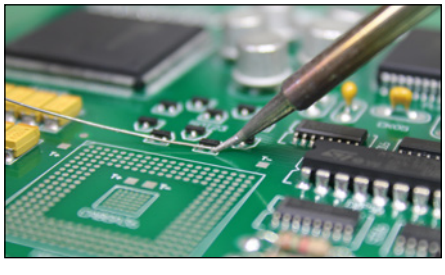
by Blackfox Training

Electronics manufacturing companies need skilled and certified workers to perform the intricate and important tasks required to build modern electronic equipment. Here, we explain how to properly achieve this:

1. **Train and Certify Manufacturing Employees and Support Staff to the IPC Standards**
2. **Fill Training Gaps with Customized Courses that Focus on Basic Knowledge and Skills**
3. **Access Tools and Resources to Assess Your Workforce and Maintain Skill Levels**
4. **Stay Up to Date Amid Constant Changes in the Electronics Manufacturing Industry**
5. **Establish Trusted Industry Partnerships to Maintain a Commitment to Quality**

IPC® Training Center





1 Train and Certify Manufacturing Employees and Support Staff to the IPC Standards

IPC certification is an internationally recognized credential that proves an employee's knowledge and skill level. IPC training and certification is industry developed and covers electronics manufacturing quality concerns, including PCB assembly and soldering, rework and repair, wire and cable harness production, and bare PCB fabrication. Having an IPC-certified workforce demonstrates an attention to detail and commitment to quality.

2 Fill Training Gaps with Customized Courses that Focus on Basic Knowledge and Skills

IPC training and other standardized courses don't cover every aspect of electronics manufacturing. Therefore, it is important to have customized courses that fill those missed gaps. Basic soldering, ESD, and electronic component identification are just a few examples of the many courses that complement IPC certification and ensure that your workforce is prepared for any challenges that may come their way.

3 Access Tools and Resources to Assess Your Workforce and Maintain Skill Levels

Assessing your workforce before and after training is an essential part of a proper manufacturing training program. The effectiveness of training and the retention of knowledge gained can be gauged through assessments that are computer-based, interview-based, or audit-based. In addition to assessments, both students and trainers need to have complete access to resource documents and training materials after training has been completed.

4 Stay Up to Date Amid Constant Changes in the Electronics Manufacturing Industry

Technological advances and new discoveries are occurring constantly that greatly impact how we manufacture electronic products and evaluate them for quality. This makes maintaining your IPC Certifications through renewal and recertification critically important. In addition, attending industry meetings and participating in IPC committees will ensure access to the latest information.

5 Establish Trusted Industry Partnerships to Maintain a Commitment to Quality

After a trained and skilled workforce has been established, it is critical to maintain relationships with trusted industry partners to sustain a high level of manufacturing quality. This includes companies and organizations that provide services such as: consulting to help correct ongoing process issues; workshops addressing common industry problems; and assistance with implementing a comprehensive training program.

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THE TOP 5 THINGS YOU NEED TO KNOW ABOUT

MULTILAYER SYSTEM SOLUTIONS

by Burkle North America

Today, printed circuit boards are the backbone of nearly every modern electronic device. With the integration of Industry 4.0 technologies and artificial intelligence, manufacturers are redefining the possibilities of automated production—delivering precise, scalable, and efficient solutions that power the growing interconnectivity of our world.

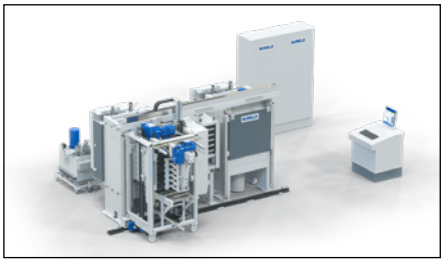
1 **Integrated Systems: Enhancing Efficiency Through the WorkCell Concept**

2 **High-volume Production Without Compromising Quality**

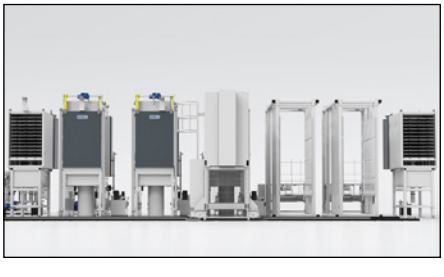
3 **Real-time Monitoring for Precision and Adaptability**

4 **Future-proofing With Industry 4.0 Capabilities**

5 **Partnering for Success: The Importance of Reliable Expertise**







1 Integrated Systems: Enhancing Efficiency Through the WorkCell Concept

The WorkCell concept exemplifies how combining loading and unloading systems, material handling robotics, and real-time process monitoring into a unified workflow enhances production flow. By streamlining lamination, cooling, and automation processes, manufacturers can reduce downtime while improving consistency and quality. **Key Takeaway:** Seamless connectivity between processes is vital for operational efficiency and maintaining high production standards.

2 High-volume Production Without Compromising Quality

Precision and scalability are no longer trade-offs in PCB lamination. High-volume mass lamination processes can now achieve consistent results without sacrificing accuracy. Advances in technologies such as electrically heated platens, thermal oil systems, and uniform pressure controls ensure multilayer boards meet rigorous standards. **Key Takeaway:** Innovations in lamination technology are making it possible to maintain quality even in high-throughput operations.

3 Real-time Monitoring for Precision and Adaptability

Modern PCB lamination lines integrate state-of-the-art monitoring and control systems. With intelligent software interfaces, parameters like temperature, pressure, and timing can be adjusted in real time, providing unmatched accuracy. This adaptability is essential for meeting the specific demands of advanced PCB designs. **Key Takeaway:** Real-time control and adjustments lead to higher yields, fewer defects, and improved production flexibility.

4 Future-proofing With Industry 4.0 Capabilities

The integration of Industry 4.0 features like MES (Manufacturing Execution System) compatibility, remote monitoring, and predictive maintenance is transforming PCB manufacturing. These capabilities provide real-time insights and ensure equipment is always operating at peak efficiency, reducing downtime and maintenance costs. **Key Takeaway:** Embracing Industry 4.0-readiness is key to staying competitive in a connected manufacturing ecosystem.

5 Partnering for Success: The Importance of Reliable Expertise

Beyond technology, having a trusted partner is critical in the evolving PCB industry. With an experienced team and a commitment to service excellence, Burkle North America helps manufacturers maximize their investments. From installation to ongoing maintenance, the focus is on delivering consistent, high-quality results. **Key Takeaway:** Strong partnerships with industry leaders can elevate operational capabilities and ensure long-term success.

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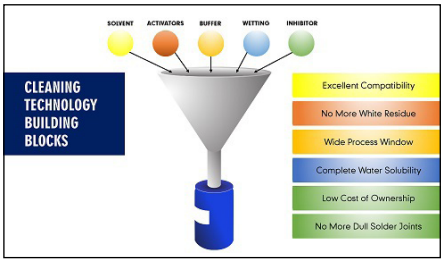
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THE TOP 5 THINGS YOU NEED TO KNOW ABOUT CLEANING

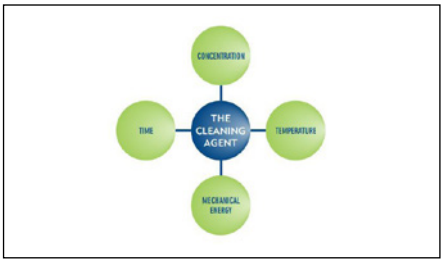
by KYZEN

An optimized cleaning process will provide reliable and dependable electronic assemblies. KYZEN's team of cleaning experts work with you to develop the most effective cleaning process for your needs. You can quickly increase productivity and yields by considering these Five Forces of Cleaning and implementing them in your process:

1 The Cleaning Agent: Choosing Wisely Will Save You Money in the Long Run



2 Concentration: More is Not Always Better



3 Time: Determine the Most Effective Wash Cycle Time

4 Temperature: Too High or Too Low Can Cost You More Than Money



5 Mechanical Energy: Adjusting Nozzles Can Make All the Difference

1 The Cleaning Agent: Choosing Wisely Will Save You Money in the Long Run

Consider the material of the substrate and the soil, and test to make sure your cleaning chemistry is effective on the soil sets you are using and compatible with all materials of construction in your assembly and your cleaning machine.

2 Concentration: More is Not Always Better

No two cleaning chemistries are created equal. The concentration at which they are effective will differ, and most often, the chemical supplier will supply a range for use. Start at the high side of the range and lower the concentration in small increments until you reach the optimal concentration for your unique process parameters.

3 Time: Determine the Most Effective Wash Cycle Time

A few factors will determine how long your assemblies will need to be exposed to the wash solution before they are completely residue-free. Is your soil easily removed? If not, can other process parameters be adjusted or optimized to shorten your wash cycle time?

4 Temperature: Too High or Too Low Can Cost You More Than Money

If your operating temperature is too high, you could harden the flux residue, making it harder to remove. High heat can also damage delicate substrates, not to mention the wear and tear to your machine. Running at a lower temperature may not take advantage of your chemistry's solvency, which will result in poor soil removal. Optimizing your process with thorough testing will help you find just the right temperature to bring success.

5 Mechanical Energy: Adjusting Nozzles Can Make All the Difference

Spray-in-air is the most common choice when it comes to PCB cleaning. Whether you choose a batch or inline washer is often determined by your throughput and floor space. There are a variety of adjustments you can make in each process to maximize the mechanical energy needed to completely clean and rinse your assemblies. Bonus tip: You are only as clean as your last rinse.

KYZEN is the leading global cleaning chemistry supplier offering a wide range of products for electronics assembly cleaning processes. For expert cleaning advice, visit us at KYZEN.com.

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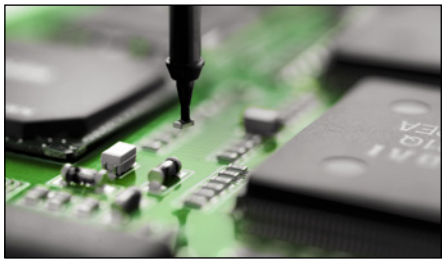
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THE TOP 5 THINGS YOU NEED TO KNOW ABOUT PLACEMENT

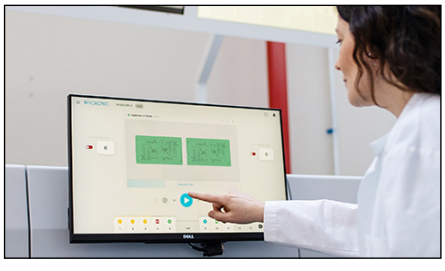
by Mycronic

Today's high-mix electronics manufacturers need to adapt to a rapidly changing environment. To meet customer expectations and maintain competitiveness and profitability, their component placement process must meet a number of conditions. Here are the top five things to consider:

1 **Combine High Placement Productivity With Consistent Reliability for Growing batch Sizes**



2 **Versatility to Cope With the Expanding Diversity of Components**



3 **User-friendly Graphical Interface for Efficient Operation and Faster Training**

4 **Optimize Your Bidirectional Material Flow**



5 **Live Process Control for Optimized Performance**

1 Combine High Placement Productivity With Consistent Reliability for Growing batch Sizes

More complex products. Diversified production. Shorter delivery times. To handle these demands, high-mix producers need to significantly raise their placement productivity while maintaining the highest precision and quality.

Boosted by the new MX7 mounthead, the MYPro A40 placement machine delivers an outstanding 59,000 CPH throughput, giving high-mix manufacturers the productivity and peak speed they need to meet aggressive production schedules.

2 Versatility to Cope With the Expanding Diversity of Components

From placing components the size of sand grains to bulky connectors, high-mix manufacturers must be prepared to place the widest combination of packages.

From 03015" packages up to long 150x40 mm connectors, the MYPro A40 series can handle it all. Handle components on reels, sticks and trays, all whilst maximizing your flexibility due to 224 feeder positions. The large feeder quantities enable a variety of optimization methods, whether multiloading or setting up a family kit to run multiple jobs with minimal changeover times. Combine this flexibility with electrical verification to eliminate errors and add an extra level of security ensuring that the right component is being used at any moment.

3 User-friendly Graphical Interface for Efficient Operation and Faster Training

Modern PCB lamination lines integrate state-of-the-art monitoring and control systems. With intelligent software interfaces, parameters like temperature, pressure, and timing can be adjusted in real time, providing unmatched accuracy. This adaptability is essential for meeting the specific demands of advanced PCB designs. **Key Takeaway:** Real-time control and adjustments lead to higher yields, fewer defects, and improved production flexibility.

4 Optimize Your Bidirectional Material Flow

Bidirectional flows of materials to and from the assembly line(s) are common in high-mix production and can cause disruption to production if inadequately controlled.

Through unique carrier IDs, Mycronic's offline material handling software knows each part location and quantity, and provides kitting assistance and changeover strategy according to production needs. When handled with MYTowers, Mycronic's automated storage solution, components are always just a click away, and with Agilis feeders, enjoy the industry's shortest changeover time when switching jobs.

5 Live Process Control for Optimized Performance

Pick-and-place production data is extremely valuable if used properly. Live KPIs enable production engineers to quickly spot any performance drift. An advanced dashboard gives them the actionable information they need to increase utilization, reduce reject rates, and improve line balancing in real time. With live component misspick and reject analysis, MYCenter Analysis makes it possible to diagnose root causes before the problems multiply.

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THE TOP 5 THINGS YOU NEED TO KNOW ABOUT IMPLEMENTING SMART AUTOMATION SOLUTIONS

by Technica, U.S.A.

There are limited production hours available each year, so make them count. It starts by integrating reliable hardware and software automation solutions. But it doesn't end there; reassessment of your automation needs will be ongoing.

1 **Choose an Experienced Partner**

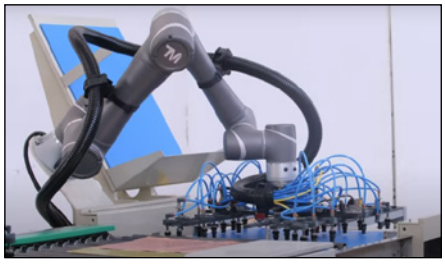


2 **Clearly Define Your Short-term and Long-term Visions**



3 **Align Your Goals With Your Budget to Execute an Automation Solution**

4 **Evaluate the Structure of Your IT Landscape**



5 **Position Yourself for the Journey of Benefitting from Big Data**

1 Choose an Experienced Partner

To ensure the journey is rewarding, it's important to have an automation partner experienced in analyzing and examining your current processes to help you choose the best robotic and cell layout solutions. Working with a company that has actually implemented full-scale automation and smart factory status into similar companies is key in designing the solution that you desire.

2 Clearly Define Your Short-term and Long-term Visions

Are you considering automation for certain purposes, such as lower operating costs, improved work safety, reduced factory lead times, increased production output, improved quality, or achieving a smart factory environment? Understanding your short- and long-term goals will determine the level of hardware and software tools that will be required to meet your goals and achieve a desired outcome.

3 Align Your Goals With Your Budget to Execute an Automation Solution

It takes a certain level of commitment as it relates to the investment of time and capital to implement a smart factory solution. How fast you begin to recognize your ROI will be based on a sound understanding of how to plan, create, and define the implementation.

4 Evaluate the Structure of Your IT Landscape

Connectivity, tracking, controlling, and analyzing are major parts of implementing a smart factory concept. Having an IT structure that can support the data journey is also important in achieving smart factory data management, factory intelligence, and material process control. Implementation of tools on the shop floor, such as factory dashboards, advanced planning, and scheduling, are outcomes of your data journey.

5 Position Yourself for the Journey of Benefitting from Big Data

Gathering data is a benefit of adding automation and connecting it to other equipment in the manufacturing process. Seamlessly sharing the collected data with enterprise software (ERP, MRP, PLM, MES, MOM) is where meaningful data will be gained to better control your processes and improve productivity. Having the personnel and software resources is important in recognizing the benefit of big data.



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Hannah Grace: The Inspiring Journey of an Emerging Engineer

Feature Q&A with Hannah Grace

Editor's note: This interview was originally recorded by IPC staff at IPC APEX EXPO 2024 as part of a series of interviews with IPC Emerging Engineers.

At last year's IPC APEX EXPO, former IPC Emerging Engineer Hannah Grace had the opportunity to reflect on her inspiring journey into the world of engineering, from her education at Valparaiso University to her internship and her first job at Texas Instruments. From pivotal moments and the unexpected turns that helped shape her early career and passion for electrical engineering, her story highlights the importance of interdisciplinary collaboration, taking opportunities that arise early on, finding confidence in one's voice, and the rewards of pursuing one's passions within the engineering field.

Hannah, please share an overview of your career path so far and highlight any key factors that motivated you to pursue a role in engineering.

Hannah Grace: It started in high school when I joined FIRST Robotics. I was on the mechanical build side, building the frames for the robots, and I got involved in the safety training stuff on our team. When I was younger, I was told that I was good at math and science,



Sarra

Automated VNA Measurement

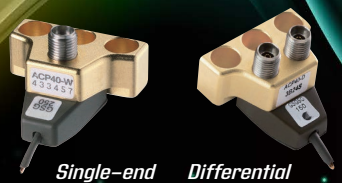


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  - » Rohde & Schwarz: ZNA40, ZNB40

Eye Diagrams



One major advantage of VNA measurements is the generation of Eye Diagrams, which make it possible to determine if the frequency bandwidth is ensured for high frequency transmission signals and how much noise and jitter are included in the signal.

www.usamicrocraft.com
sales@usamicrocraft.com

MicroCraft


Hannah Grace

and I should pursue that career path. That stuck with me.

I played French horn, so I wanted to pursue a degree in music performance. I also wanted to pursue math, so I started with a double major in music performance and math.

When I took an Intro to Engineering course, things changed. I got to play around with Arduinos and build cool things, and I just loved seeing the artistic side of engineering. I loved the problem solving and being involved in interdisciplinary teams was incredibly rewarding for me.

Soon after, I dropped both my double majors and switched to electrical engineering. I haven't looked back. I got involved with IPC during my junior year, and that's when I really started enjoying my electrical engineering courses. I got more involved in the RF side of PCB design, which is what I do in my career now.

What's something that has surprised you about your career journey so far?

What really surprised me is that I ended up going a more technical route, when at first I told myself I didn't want to do anything technical. I told myself, "I'll just do the people of side things and more quality stuff." But, as an IPC Student Board Member, I became involved with more professional development education.

I moved toward PCB design because of a Professional Development Course I attended called Antenna Theory, and I really clicked with it. I asked one of my EE professors if I could get involved in PCB design as an independent study and he allowed me to do that. I just love designing PCBs. It's been so rewarding to me.

What was your experience like as an IPC Student Board Member?

It's probably been my favorite experience so far. During COVID, my IPC Student Chapter was losing steam. I hadn't been involved, but someone suggested that I help get it restarted. I took a leadership position so I could get it on my resumé. When I did that, my professor pushed me into talking to the IPC Education Foundation. He said I should apply for IPC's Emerging Engineer program, and once I did, IPC told me I would be a great candidate for the Student Board Member position. "What is that?" I wondered. "What do you want me to do?" But I applied, was selected, and attended IPC APEX EXPO.

I met the board of directors, and they're incredible people. I felt like I grew professionally so much in that experience. I was able to give my opinion to these CEOs and CTOs and my opinion was valued.

They had many years of experience, and I didn't have any. It helped me look at engineering from a new, fresh perspective. I had been a little discouraged in my classes because I didn't think I was perfect or smart enough to give my opinion. But now I know more people in the industry and that if I have a question, I just need to ask it. Being in that role gave me a new level of personal and professional confidence.

Hannah, what advice do you have for aspiring engineers?

My advice is to just put yourself out there and network with everyone. Don't be afraid to say something stupid—we all do it, especially the first year at APEX EXPO. Take every single opportunity that comes your way. I believe my career grew by taking the moonshots that I

had thought were impossible, but with a ton of hard work, they came true.

Simply reaching out to people and networking can change your career.

When you were contemplating your career choices, what do you wish you had known?

I wish I would have known that nobody knows everything. In high school, I thought my mentors knew everything. I thought they were the smartest people. I didn't think I could ever be that smart. But, as I've progressed in my early career, I've realized those smart people still don't know everything, but they know how to use resources. One colleague who works on my team has 24 years of experience and is specialized in one topic, but another is specialized in a different topic. When they work together, they can solve a problem as a multidisciplinary team. So, just knowing that you won't always know the answer and that is okay, but also that it's so incredibly important to ask for help when it's needed.

> "I wish I would have known that nobody knows everything."

What support have you received from your employer, professors, and mentors?

My employer is Texas Instruments (TI). I'm an applications and validation engineer, and this has got to be the best first job I could have ever imagined. It's my dream job. As a semiconductor company, you wouldn't necessarily expect them to believe that you can go to a PCB conference and learn anything about semiconductors. But it's so important in the PCB industry to learn about packaging placement through design.

What support have you received from the IPC Emerging Engineer Program? How has your career been influenced by this program, and how has your mentor helped your career?

It has significantly impacted my early career. It helped me find my passion. I was involved in professional development courses—some IPC EDGE training courses—which helped me learn more about the board manufacturing industry and some of the processes they go through, which still helps me in my career today. Some of the PD courses, like the antenna course, put me in the direction of PC board design.

With IPC, I get continued support to get involved in and even lead committees, and that's only one year into my career. I didn't think I would get the opportunity, so I really appreciate the continued support.

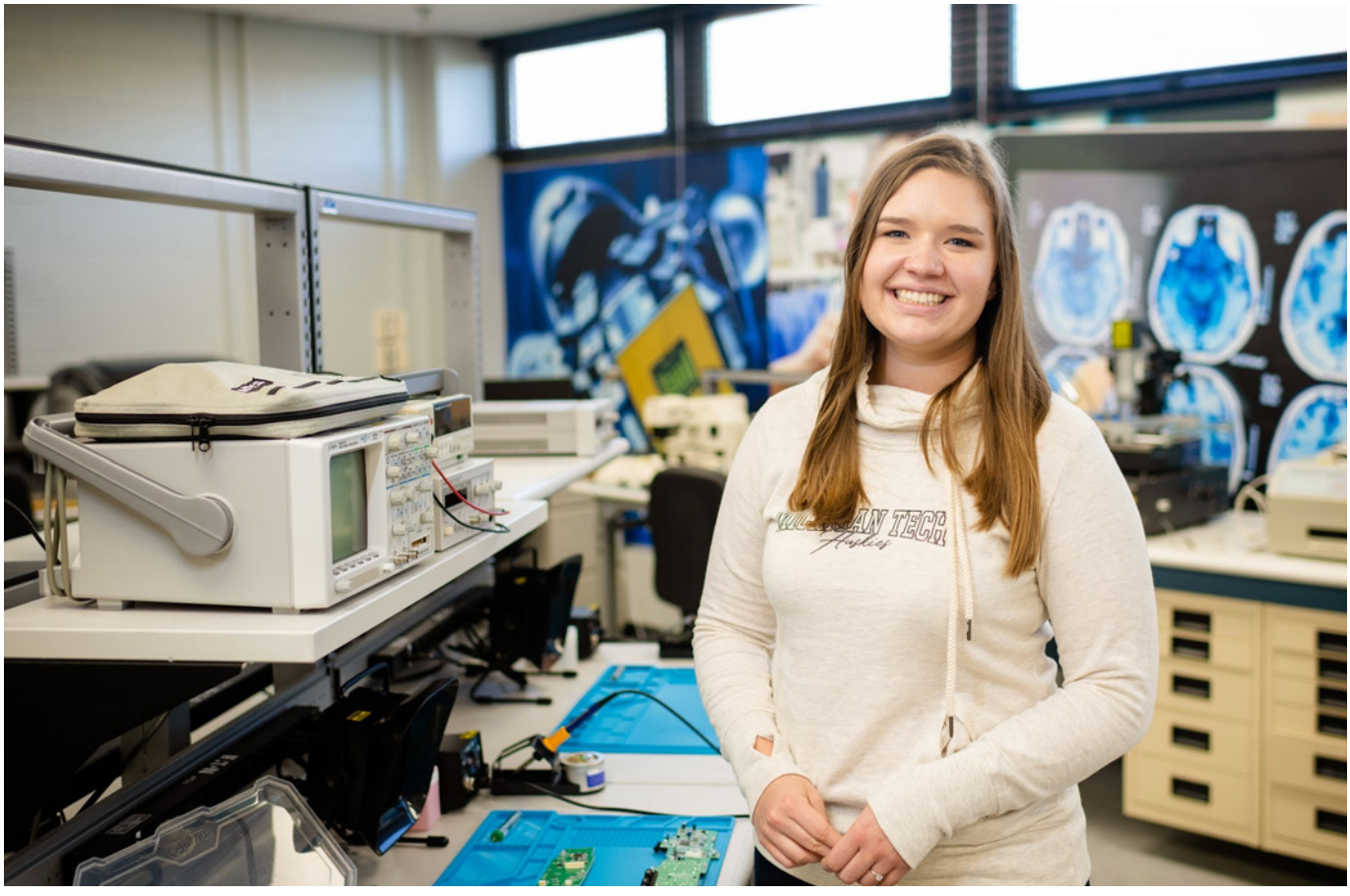
What professional development have you received at the show?

I've taken professional development courses ranging from antenna theory to PCB design to how we integrate chip packaging on our boards as chip sizes are decreasing. There's just such a variety, and you learn so much. In my day-to-day, I deal with semiconductors directly on the silicon, but I don't get to see it. Here, I see the reflow process and what they are doing in that space. Here, I get to see how to prevent failures, which I don't deal with on a regular basis. I have to problem solve. I think it is incredibly helpful in growing my career. I'm getting education and exposure to a variety of different topics that may be important for my future job or a different profession.

What about the community of emerging engineers you've built through the program? Has that impacted your career?

The community is amazing. It feels like one big family. I keep in contact with some of the friends and mentors that I've made. Throughout the year, I see them, and they feel like personal friends who you can talk to about your career and your life. They can help you grow and network with others to solve your problems in your company. **PCB007**

Paige Fiet: From Emerging Engineer to Quality at TTM



Feature Q&A with Paige Fiet

Editor's note: This interview was originally recorded by IPC staff at IPC APEX EXPO 2024 as part of a series of interviews with IPC Emerging Engineers..

Paige Fiet is a graduate of the IPC Emerging Engineer program and now works at TTM Technologies in Logan, Utah. She was an IPC Student Board Member and has been a columnist for I-Connect007. She is a stellar example and an encouragement to other young engineers about how to be successful in your early career.

Paige, pleave give an overview of your career so far? Highlight any key factors that motivated you to pursue your role in engineering.

Paige Fiet: My dad was an engineer and as a kid, I remember going to visit him at his factory. I distinctly remember the day they put in a robot arm and how excited he was. I thought it would be like something from "The Jetsons," but it was just an arm. I was freaked out at first, but he thought it was so cool. That day has stayed with me ever since.

In kindergarten, when everyone said they wanted to be a firefighter or a doctor, I said I

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Paige Fiet with Happy Holden

wanted to be an engineer. Now, that may have changed a few times over the years, but by college, I knew I wanted to pursue electrical engineering.

I got into electronics through a PCB manufacturing class at Michigan Technological University in Houghton, and I really enjoyed it, so I joined the electronics club. Later, I applied and was selected as the IPC Student Board Member, which was an incredible learning opportunity for me.

Looking back at your career journey so far, what's been the most unexpected aspect or experience you've had?

I remember taking this English course in high school, and we had to write a weekly blog about whatever we wanted. I told myself that I would never write articles again. Now, I've been writing articles for I-Connect007 for about two years. It's funny how these types of things work out.

What advice would you give to someone contemplating a career in engineering?

I would definitely recommend that they learn good problem-solving skills. It's easy to punch numbers into a calculator and get the answer, but knowing what to do with those numbers and applying them to the real world is what really makes the difference.

What do you wish you had known when you were deciding to become an engineer?

I wish I had learned the softer skills, like learning how to network and being an active listener, and I wish someone had told me earlier about IPC standards committees.

How have your employers helped you grow and develop as an engineer?

I've been very fortunate to have employers who have encouraged my involvement in IPC and the industry as a whole. My current employer has offered many opportunities for me to be active in the industry, including committee standards involvement, allowing me to chair committees and network with other people in the industry. This has increased my career opportunities, both at my company and outside of it.

In what way do you feel your career path has been influenced or supported by the IPC Emerging Engineer program?

The Emerging Engineer Program was a launch pad for my career. I met other like-minded individuals in the program, and people who have been in the industry for decades. They have taught me so much about electronics. It's been an invaluable experience.

How was your experience with your mentor in the program?

My mentor in the Emerging Engineer program was fantastic. He introduced me to many individuals from varying disciplines, and showed me the ropes about where to go, who to see, and what to do. It was amazing. I've met several Emerging Engineers who have become lifelong friends. They're no longer simply customers and vendors. I look forward to seeing and working with them every year.

Considering the current trends, how do you perceive the job market and the demand for your engineering expertise?

I think engineering is just starting to take off and it will continue to grow. I can see machine learning becoming a bigger thing, obviously AI and Factory 4. 0, and that requires engineering skills.

What growth potential do you see for your specific skill set?

As far as growth potential, I'm currently enjoying my quality role. I hope to go deeper into that with both customer and facility facing roles. I'm excited to see where the quality discipline takes me.

> "I love going back to work with the feeling that I've contributed more than my day-to-day tasks."

Talk about your involvement with IPC standards committees.

My involvement with the IPC committees is considerable. I co-chair and co-vice chair a couple of committees. I love attending committee meetings and having influence over the standards that I reference every day. I love going back to work with the feeling that I've contributed more than my day-to-day tasks. **PCB007**

Artificial Real Biological Processes Could Enable Perceptual Capabilities in Robotics

Artificially engineered biological processes, such as perception systems, remain an elusive target for organic electronics experts due to the reliance of human senses on an adaptive network of sensory neurons, which communicate by firing in response to environmental stimuli.



A new collaboration between Northwestern University and Georgia Tech has unlocked new potential for the field by creating a novel high-performance organic electrochemical neuron that responds within the frequency range of human neurons. They also built a complete perception system by designing other organic materials and integrating their engineered neurons with artificial touch receptors and synapses, which enabled real-time tactile signal sensing and processing.

The research, described in a paper published this month in the journal Proceedings of the National Academy of Sciences (PNAS), could move the needle on intelligent robots and other systems currently stymied by sensing systems that are less powerful than those of a human.

"The study highlights significant progress in organic electronics and their application in bridging the gap between biology and technology," said first author Yao Yao, a Northwestern engineering professor. "We created an efficient artificial neuron with reduced footprint and outstanding neuronal characteristics. Leveraging this capability, we developed a complete tactile neuromorphic perception system to mimic real biological processes."

According to corresponding author Tobin J. Marks, Northwestern's Charles E. and Emma H. Morrison Professor of Chemistry in the Weinberg College of Arts and Sciences, existing artificial neural circuits tend to fire within a narrow frequency range.

"The synthetic neuron in this study achieves unprecedented performance in firing frequency modulation, offering a range 50 times broader than existing organic electrochemical neural circuits," Marks said. "In contrast, our device's outstanding neuronal characteristics establish it as an advanced achievement in organic electrochemical neurons."

Source: Northwestern University

The Secret Value of Committee Work



Feature Interview by the I-Connect007 Editorial Team
I-CONNECT007

Teresa Rowe leads the standards and practices at IPC, and in this conversation delves into the nuts and bolts of getting involved in standards development. It's a commitment of time that's well worth the effort, she says, because you learn not only how a standard comes to light, but why and how dissenting opinions are purposely left out.

You'll come away from this discussion feeling comfortable about how you can get involved and why it will make a difference for your company. For those passionate about advancing their careers and contributing to industry standards, Teresa's insights make a compelling case for getting involved.

Nolan Johnson: Teresa, you're arguably the greatest expert on IPC committee processes. What is the value of being involved in committee work?

Teresa Rowe: To some, standards development work sounds very dry and boring, but it can

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also be one of the most exciting things that you do for yourself and your career. It's an opportunity for industry experts to discuss subjects you might know nothing about. Maybe it's something your company has been struggling with, or you've wondered about. You can be there to represent your company and take information back. You were in the "room when it happened." It helps you understand where some of those requirements come from.

I know standards committee work is not for everyone. Some come into the meeting room excited, and five minutes into the meeting, they say, "This is not for me." That's fine. Everyone is different. But give it a chance. It's a great way to learn, and you can take the knowledge with you.

Marcy LaRont: Teresa, when did IPC first start doing standards?

IPC started developing standards in the early 1960s. Take some time to research the standards. Look at the original publication dates. It's interesting.

Johnson: What is it like to participate in developing a standard, a "day in the life," if you will?

It depends. Some committees are small—maybe five to 10 people—and the discussion is less formal. It's more conversational, and good work comes from those small groups. Sometimes, those groups will grow larger as more people become interested in the topic.

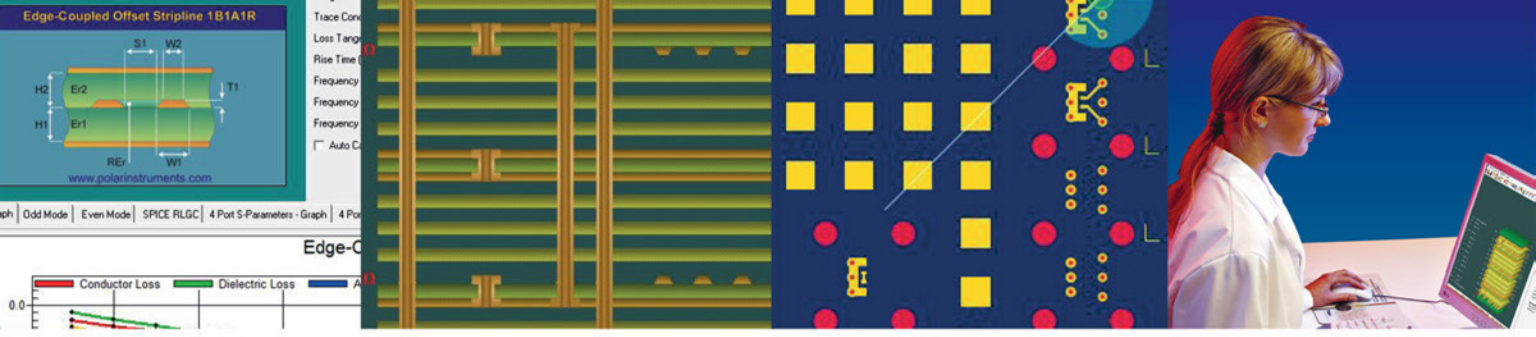
We also have massive groups, like the IPC-A-610 or IPC-J-STD-001. These are actually two task groups working on two standards: IPC-J-STD-001 requirements for soldered electrical and electronic assemblies, and IPC-A-610, the acceptability of the assemblies. Several revisions ago, we realized we had a greater than 85% participant crossover. We would discuss and establish the process requirements in the J standard, but when we got to 610, the same people argued that the new requirements weren't right. That makes it very difficult to use the documents together if that is what is desired. So, we brought these groups together for discussion. This combined group can be 125 people or more.

LaRont: How do you have a meaningful discourse with that many people in a room?

We use a modified version of Robert's Rules for our discussions. There's a leader for the group, people raise their hands to speak, each topic is properly introduced, and the leader ensures that everyone is aware of what comment or content they're working on. Runners circulate microphones to ensure everyone can be heard. Every comment is given equal treatment. We want anyone to feel comfortable voicing their opinion.



There's also the leadership aspect. Leaders might spend a couple of hours preparing for a meeting, making sure minutes are posted, working with IPC staff liaisons, or proofing a document before we're finished. There's more time spent by the leadership with IPC staff, ensuring all documents are prepared, comments reviewed with recommendations, and being ready when the big group comes in the room.



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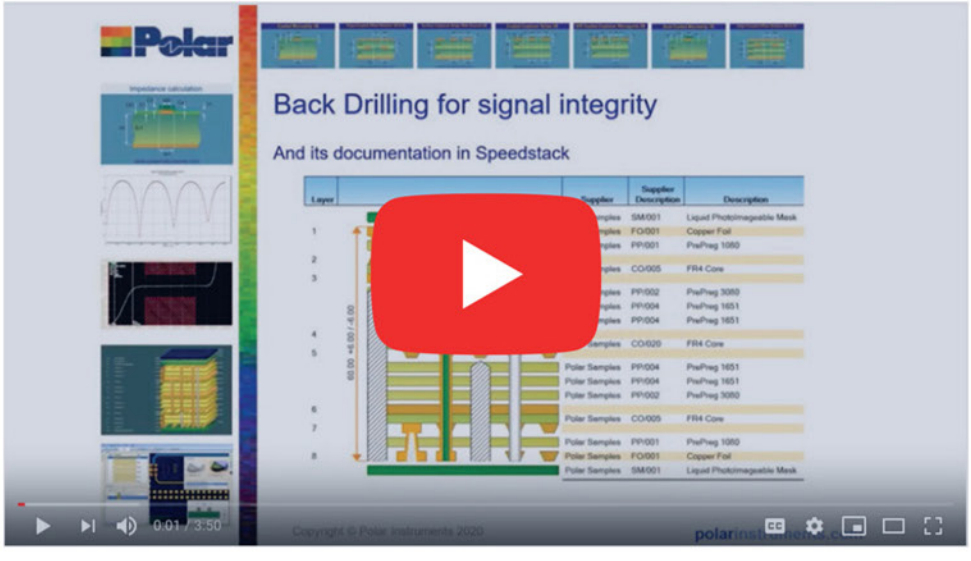
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We realize time is money, and everyone is a volunteer from their companies.

People may wonder what the time commitment is to be a volunteer. It depends on how much preparation you do. We hope you will come to a meeting having fully read all the documentation, but it's not required. You can just sit in on a meeting and listen to the conversation. We don't discourage that.

LaRont: Are all standards committees structured with an A-Team and a larger task group?

Most are. A few are still working on concepts and planning to form their A-Team. Our process is identified in our committee policies, and standardization procedures provide a higher-level look at how we develop and produce a standard. It's the attention to detail that ensures everyone has a positive experience.

Leaders may ask for an action to be addressed by an A-Team. A-Teams are an excellent way to get more deeply involved. They are small teams, no more than 15 people, that are focused on a topic or concern from the industry, and they often meet multiple times on video calls to discuss the topic and prepare their information for the larger group.

"It's the attention to detail that ensures everyone has a positive experience."

Johnson: Can you talk about the dissenting views? Sometimes, knowing what didn't get into the standard is more valuable than what did. Why is that?

Absolutely. Typically, there's a lot of conversation behind what's being asked. The important thing is the attention to detail we give when someone submits their comment. We'll ask you to tell us the background and explain why you chose that recommendation. Can you provide data to support it? Do you have time to talk to the committee members or the A-Team working it? The answer typically is they'd love to be a part of that process.

Also, when they go back to their company, they can share why they shouldn't be doing a certain process. If someone asks, "Does this look good?" they can now say, "No, and here is the ramification for that."

Johnson: Right. You get the context of how the decision was made and that's a valuable technical resource.

There's a set of specifications that give you the "shall" requirements—the things you have to do—and then there's a set of guidance documents that talk about the whys, the reasoning behind it. These are the things you should be doing in your process. It's important to understand the difference between those two documents but not to confuse them.

Many times, the tribal knowledge in our guidance documents is the information that will help you to make an informed decision. Is that requirement in the standard something I want to use because I know it's a requirement for this reason, or is it something else? Does my product go beyond that standard? Perhaps I need to take exception to that detail in my internal engineering documentation and recognize that the standard is an industry consensus document and that my product has a different set of customer requirements. In that case, I will need to make sure my engineering documentation meets my customer's requirements. Of course, engineering documentation always takes precedence over IPC standards.

I encourage everyone at the IPC APEX EXPO to stop in and see what a committee is like—especially on a topic they're interested in—so that they know what's going on in the industry and how it happens. If they have any time to contribute or to sit and listen to conversation, we welcome them with open arms.

Johnson: Teresa, thank you. **PCB007**

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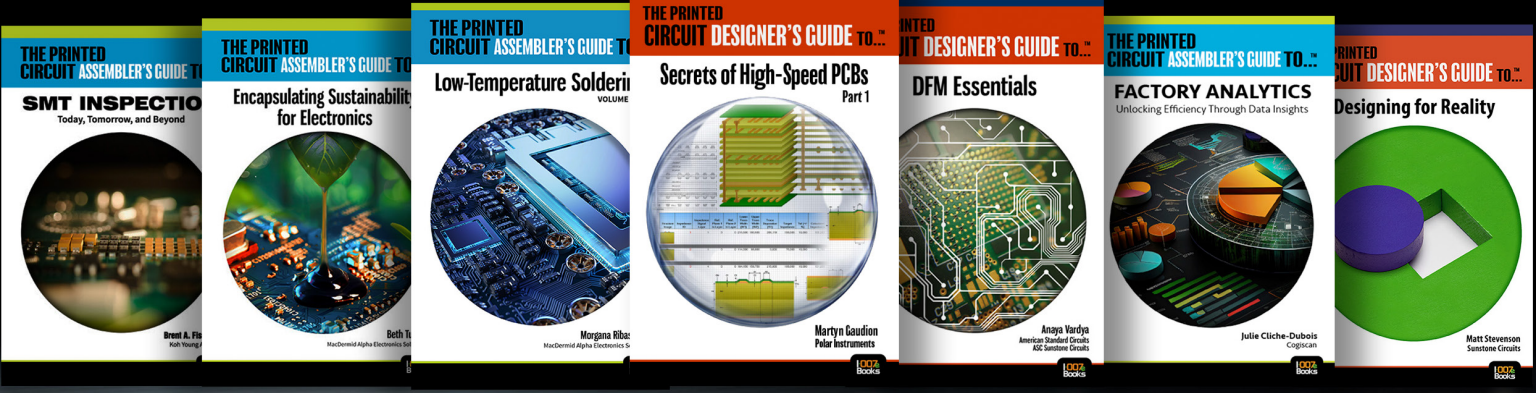
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Standards Out in Front at IPC APEX EXPO

Feature Article by Teresa Rowe
IPC

Standards development task groups will once again meet during IPC APEX EXPO 2025. This is an opportunity for subject matter experts from around the world to gather and discuss requirements and guidance documents for the electronics industry. During these meetings, attendees will hear discussions on topics that include supply chain, Factory of the Future, printed boards, materials, assemblies, and coatings.

Standards development task groups will meet March 15–20. Technical discussions will allow attendees to share knowledge, learn from and network with others also interested in technology. As in years past, you will find many meetings occurring at the same time, with some of them on new topics.

Staff liaisons are busy preparing for the meetings. Updating documentation, gathering comments, and meeting with leaders to



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discuss agenda items are some of their responsibilities leading up to the meetings at APEX EXPO. Discussions with leaders help to scope a meeting agenda and keep the group focused during the valuable time set aside for a face-to-face meeting. This provides the best experience for everyone at the table.

In some cases, task groups will be discussing assigned action items and the input gathered from the A-Team or assigned task group members. These will be presented, and the content discussed for possible inclusion or update to existing documents.

If you have not attended a standards development meeting, we encourage you to take the time to see what happens at one of these meetings. It's a chance to meet others and have your voice heard in developing requirements that drive our industry. If, by chance, you or anyone planning to attend finds that there is a conflict between two or more standards development task group meetings, the meeting minutes published after a meeting can serve as a means to remain current with an activity.

The key is to be a member of the task group and follow the progress. While staff prepares to greet you at IPC APEX EXPO 2025, we ask you to consider taking steps today to join a task group by clicking here and completing the "Join a Committee Today" form. There's no better time than the present to get started on standards development activities. **PCB007**



Teresa Rowe is senior director of assembly and standards technology at IPC.





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An Overview of the Keynote Presentations



Compiled by Marcy LaRont
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"AI, Automation and the Digital Transformation"

Presenter: Kevin Surace, futurist, visionary, and inventor of disruptive innovation and generative AI
8:30–9:30 a.m. Tuesday, March 18 (Open to all)

Discover where artificial intelligence stands today, where it's headed, and how you can participate. Witness robots and algorithms achieving real-world success and learn about the processes that can transform your company starting now—nothing to fear, it's just math. You'll laugh out loud while also being prompted to think deeply, leaving with fresh insights ready to implement.

As AI, IoT, and cloud computing represent the most significant technological shifts in decades, understanding what they are, how they work, and the practical knowledge you can apply today is crucial. Those who embrace these innovations will effortlessly outpace their competition. Regardless of your industry, integrating these technologies into your business

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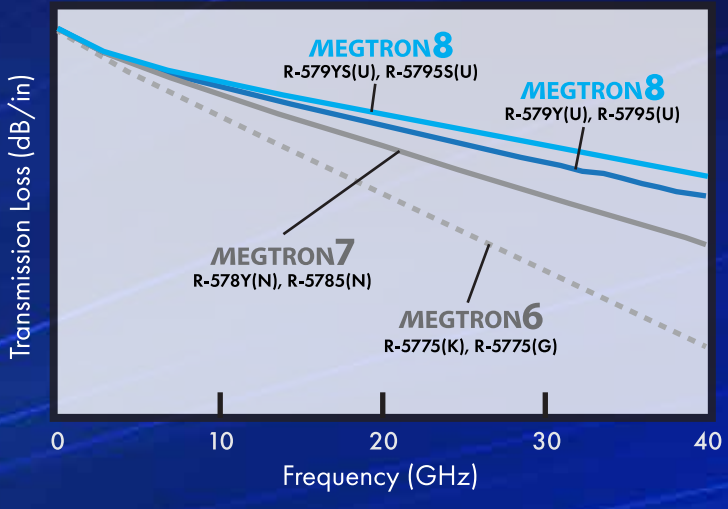
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Surace, known as the father of the virtual assistant, is a Silicon Valley "disruptive" innovator and leader in the application of AI, with 94 worldwide patents. He was *INC Magazine*'s Entrepreneur of the Year, a CNBC top Innovator of the Decade, World Economic Forum Tech Pioneer, featured for five years on TechTV's Silicon Spin, and inducted into RIT's Innovation Hall of Fame.

He led pioneering work on the first cellular data smartphone, the first AI virtual assistants (like Siri), the first generative AI in software testing, and many artificial intelligence inventions.

"3D Integration and Chiplets: An Edge AI Perspective"

Presenter: Dr. Ahmad Bahai, senior VP and CTO, Texas Instruments

8–9 a.m. Wednesday, March 19 (Open to all)

Advances in semiconductor technology and packaging have accelerated further since CMOS scaling has slowed down. Analog and mixed-signal circuits and systems have utilized a variety of processes such as BCD, SiGe, and Wide bandgap semiconductors to address diverse applications in power, RF, precision, and high voltage. Also, MEMS nanotechnology relies on many advances in CMOS manufacturing but doesn't depend on cutting edge lithography.

Edge AI sensing applications bring together diverse technologies such as MEMs transducers, RF connectivity, power management, ML engines, and analog frontend in one package or module. The coexistence of multiple technologies in a single chip or module has fueled many innovations on advanced packaging techniques such as 2.5D and 3D integration. Wafer level packaging and hybrid bonding promise to bring the efficiency of silicon fabrication to packaging flow. In this talk, we review the impact of 3D integration on system performance and assembly of system in package and modules with particular attention to edge AI sensing.

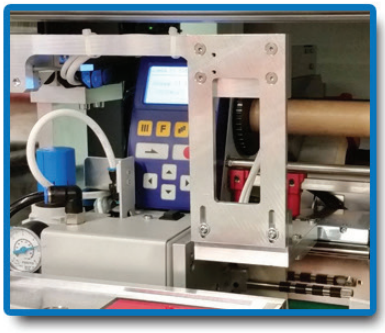
Ahmad Bahai is a senior vice president and chief technology officer (CTO) of Texas Instruments responsible for guiding break-through innovation, corporate research and Kilby Labs. He is a professor of The Practice at Massachusetts Institute of Technology, IEEE Fellow, and a member of Industrial Advisory Committee of the CHIPS Act. He also served on the Presi-

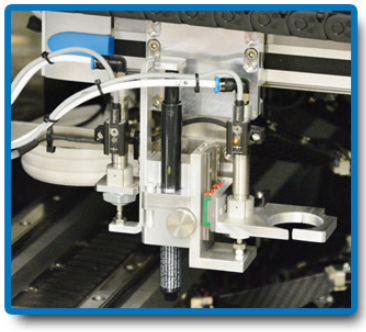

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dent Council of Advisors on the Science and Technology semiconductor working group. He was an adjunct professor at Stanford University from 2017–22 and a professor in residence at UC Berkeley from 2001–10.

Throughout his career, Bahai has held a number of leadership roles including director of research labs and chief technology officer of National Semiconductor, technical manager of a research group at Bell Laboratories, and founder of Algorex, a communication and acoustic IC and system company, which was acquired by National Semiconductor.

He holds a Master of Science in Electrical Engineering from Imperial College, University of London and a doctorate degree in electrical engineering from University of California, Berkeley.


Dr. John W. Mitchell

"Electronics: The Resource Transforming the Global Economy"

Presenter: Dr. John W. Mitchell, president and CEO, IPC

Noon–1:30 p.m. Wednesday, March 19 (Separate registration required)

Electronics is the critical resource for the continued growth of the global economy. Mitchell will discuss the role of industry, governments, and global bodies in resolving supply chain, sustainability, technology, and information challenges and propose solutions allowing electronics to continue to transform how we live, work, and communicate successfully.

Mitchell is a best-selling author and a leading expert on solving global workforce issues. A big-picture thinker who routinely works with global leaders from more than 3,000 companies worldwide, he has made it his mission to bring innovative and original systems and frameworks to hiring, developing, and retaining talent. In his keynote talks, Mitchell shares inspiring stories of companies and organizations that have adapted to fundamental workforce changes by focusing on what matters most: The human beings they hired. He delivers the key business strategies and management directions to recruit and retain the best talent for your companies. Whether you're a seasoned CEO or a workplace neophyte, Mitchell can help you build a successful workplace in a rapidly changing landscape. He will share practical, actionable insights that you can implement immediately. **PCB007**



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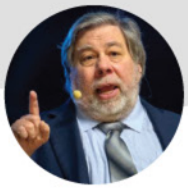
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2004
Mike Cannon



2003
Bob Herbold



2002
Donna Shirley



2001
Robert Ballard



2000
Norman Schwarzkopf



2024 Sustainability Highlights:
IPC's Commitment to a Greener Future



Feature Article by Kelly Scanlon
IPC

In 2024, IPC's Sustainability for Electronics program made significant impacts through multiple channels of engagement by providing the industry with insights and tools needed to build electronics better. IPC representatives shared expertise at industry events, demonstrating how standards, education, and advocacy support sustainability goals. Industry leaders reciprocated by presenting their successful sustainability initiatives at IPC events, offering valuable real-world perspectives on implementing sustainable practices.

Responding to calls for industry alignment, we formed strategic partnerships with other electronics associations to consolidate and distribute sustainability resources across our extensive industry network. Our efforts focused on harmonizing approaches and maximizing impact through collaborative action. We played a crucial role in highlighting critical industry challenges, including emerging global plastics policies, new due diligence requirements, circular design innovations, and sustainable chemical alternatives. A key achievement was the publi-

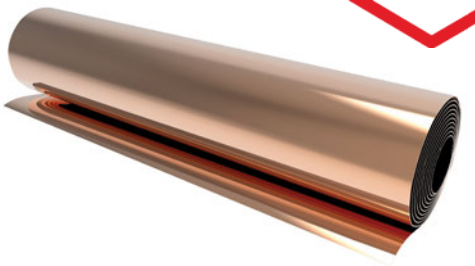
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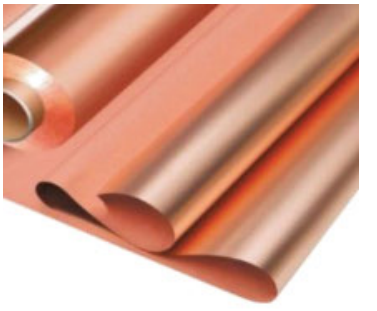
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cation of our white paper on double materiality assessments (DMAs), which addresses new due diligence laws (more on this below).

Throughout the year, IPC maintained its position as a trusted source of guidance on complex sustainability matters, helping the electronics industry adapt to evolving demands while promoting more sustainable practices. We recognize the need to build a network of industry partnerships by collaborating with key organizations like Clean Electronics Production Network, the Responsible Business Alliance, iNEMI, and ChemFORWARD, and hosting an online seminar for 123 unique companies on greener cleaning standards (e.g., IPC-1402) and innovative tools (e.g., CleanScreen app). (View webinar recording here.)

Events

Throughout 2024, IPC expanded its global sustainability community by hosting and attending almost two dozen events about sustainability for electronics. At IPC APEX EXPO 2024, we had more sustainability-related content than ever before, including 27 technical presentations, multiple on-camera exhibitor interviews, and executive leadership discussions.

We hosted events with industry representatives to talk about pressing sustainability challenges, including circularity. We hosted a four-hour workshop at the Electronics Goes Green conference in Berlin in June and we received thoughtful, useful insights from 33 participants from 27 electronics-related companies on their circularity problems. We spoke about sustainability "problems" and "solutions" with:

- Electronics recyclers and refurbishers (eSummit in Austin)
- Lifecycle assessors (ACLCA in Utah)
- EMS and PCB companies in Europe (electronica in Munich)
- Electronics manufacturers in Asia (IPC CEMAC in Shanghai)
- Electronics-related chemical manufacturers and users (Chemical Watch event in Boston)
- IPC-hosted events across Europe

IPC hosted online discussions about policy drivers (e.g., CSDDD and ESPR) and standards that can help the industry (e.g., IPC-1402 on greener cleaners).



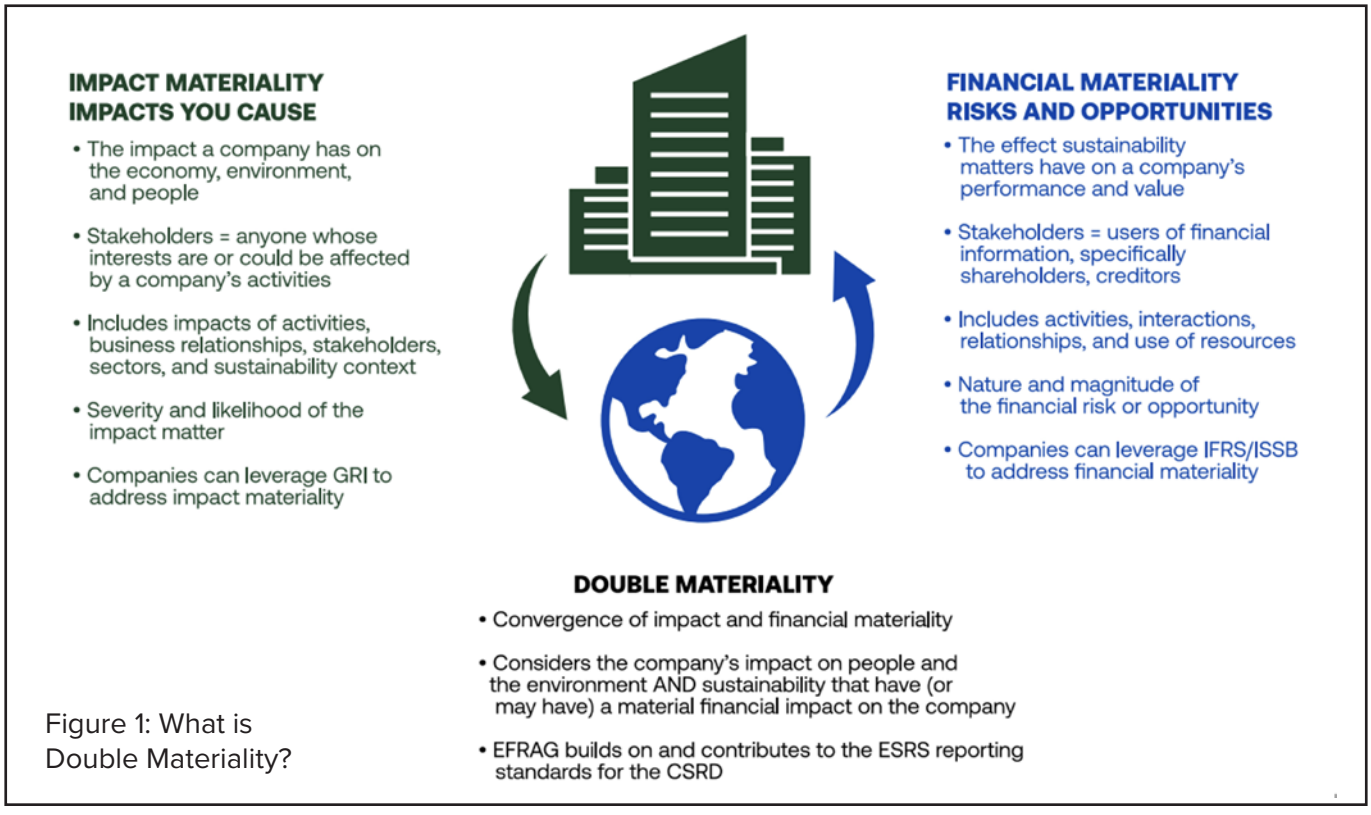


Figure 1: What is Double Materiality?

We've directly interacted with hundreds of electronics industry experts including those who work directly in electronics manufacturing, academia, governments, and NGOs. This community continues to grow, and IPC is the hub for resources and connecting colleagues.

Double Materiality White Paper

In December, we released a white paper on the topic of double materiality assessments (DMAs) with input from 15 industry experts, and provided timely guidance for 2025 reporting requirements.

The concept of double materiality may seem complex at first glance, but its significance for the electronics manufacturing industry is both tangible and far-reaching. It's about understanding how sustainability impacts your business, how your business impacts the world, and then leveraging that understanding for growth and compliance.

At its core, a double materiality assessment (DMA) requires companies to take a dual approach to sustainability by evaluating impact materiality (how your organization affects the environment and society) and financial materiality (how sustainability-related issues affect your organization's financial performance). This dual perspective is at the heart of the European Union's Corporate Sustainability Reporting Directive (CSRD), a landmark regulation that's reshaping sustainability reporting requirements across the globe.

IPC collaborated with Anthesis Group, a global sustainability consultancy, for the white paper, "Why Double Materiality Assessments Matter: Compliance and Competitive Advantage." This guide is for anyone navigating the CSRD.

The white paper breaks down the DMA process into four key areas:

1. Understanding the concept: Why double materiality matters and how to approach it.
2. Structured methodologies: A step-by-step guide to conducting a DMA, from defining sustainability priorities to engaging stakeholders and validating data.
3. Navigating regulations: Insights into the CSRD and how it aligns with global frame works like ISSB and GRI.

Figure 2: CSRD reporting criteria.



4. Engaging stakeholders: Tips for effective communication with investors, suppliers, and internal teams.

The white paper includes a glossary, FAQs, and real-world case studies. For example, imagine a European semiconductor manufacturer using a DMA to uncover risks in its supply chain, everything from responsibly sourcing raw materials to reducing production waste, or consider a multinational tech company aligning its sustainability reporting with CSRD and ISSB standards, achieving greater transparency and efficiency across its subsidiaries.

Yes, the CSRD sets a high bar for sustainability reporting. But DMAs offer organizations value beyond just regulatory compliance. By understanding how sustainability issues affect their business—and vice versa—electronics companies can gain operational efficiencies in a competitive global marketplace.

Mari Desangles of Anthesis agrees. "Through a double materiality assessment, companies can understand their most significant sustainability-related impacts, risks, and opportunities, then make informed strategic decisions about how to address them," she says.

Whether you're grappling with the CSRD for the first time or looking to refine your sustainability strategy, this white paper is an essential resource. It's about more than ticking a regulatory box, it's about setting your company up for long-term, sustainable success.

What's Coming in 2025

Additional Resources for the DMA Toolkit

Context Report: The Context Report provides a foundational resource for members of the electronics manufacturing industry (EMI)

to conduct double materiality assessments (DMA) in alignment with the European Sustainability Reporting Standards (ESRS) under the Corporate Sustainability Reporting Directive (CSRD). It is designed for internal project teams, senior management, and stakeholders involved in sustainability reporting, strategy development, and stakeholder engagement. By offering an overview of the EMI's value chain, activities, business relationships, and sustainability matters, the report enables EMI members to efficiently understand their operating context.

Project Plan: IPC partnered with Anthesis Group to develop an industrywide Double Materiality Assessment (DMA) Toolkit. The Project Plan is a foundational resource to plan a double materiality assessmWent and is meant to be used alongside the rest of the DMA toolkit assets. The purpose of the Project Plan is threefold:

1. Educate yourself on double materiality assessments and better understand your company's capacity. Use this guide to better understand what a double materiality assessment is and how to implement within your organization.
2. Develop a project plan that can be customized to fit your organization's specific needs. Specifically, consider your SMEs and key stakeholders when getting ready to adapt this project plan for your organization.

Empower your company to engage the right team to execute the process and understand what parts, if not all, of a DMA process your organization will undertake in-house vs. hiring an external consultant. It can be especially helpful when engaging with external sustainability consultants or auditors during the RFP or procurement process.

IRO scoring template: A resource to support scoring your company's unique impacts, risks, and opportunities. This is accomplished by:

- Understanding the organization context: Activities, business relationships, sustainability context, stakeholders
- Understanding actual and potential impacts, caused (impact materiality) and incurred (financial materiality)
- Understanding the scale, scope (and likelihood) of these actual and potential impacts, and the time horizon over which they will (or may) occur *(Continued on page 92)*



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> "This document captures insights from industry engagements, identifies pressing issues, and outlines pathways to a circular economy."

- Determining a threshold for materiality and assessing impacts to be above or below the threshold

The outcome of this process is a scored list of sustainability impacts, risks, and opportunities.

Safer Chemical Alternatives Training Guide

Recognizing the need for practical knowledge and resource sharing on safer alternatives, IPC has partnered with the Clean Electronics Production Network (CEPN) to develop a Safer Chemical Alternative Training Guide for interested stakeholders throughout the electronics manufacturing supply chain. It provides practical information for businesses in the electronics sector seeking to use safer alternatives in their products and processes and is intended for use by a wide range of individuals charged with making chemical selection decisions.

Scope 3 GHG Report and Webinar

In 2024, IPC evaluated the Scope 3 greenhouse gas (GHG) emissions landscape including the current state of Scope 3 reporting by organizations in the electronics sector. Leveraging data reported to CDP, IPC has reviewed the frequency of Scope 3 reporting across the industry to better understand the relative magnitude of emissions across and within the various Scope 3 categories. This report will expand on the work already completed by conducting a deeper dive into the data to further understand the Scope 3 methodologies being used by companies reporting to CDP. The findings from the initial CDP effort and this additional research will be developed into a white paper summarizing the results of the data analysis and will highlight the implications for enhancing and expanding Scope 3 accounting and reporting across the industry. IPC will be hosting a follow-up webinar to share the findings of this report with the broader electronics manufacturing industry.

There's No End to a Circle

This report explores the importance of the concept of circularity within the electronics industry, focusing on the challenges, opportunities, and actionable solutions to promote sustainable practices. Circularity aims to create systems where resources are reused, recycled, or repurposed to minimize waste and maximize efficiency. This document captures insights from industry engagements, identifies pressing issues, and outlines pathways to a circular economy.

Importance of Circularity

Circularity is vital for sustainable development, reducing environmental impact, conserving resources, and creating economic opportunities. Its benefits include:

- **Resource conservation:** Minimizing extraction of finite materials through reuse and recycling
- **Waste reduction:** Designing products for longevity and repairability
- **Energy efficiency:** Reducing energy demands in production
- **Economic growth:** Unlocking business opportunities in recycling and refurbishing
- **Environmental protection:** Lowering emissions and pollution

Key Challenges

- **Data availability and standards:** Lack of reliable, consistent data hinders lifecycle assessments (LCAs) and informed decision-making
- **Economic incentives:** Insufficient ROI for adopting circular practices discourages investment

- **Design for circularity:** Existing products are not designed for reusable or repairable disassembly nor optimized for material recovery when life extension is not feasible
- **Supply chain coordination:** Fragmented supply chains struggle to align efforts for effective circularity
- **Lack of awareness and education:** Limited understanding of circular principles among stakeholders

Industry Engagements and Findings

- **Workshops and surveys:** Stakeholders identified barriers such as low economic incentives, lack of global policies, and the need for better data collection via digital product passports
- **Case studies:** Initiatives like chip reuse projects and standards for marking boards demonstrate the potential of circular solutions
- **Collaborations:** Partnerships among manufacturers, policymakers, and academia have highlighted the value of collective action

Recommended Actions

- **Foster collaboration:** Engage the entire supply chain to identify and address circularity challenges collectively
- **Develop standards:** Create frameworks for data sharing, product passports, and circular product design. Leverage existing CEP guidelines
- **Enhance education:** Provide training and resources to build awareness and skills in circular practices
- **Improve infrastructure:** Invest in systems for recycling, refurbishing, and data sharing
- **Promote economic models:** Implement tax incentives and subsidies to make circularity financially viable

2025 Outlook

- **Working groups:** Continue efforts in data challenges, education, and economic initiatives
- **Stakeholder engagements:** Expand participation in forums and webinars
- **Industry resources:** Develop a repository of case studies and standards to guide circular practices

We will have more exciting news to announce in the coming months so stay tuned. **PCB007**



Kelly Scanlon is the lead sustainability strategist at IPC.





Standards Driving Factory of the Future

Feature Interview by Marcy LaRont

Thomas Marktscheffel, product manager for ASMPT's software portfolio, has been deeply involved with IPC committee and standards work for many years. He chairs the IPC HERMES-9852 standard committee and is involved in the evolving DCX standard.

In this conversation, Thomas discusses the challenges of skilled labor shortages and the rising significance of cybersecurity in modern manufacturing. He emphasizes the collaborative effort required from various vendors to achieve a truly intelligent and efficient factory ecosystem, highlighting the importance of data-driven automation, AI integration, and seamless interoperability through adopting standards. Thomas is enthusiastic about what is possible today with manufacturing's use of data and how that is an evolved vision for Factory of the Future. Though this industry buzzphrase is currently focused solely on EMS, it is reflective of what is coming for PCB fabricators as well.

Marcy LaRont: Thomas, why do we need IPC standards to work toward a Factory of the Future vision for our organizations?

Thomas Marktscheffel: The Factory of the Future is a data-driven factory. At first, it was about simple automation. Then came the Smart factory, which analyzed data to drive decisions

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Thomas Marktscheffel

about automating workflows. Now, we have artificial intelligence. Of course, the Factory of the Future will be AI-based, not only in analyzing the data and looking for correlations but also in learning from what has happened to a project and what will happen in the future.

This will be the "Intelligent Factory," and it will be automated as much as possible. More than ever, we need transparency to know what's going on. There are deadlines for production, quality requirements, and yield costs. My priority is to know what is happening in my production to make the right decisions and know that what I promised is happening seamlessly and in an integrated way. But there is no single machine or software vendor that can do it all.

A Factory of the Future is always a combination and cooperation between different vendors. As a manufacturer, I don't want to be concerned about where and how they come together; it simply must work. That's seamless integration. It must be easy to deploy with new equipment because, as a manufacturer, I don't have days or weeks for integrating this new equipment into my intelligent factory.

How does cybersecurity fold into this picture?
Cybersecurity is always on the agenda. We have heard about companies that have been hacked and their data either destroyed or encrypted. They had to pay ransom, and the factory was down for days or even weeks. Factory downtime always translates into business and financial losses, as well as a loss of customer trust.

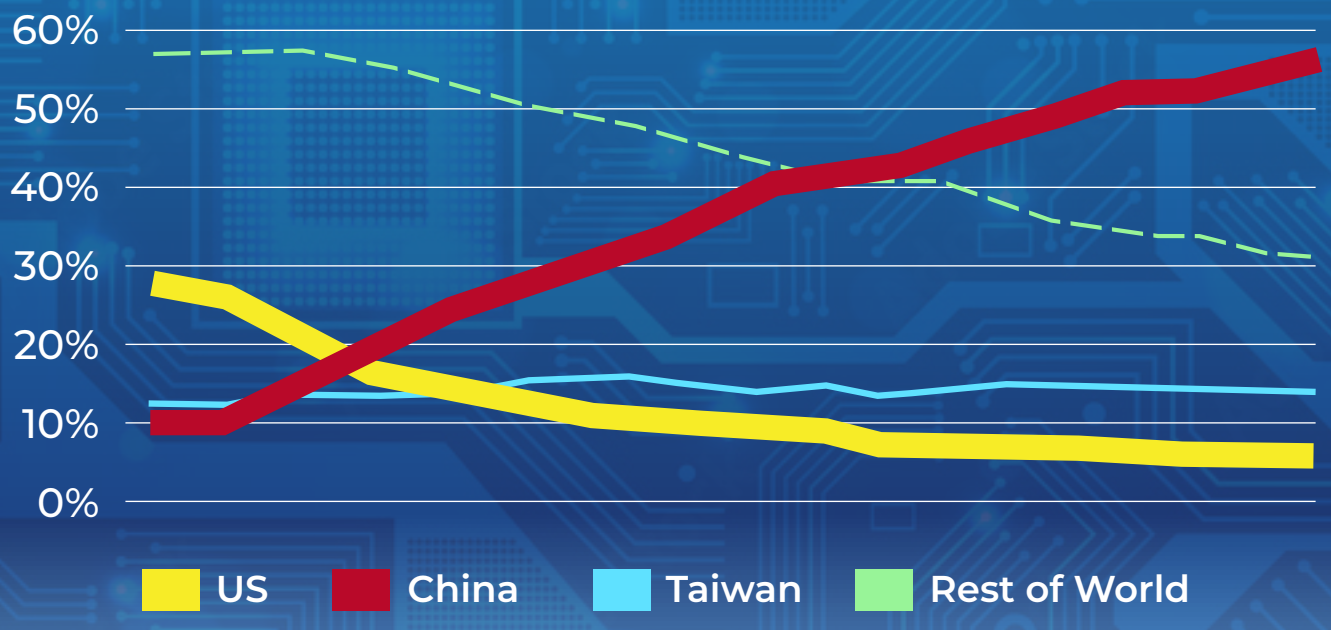
The U.S. has the CMMC, a phased cybersecurity compliance. What does Europe have?
We have the Cybersecurity Resilience Act, which will be mandatory in 2025. It puts a lot of responsibility on factories and their suppliers because a factory can pass on the responsibility to the supplier. The supplier must ensure that the products are secure. It is the same with the CMMC. You can't say, "Once I have sold something as a machine vendor or software vendor, I bear no responsibility, and the factory will get back to me if something happens." That is no longer the case. Everyone along the supply chain has liability and responsibility.

It feels like intelligent data for decision-making, process optimization, communication, data transfer, and utilization between machines is one of the most significant developments in the past year for both PCB fabricators and assembly providers. What do you see?
Definitely. I was the head of a software R&D department, and for more than 20 years, I did a lot of integration work transforming data from one format into another and building interfaces to transfer it from one machine to another. The gains we are making in intelligent data deployment and communication are important for automation, but even more for AI.

Assembling PCBs on an SMT line is always a cooperation between all machines. If one machine is not integrated into the overall workflow, it does not work. If data cannot flow, then you have built-in hurdles that hinder you from applying automation or, even worse, from using AI because if there is a systemic hurdle blocking you from training your AI with your data, it will not work. You cannot participate in the training, and you will not achieve that technical progress. Now, AI is everywhere. You don't

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have to search for it. You just download and use it. There's no technical limitation. The only limitation is a process limitation in the factory.

With the CFX standards, when training AI, the data must be consistent. The standard-to-transfer data is one good example. So, if I call China, the GSM protocol means I immediately get a connection. When someone answers the phone, I don't need to worry if it's an iPhone or a Samsung, it just works. I'm more concerned about what language they speak, to be honest.

The same applies to a factory. If all these different machines speak their own language, it's like the Tower of Babel. You have a lot of expensive equipment, but you cannot get it to work together. That's the huge benefit of these standards. When we introduced CFX in 2019, it was a breakthrough because it was the first time such a standard was published and then, step by step, was adopted by the entire industry. That is where we are now.

What about ESG data and all the reporting now required in different formats based on one's country? I assume CFX helps with that as well.

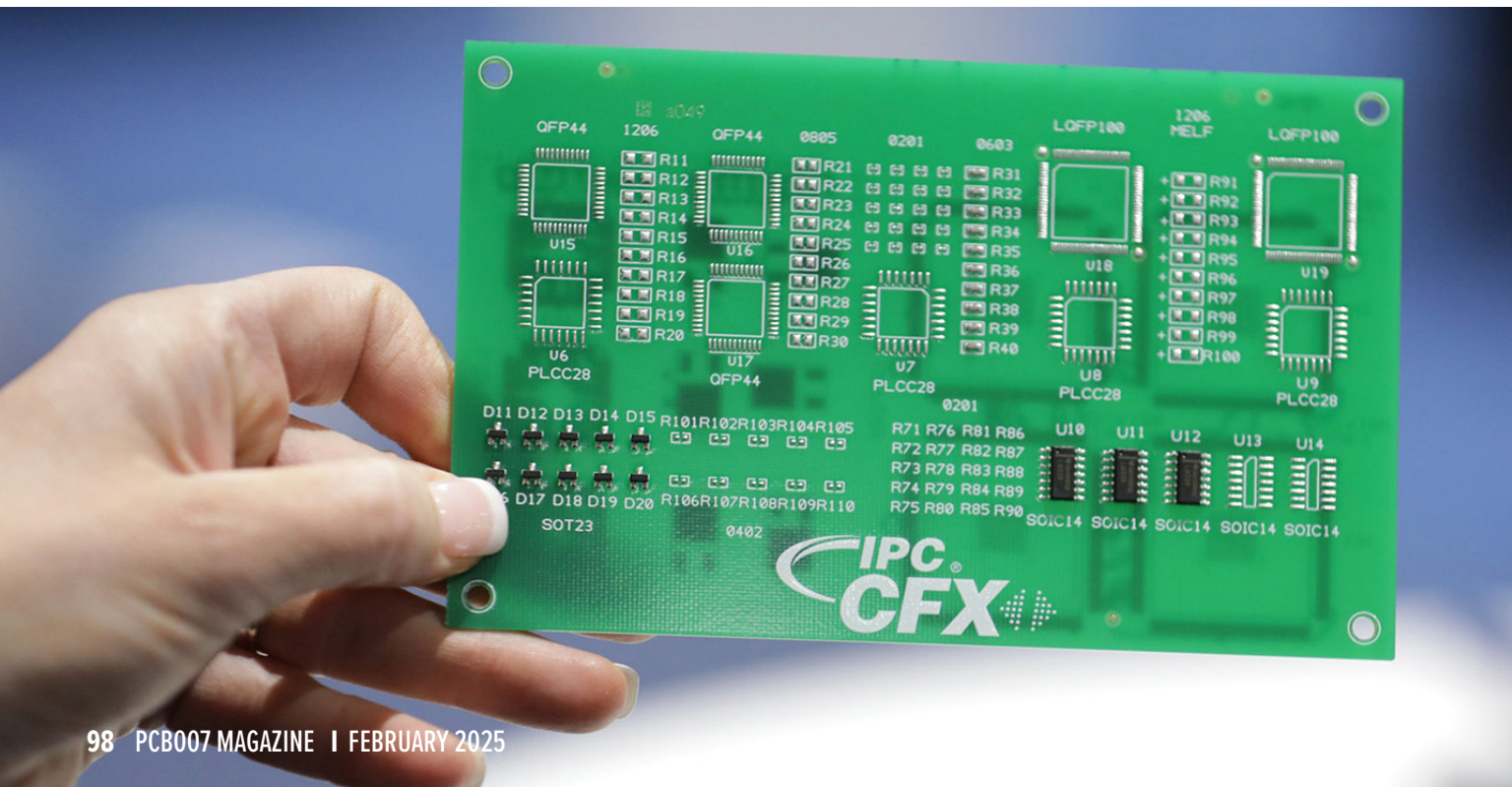
Yes, customers want economic, traceability, and even sustainability data. All these standards are built around CFX. This year, we will be adding a standard that supports secure transfer and management of access permissions so that when publishing traceability data, you get a clear picture of which components were used and where they are from within an electrical device. This aspect of data security is important because this information can also be used to steal the IP—to re-engineer the device and rebuild it.

That is, of course, one of the most important aspects of cybersecurity and the need for such a standard.

There are technologies available that allow us to protect IP, but the standard gives the customer security and trust that there was a process and that there is data traceability in case of a problem. This is the missing piece in the set of standards for Factory of the Future that we currently have.

I imagine we will see more on that in the coming year. What are the biggest reasons a factory owner would be compelled to adopt Factory of the Future?

First, an owner can achieve up to a 90% reduction in lost yield. That's a game-changer. The gains are achieved in the cumulative correction compensation as you go through the process.



Factory of the Future Standards Ecosystem

IPC-175X – Product Declaration

IPC-1782 – Traceability

IPC-1783 – Data Collection and Reporting for Sustainability Compliance

IPC-1792 – Cybersecurity

IPC-2551 – Digital Twin

IPC/DAC-2552 – MBD for Components

IPC-HERMES-9852 – The Hermes Standard

The Center of it all:
IPC-2591 – Connected Factory Exchange

To be done:
IPC-2592 – Digital Credential Exchange (DCX)



The print process provides a good example of using CFX, not just to communicate data, but also to show what AI can do with this data. It is one of the most error-prone processes in SMT production. In the past, you needed experienced technicians who could correct for errors. What happens when an expert leaves? The print process might degrade. Other challenges can arise, such as not enough or too much solder paste, so that the solder process of components is not sufficient, or after reflow, components may swim around and move into a wrong position.

With AI, the machine measures data taken from the inspection system, looks at the print results, analyzes whether it is a good result, and if not, feeds the corrective action back to the printer. This is a closed loop that automatically stabilizes the print process with no need for a process expert with decades of experience to do it manually. This provides a big yield increase because a stable print process guarantees that the pick-and-place process will work reliably and consistently.

In the past, there were several proprietary standards that tied manufacturers to certain combinations of machines. A business would purchase what they believed to be a best-in-class inspection system and printer, only to realize later that the two do not work together. They do not understand each other. That's not a problem with CFX.

It also enables a manufacturer to choose the best software solution for analysis. Maybe there's a company with huge expertise in the print process, and they provide software. In the past, with proprietary interfaces, maybe that software was not able to connect to a certain printer or inspection system. CFX decouples software applications from machines. It eliminates dependencies of particular machines to specific vendors.

Thomas, you have referred to the group of standards governing this area as the Factory of the Future ecosystem. Can you give a brief summary of these standards?

Yes, let's start with IPC-175x, Product Declaration, a standard that describes the components used during manufacturing, and what is coming into the factory from the supply chain. It was created about 20 years ago, and, in its simplest form, describes the component and maybe some of its electrical properties. With some components, *(Continued on page 102)*

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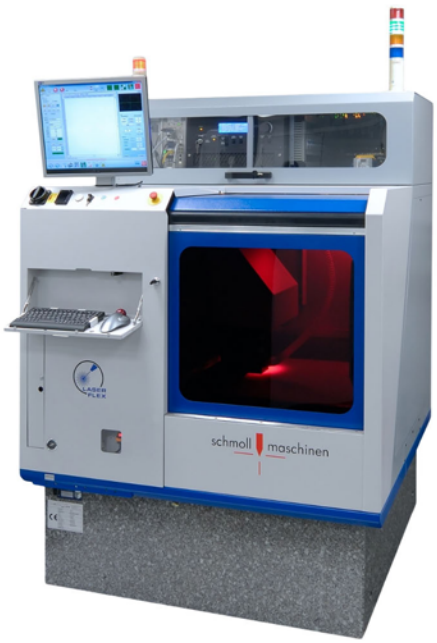
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All four machines will be on display!

it's a bit more complicated as there may be legal requirements.

For example, if there is a hazardous variable, i.e., certain chemicals used, or it's being used for the military, it requires additional information and lets the manufacturer know whether special handling is required. This can be included in the product declaration. If there's a problem in the field, it can be tracked back, even identifying the lot from which it came to track other potentially bad components. That would be important in, for example, the automotive industry if there's a recall. There are billions of these declarations out in the world sitting somewhere in a database.

That is a lot of data to mine through.

Another one is IPC-1782, which originally started with different levels of traceability and covers the supply chain. During the pandemic, there were disruptions to supply chains and sometimes even known quality components suppliers didn't have enough capacity to fulfill a certain order. They took components from partner suppliers, which for some products and manufacturers was okay; but it wasn't okay for others. It became a violation of the contract. Sometimes a different vendor may not meet the quality requirements for a certain product, especially for medical, automotive, and military applications.

What about IPC-1783 that's meant for reporting data collection and reporting for sustainability?

Yes, that one is brand new. There are a couple of new standards in Europe: digital product passports and sustainability standards. There are three scopes that require certain data from production. So, how can this data be retrieved from production?

We are specifying a standard approach, a procedure for how to get this data, which will provide the databases to fulfill the legal requirements for digital product passports and reporting to governments, whatever it may be. Today, this is difficult and requires a lot of effort, because every manufacturer develops this independently. There's a costly audit certification before the manufacturer can publish this data. Our objective is to provide this defined standard on how to collect this data that will simplify the audit and make it less costly.

What about cybersecurity and digital information exchange, a standard still being defined?

Cybersecurity is about handling security incidents. What if you discover a breach in your security? How do you stop and recover? We have IPC-1792 to help with this.

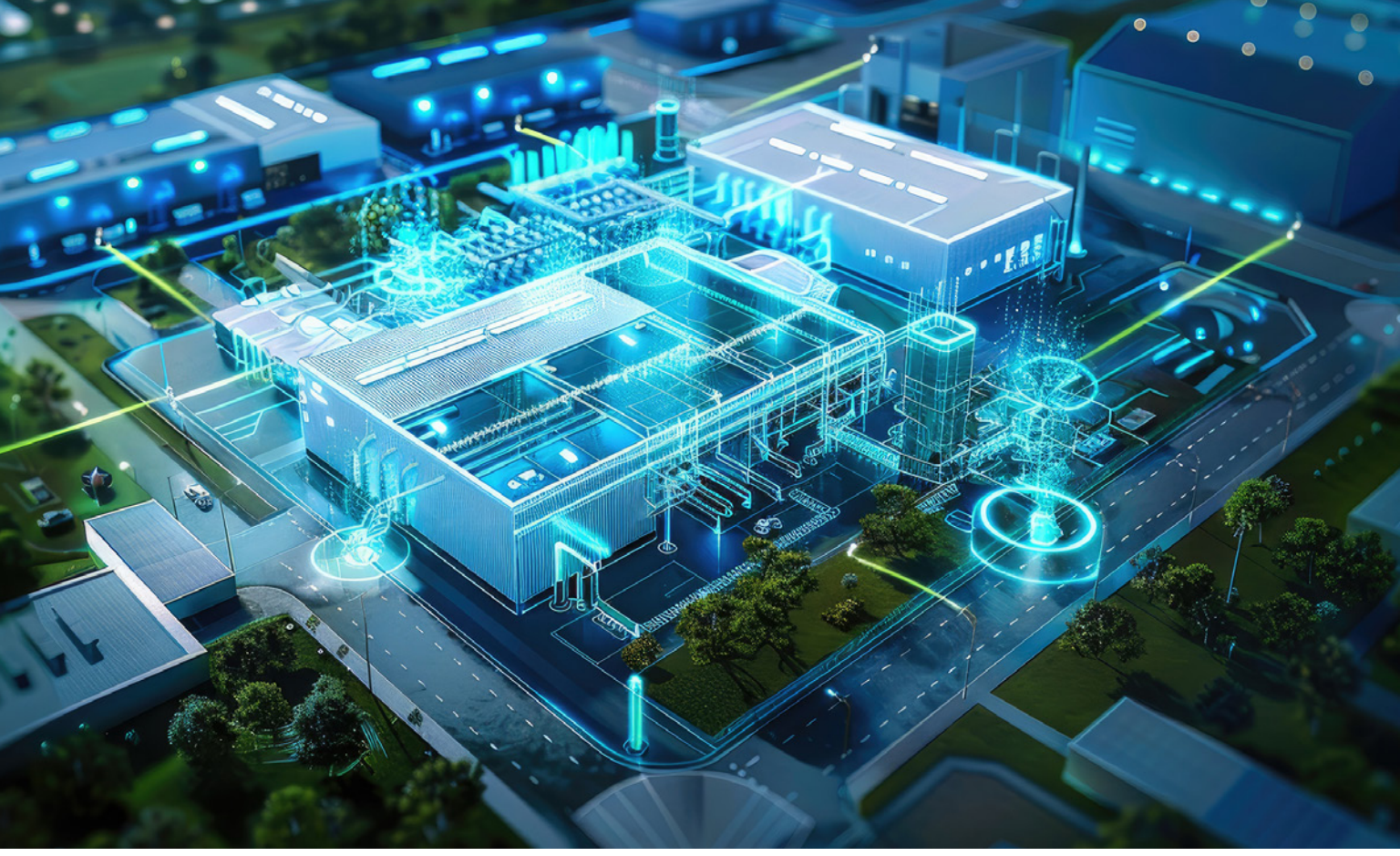
IPC-2591, Connected Factory Exchange, is at the heart of this. We will begin working on IPC-2592, Digital Credential Exchange (DCX), this year. This standard is about reporting to potentially different stakeholders who may need completely different data. It can be done with a digital credential exchange. The information is encrypted, and then, based on the access permission, the different stakeholders can see the different levels of data details they specifically need.

"What if you discover a breach in your security? How do you stop and recover? We have IPC-1792 to help with this."

That is next-level and, quite frankly, something we have just gotten to recently

When talking about data, until about five years ago, there was a long-used SMEMA standard, which is also an IPC standard, but it was limited. It was really about a couple of cables and electrical signals that took care of handing PCBs over. At that point, all data was lost. It could no longer be used by the SMT machines. They basically had to start over.

The idea behind the Hermes standard is that certain data, such as which products are being built, the board's physical dimensions, or any-



thing important for the next machine to handle the board, will be transferred with Hermes.

It allows you to put a PCB at the beginning of the line and tell the first machine about the product that is being built and any other important information. Then, the machine talks to the MES system to identify the proper program. Each machine hands over to the next machine, one after the other, with each machine getting what information it needs to do its part in the process automatically.

Thomas, what do you hope is accomplished this year?

As we look at digital credential exchange, one missing piece is the ability to connect all this to customers and governments. I also see that we still have much work to do around sustainability, which is becoming more important. These two pieces are missing today. We have plans to address them over the next two years. Still, the most important thing is to continue pushing for the adoption of standards. Companies need to be open and cooperate so that the discussion of whether you do or don't build to this or that standard becomes unnecessary. The answer should be, "Of course I support it." That will open the door for completely new solutions and will also enable more AI solutions, and ones that are not just propriety.

Do you feel like we're getting there? Cooperation has always been difficult for our industry.

Yes. Much has changed over the past two to three years, and many machine and software vendors are now offering CFX. This makes it easier to avoid the hen and egg problem of "Why should I implement CFX on my machine?"

The minimum standards to comply with are Hermes and CFX. This is a standard requirement specification for large companies when asking for quotes on capital equipment. It is a must to support these standards so this will grow.

Absolutely. Thomas, thank you so much for your time. I look forward to seeing you at IPC APEX EXPO.

Thank you, Marcy. **PCB007**



Highlighting Denny Fritz

Article by Dan Feinberg

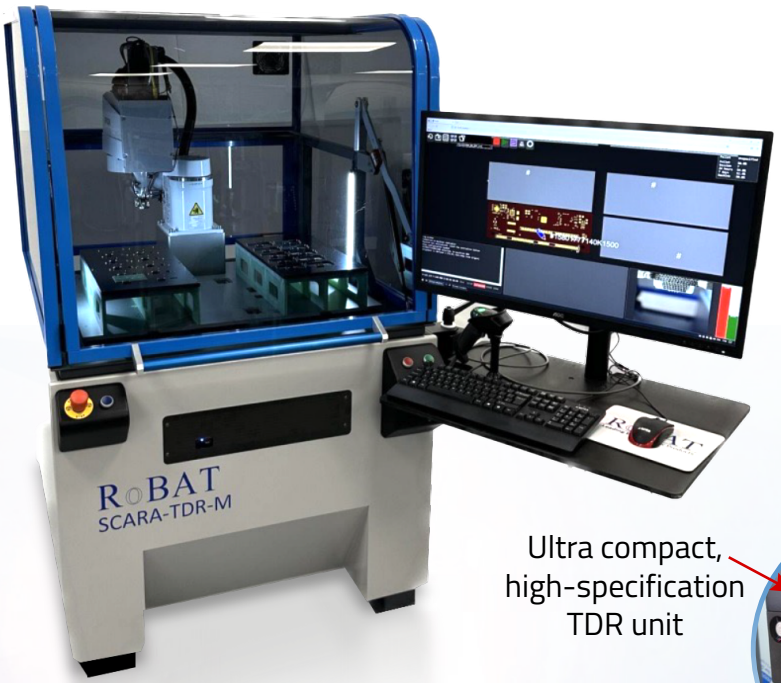
Editor's note: Dan Feinberg continues his series on the IPC Hall of Fame, spotlighting the achievements of past Hall of Fame members.

Many IPC members who have contributed significantly to IPC and our industry have been awarded the IPC Raymond E. Pritchard Hall of Fame (HOF) Award. Though many early HOF members have passed away and are unknown to today's IPC membership, their contributions still resonate. This special series on IPC Hall of Fame members provides a reminder of who was honored and why. As a bonus, for those who are still around, we get to find out what these talented individuals are up to today.

This month, the Hall of Fame spotlight features Denny Fritz, a long-time friend and associate of mine.

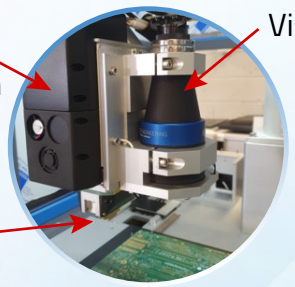
Denny first got involved with IPC in 1978 while working with MacDermid. His first efforts were with the various board fabrication committees, something he believes helped lead to

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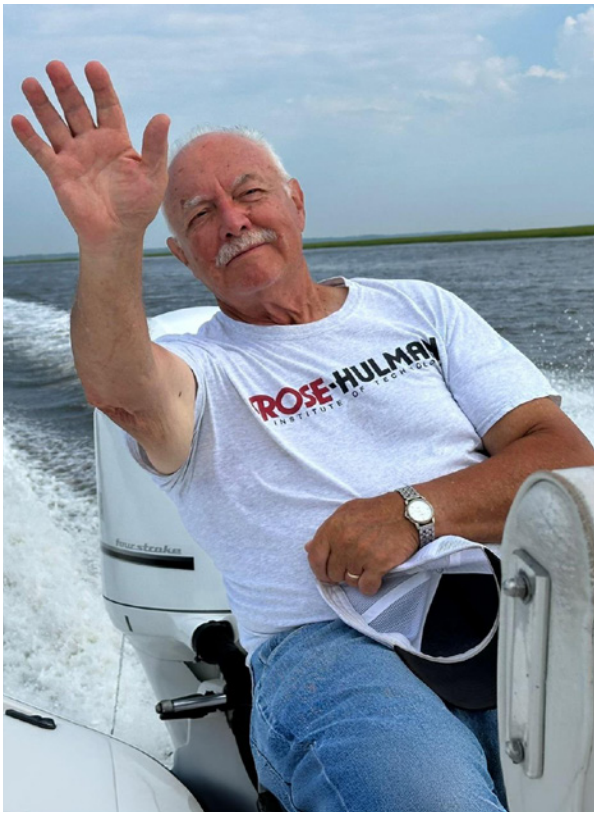
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his eventual Hall of Fame award. He considers his patron saint, Dieter Bergman, to be the one who got Denny so involved, encouraged him when he did, and also supported his nomination for the Hall of Fame award.

As with so many HOF recipients, their involvement in IPC endeavors is difficult to fully convey, but I will try here to list out many of Denny's innumerable IPC accomplishments.

Fabrication Standards Activities

- SM-840 standard, 1978–1987
- IPC Process Effects: IPC-740, chair 2005–2014
- IPC Microvias: IPC D-33D, 1995–2004
- IPC Buried Components (Resistors): D-55, 1997–2005
- Surface finishes: IPC 455x, 1995-2012

Assembly Standards

- IPC Component solderability J-002: Vice Chair, 1997–2020

Councils

- October Project: Cooperative PCB Research, 1995-2003
- Assembly and Joining Committee, 1997-2020

Roadmaps

- IPC Technology Roadmap, Fabrication Section Editor, 1996-2015
- iNEMI Roadmap, Bare Board Chapter Participant, 1998-2012

Books

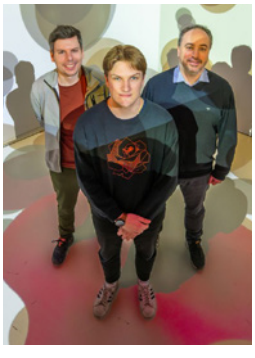
- *Printed Circuit Handbook:* Editor of the chapter on Embedded Components, 6th edition, 2012

Toward the advancement of global manufacturing, Denny also chaired the North American group of the JISSO International Council from 2006–14. The JISSO International Council (JIC) was an independent nonprofit organization in Japan governed

by a steering committee to facilitate a strategic partnership among organizations interested in the total solution for interconnecting, assembling, packaging, mounting, and integrating system design standardization. According to an IPC paper presented at ECWC 10 at the IPC Printed Circuit Expo, as it was called at the time, JISSO is a made-up word that Japanese technologists created to stand for total system integration, akin to the "silicon to systems" phrase that IPC uses today. The JIC and its members were committed to fostering open competition in the development of products and services based on industry needs. IPC was one of the initial JISSO organizers, along with Japan Printed Circuit Association (JPCA), Japan Exchange and Teaching Association (JETA), and Joint Electronic Device Engineering Council (JEDEC). Denny's early work with these groups was foundational in where IPC finds itself today in developing global manufacturing standards.

Denny is still involved with IPC and remains interested in and follows the industry's technological advancement. Denny was considered for the Hall of Fame Award due to his involvement in the Assembly and Joining Committee, as well as his interest and involvement in all aspects of printed circuit board manufacturing and assembly technology. Thank you, IPC Hall of Fame member Denny Fritz, for your contributions to IPC and the industry at large. **PCB007**

Searching for Materials for Ultra-fast Quantum Computers



The number of materials that could be used in the fast quantum computers of the future has increased thanks to Oscar Groppfeldt's degree project, for which he had access to the university's supercomputers.

It is hoped that quantum computers will revolutionise several different scientific fields such as pharmaceutical production, materials development and give a deeper understanding of how the laws of nature work.

"If we are to be able to supplement ordinary computers with quantum computers in the long term, they need to work at room temperature. We are investigating which materials could be suitable for this," says Rickard Armiento, researcher in theoretical physics at Linköping University and examiner of Oscar Groppfeldt's master's thesis.

What Oscar Groppfeldt has done in his master's thesis on the MSc programme in Applied Physics and Electrical Engineering (the Y programme) is to investigate which material defects could be suitable for future quantum computers.

"Imagine that we have a crystal in which the atoms repeat themselves in a space, and then you remove something, like a nitrogen atom. Then what we call a defect arises that can give a lot of interesting states, which you can manipulate and get information out of. But then you need to have a defect that makes sense," says Oscar Groppfeldt.

You may think that a defect indicates the material is damaged and therefore a randomness arises. But in this case, the opposite is true. What he has done is to use computer calculations to simulate the electrons in a variety of materials where he systematically replaced and removed atoms to see which optical properties can be used for quantum bits.

According to Joel Davidsson, postdoc at the Department of Physics, Chemistry and Biology and thesis supervisor for Oscar Groppfeldt, the work would not have been possible just 10 to 15 years ago.

Source: Linkoping University

TOP TEN EDITOR'S PICKS

U.S. Work Visas Demystified



The H-1B visa has been a long-time friend of the U.S. technology and manufacturing sectors. It allows companies to bring high-level talent from other countries or transition university students with student visas over to the workforce. According to Mark Howard of the U.S. Department of Security's Bureau of Educational and Cultural Affairs, the U.S. visa is, in fact, a public diplomacy program, whether it's for tourism, study, or work.

Data Paints a Picture—Can You See It?

Andrew Kelley is CTO of Xact PCB, a company founded by engineers with firsthand experience in PCB fabricators. Xact PCB has developed a cutting-edge system to monitor and predict the registration of inner layers through advanced registration control systems. By leveraging data collected from various production stages, Xact PCB's GX tool enhances precision. It minimizes errors, ensuring that the final products meet their customers' exact specifications while eliminating the need for costly pilot lots.

The Promising Future for CEE PCB in Thailand

Tom Yang, CEO of CEE PCB, understands the importance of collaboration between U.S. and Chinese fabricators. He believes that to understand the current political and economic conditions between the two countries, we must maintain a level of international business cooperation. In this interview, we discuss market conditions under a new U.S. administration, how companies like CEE are responding to potential changes, and CEE's strategic move into Thailand.

Flexible Thinking: Another PCB Design Paradigm Shift in the Works

Spend a half-century engaged in any kind of manufacturing technology, and you will see a boatload of change, especially in the realm of printed circuits. Paul Eisler is often credited with the invention of circuit boards in the 1930s, but the patent was suppressed for strategic reasons in the run-up to World War II. It was a military application that ushered in the mass production of printed circuits. Since then, the rapid advancement of technology has altered the landscape of PCB design over the years. We have shared and codified what we have learned into industry standards.

Meet Diana Radovan, IPC's Global Sustainability Policy and Advocacy Lead



Dr. Diana Radovan joined IPC in August 2024 as the advocacy lead for sustainability policy, a role that requires awareness of global policy activities. From the IPC Munich office, Diana has been busy working as a policy analyst with Dr. Kelly Scanlon, IPC lead sustainability strategist. In this interview, she shares her background, her role at IPC, and what she wants to accomplish for the benefit of our industry.

The Future of Electronics Manufacturing in APAC



The Asia-Pacific (APAC) region is solidifying its leadership in electronics manufacturing, fueled by significant new investments from global industry leaders. This growth is driven by surging demand for high-performance components in key sectors like AI, autonomous vehicles, and sustainable energy, making strategic innovation in semiconductors and advanced electronics essential. APAC's strong supply chains further enhance its appeal to investors.

Bridging Career Pathways in Electronics



In today's rapidly evolving technology landscape, it's crucial to prepare the next generation for the challenges and opportunities that lie ahead, especially in the field of electronics. Dr. Lisa Burns is the career and technical education (CTE) coordinator at Fremont Unified School District in California, where several middle and high schools are participating in Project Lead the Way, a specialized curriculum involving partnerships among schools, industry, and higher education.

NAMICS Brings Innovative Thermoset Materials to PCB Fabrication

At PCB Carolina, Matt Lake and Ken Araujo of NAMICS Technologies spoke with Andy Shaughnessy about the introduction of an innovative thermoset material to PCB fabrication. This groundbreaking material, originally developed for the semiconductor packaging industry, addresses a longstanding demand for unreinforced thermoset films that enhance dielectric properties in PCB applications and allow for manufacturing the very finest of features, 0.002" and below.

Punching Out: New Year's Goals for Selling a Business

New Year's resolutions are great because they are so fun to break. So, if you're planning to sell your business, rather than making fragile resolutions, it's better to make some New Year's goals. Financials: It's not all about the numbers, but it's mostly about the numbers. If you are looking for a Mercedes-level valuation, you should have Mercedes-level financials. If your financials are more like a used Datsun, try to upgrade to at least a VW Passat. If your financials are in good shape, you might still consider getting a sell-side quality of earnings report.

Building a Manufacturing Career at DIS





Ryan Moore, 27, and Emily Telesca, 31, are two millennials who share their unique perspectives on building a career in the manufacturing industry. With backgrounds ranging from computer science to military service, they highlight the fulfilling nature of their roles and the sense of camaraderie within the company. Their stories illuminate the opportunities available in manufacturing, especially for a younger generation seeking meaningful work.

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Career Opportunities

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Compunetics is currently seeking an individual to take ownership of selected manufacturing processes and related process controls, work to strengthen existing controls and work instructions, and participate in engineering/quality activities.

This role is located at our PCB manufacturing facilities in Monroeville, PA.

Responsibilities

- Introduce new controls as needed
- Participate in engineering/quality activities
- Assess/monitor equipment and human resources to meet production requirement
- Select and make recommendations for new equipment
- May require direct supervision of Technicians and Operators

Qualifications

- BS in Chemical, Mechanical, Electrical or Industral Engineering
- 3-5 years' experience in a PCB manufacturing environment with involvement in and responsibility for process control, process improvement, and new process development is required
- Experience with direct supervision of Junior Engineers, Technician or Operators preferred
- Problem-solving/fail analyst, cost reduction, selection of new equipment, and personnel training required
- Strong interpersonal and computer skills requird
- Familiarity with SPC techniques and software, process control, and quality metrics is preferred

****As a condition of employment, candidates MUST be a US Citizen.**

Compunetics is a progressive employer offering competitive wages and an excellent benefits package, as well as an Equal Opportunity Employer.

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AMI

Manufacturing Electronics. Exceeding Expectations.

Business Development Manager

Alternative Manufacturing Inc. (AMI) is seeking a Business Development Manager (this is a "hunter" role) to support the continued growth in Electronics Contract Manufacturing Services at our Winthrop, Maine, location. Position can by remote; however, must be located in the Northeastern portion of the USA, (preferably New England). BDM will be required to be present at the facility on an "as-needed" basis.

About the Role

The Business Development Manager role primarily involves identifying, researching, and pursuing new business opportunities to drive company growth by developing and executing strategies to attract new clients, build relationships, and close deals—often through market analysis, lead generation, proposal creation, and client presentations, acting as a key player in expanding a company's market reach and revenue streams.

Our core values include teamwork, respect for all people, and a culture of continuous improvement.

Key responsibilities:

- Market research
- Lead generation
- Relationship building
- Proposal development
- Sales presentations
- Contract negotiation
- Account management
- Sales pipeline management
- Collaboration

Required Skills:

- Excellent communication skills
- Strong networking abilities
- Sales acumen
- Market knowledge
- Analytical skills
- Ability to deliver effective presentations
- Negotiation skills

Candidates must be a U.S. citizen due to ITAR restrictions.

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Career Opportunities

American Standard Circuits
Sunstone Circuits

Sales Coordinator

Come join the sales team at ASC Sunstone Circuits in Mulino, Oregon, as our Sales Coordinator! This position is responsible for ensuring the seamless processing, tracking, and delivery of customer orders while providing exceptional client communication and internal coordination. Some of the duties include:

- Order processing
- Order tracking and status updates
- Customer communication
- Internal coordination with sales, production, and shipping
- Administrative support

Education & Experience

A high school diploma or GED is required for this role. In addition to the education requirement, a minimum of two years of related experience in an administrative or support role, within a sales or customer service environment, is required. An equivalent combination of education, training, and experience may satisfy these requirements.

Knowledge, Skills, and Abilities

The ability to adjust to new situations, environments, and changing priorities, to effectively convey information and ideas through written, verbal, and non-verbal means; and proficiency in Microsoft Office Suite or related programs are essential.

Benefits

- 401(k) matching
- Dental insurance
- Employee assistance program
- Flexible spending account
- Health insurance
- Life insurance
- Paid time off
- Vision insurance

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Join the Team at Accurate Circuit Engineering!

Located in Santa Ana, California, Accurate Circuit Engineering (ACE) delivers high-quality PCB solutions with a focus on innovation and precision.

Role: Accurate Circuit Engineering is looking for detail-oriented PCB Manufacturing Technicians for all areas in PCB manufacturing. Responsibilities include operating manufacturing equipment, performing quality checks, and documenting production data.

Qualifications:

- High school diploma or equivalent; technical training preferred
- Experience in PCB manufacturing or electronics assembly a plus
- Strong attention to detail and ability to follow instructions
- Familiarity with PCB manufacturing and testing tools is advantageous

What ACE Offers:

- Competitive wages and benefits
- Career growth opportunities
- Supportive work environment with comprehensive training

To apply, send your resume and cover letter to sales@ace-pcb.com with the subject "PCB Manufacturing Technician Application."

Accurate Circuit Engineering is an equal-opportunity employer and values diversity in the workplace.

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Career Opportunities

Europe Technical Sales Engineer

Taiyo is the world leader in solder mask products and inkjet technology, offering specialty dielectric inks and via filling inks for use with microvia and build-up technologies, as well as thermal-cure and UV-cure solder masks and inkjet and packaging inks.

PRIMARY FUNCTION:

1. To promote, demonstrate, sell, and service Taiyo's products
2. Assist colleagues with quotes for new customers from a technical perspective
3. Serve as primary technical point of contact to customers providing both pre- and post-sales advice
4. Interact regularly with other Taiyo team members, such as: Product design, development, production, purchasing, quality, and senior company managers from Taiyo group of companies

ESSENTIAL DUTIES:

1. Maintain existing business and pursue new business to meet the sales goals
2. Build strong relationships with existing and new customers
3. Troubleshoot customer problems
4. Provide consultative sales solutions to customers technical issues
5. Write monthly reports
6. Conduct technical audits
7. Conduct product evaluations

QUALIFICATIONS / SKILLS:

1. College degree preferred, with solid knowledge of chemistry
2. Five years' technical sales experience, preferably in the PCB industry
3. Computer knowledge
4. Sales skills
5. Good interpersonal relationship skills
6. Bilingual (German/English) preferred

To apply, email: BobW@Taiyo-america.com with a subject line of "Application for Technical Sales Engineer".

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Service Engineer: Chicago

Join the Schmoll America Team as a Service Engineer—Where Innovation Meets Customer Excellence! Are you a technical mastermind with a passion for solving complex problems and delivering exceptional customer experiences? Look no further than Schmoll America!

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What we offer:

- A dynamic and supportive work environment where your voice matters
- Opportunities for professional growth and development in a cutting-edge industry
- A competitive salary and benefits package
- The satisfaction of knowing you're making a real difference in our customers' lives

What we're looking for:

- Engineering degree preferred
- 3+ years of experience in an engineering role
- Strong technical knowledge of electrical and mechanical systems
- Excellent problem-solving and analytical skills
- Willingness to travel (up to 75%) to customer sites and HQ in Germany

If you're a motivated professional looking for a challenging and rewarding role, we want to hear from you! Please submit your resume and cover letter to HR@SchmollAmerica.com.

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Career Opportunities

The Test Connection, Inc.

Sr. Test Engineer (STE-MD)

The Test Connection, Inc. is a test engineering firm. We are family owned and operated with solid growth goals and strategies. We have an established workforce with seasoned professionals who are committed to meeting the demands of high-quality, low-cost and fast delivery.

TTCI is an Equal Opportunity Employer. We offer careers that include skills-based compensation. We are always looking for talented, experienced test engineers, test technicians, quote technicians, electronics interns, and front office staff to further our customer-oriented mission.

- Candidate would specialize in the development of in-circuit test (ICT) sets for Keysight 3070 (formerly Agilent & HP), Teradyne/GenRad, and Flying Probe test systems.
- Strong candidates will have more than five years of experience with in-circuit test equipment. Some experience with flying probe test equipment is preferred. A candidate would develop, and debug on our test systems and install in-circuit test sets remotely online or at customer's manufacturing locations nationwide.
- Proficient working knowledge of Flash/ISP programming, MAC Address and Boundary Scan required. The candidate would also help support production testing implementing Engineering Change Orders and program enhancements, library model generation, perform testing and failure analysis of assembled boards, and other related tasks. An understanding of stand-alone boundary scan and flying probe desired.
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TTCI is an Equal Opportunity Employer. We offer careers that include skills-based compensation. We are always looking for talented, experienced test engineers, test technicians, quote technicians, electronics interns, and front office staff to further our customer-oriented mission.

Associate Electronics Technician/ Engineer (ATE-MD)

TTCI is adding electronics technician/engineer to our team for production test support.

- Candidates would operate the test systems and inspect circuit card assemblies (CCA) and will work under the direction of engineering staff, following established procedures to accomplish assigned tasks.
- Test, troubleshoot, repair, and modify developmental and production electronics.
- Working knowledge of theories of electronics, electrical circuitry, engineering mathematics, electronic and electrical testing desired.
- Advancement opportunities available.
- Must be a US citizen or resident.

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Career Opportunities

Prototron Circuits

Sales Representatives

Prototron Circuits, a market-leading, quick-turn PCB manufacturer located in Tucson, AZ, is looking for sales representatives for the Southeastern U.S. territory. With 35+ years of experience, our PCB manufacturing capabilities reach far beyond that of your typical fabricator.

Reasons you should work with Prototron:

- Solid reputation for on-time delivery (98+% on-time)
- Capacity for growth
- Excellent quality
- Production quality quick-turn services in as little as 24 hours
- 5-day standard lead time
- RF/microwave and special materials
- AS9100D
- MIL-PRF- 31032
- ITAR
- Global sourcing option (Taiwan)
- Engineering consultation, impedance modeling
- Completely customer focused team

Interested? Please contact
Russ Adams at (206) 351-0281
or russa@prototron.com.

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Sales Manager

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This is a full-time, on-site role for a Sales Manager at Blackfox Training Institute in Longmont, CO. We are looking for a Sales Manager with a strong track record of B2B sales management experience. The Sales Manager will be responsible for day-to-day sales activities, developing sales strategies, building and maintaining client relationships, and achieving sales targets. Additionally, the Sales Manager will participate in industry events, represent the company at trade shows, and collaborate with the marketing team.

Qualifications:

- Sales Strategy Development, Client Relationship Management, and Sales Target Achievement
- Experience in B2B sales and a proven track record of meeting sales goals
- Structured and growth-oriented approach to Sales Leadership
- Excellent communication and negotiation skills
- Knowledge of the training or education industry a plus
- Able to work effectively in a team and independently
- Bachelor's degree in Business Administration, Engineering or related field
- Proficiency in CRM software such as Hubspot
- Services sales experience will be a strong plus

Contact Jamie Noland to apply:
jamien@blackfox.com

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Career Opportunities

INSULECTRO

Are You Our Next Superstar?!

Insulectro, the largest national distributor of printed circuit board materials, is looking to add superstars to our dynamic technical and sales teams. We are always looking for good talent to enhance our service level to our customers and drive our purpose to enable our customers to build better boards faster. Our nationwide network provides many opportunities for a rewarding career within our company.

We are looking for talent with solid background in the PCB or PE industry and proven sales experience with a drive and attitude that match our company culture. This is a great opportunity to join an industry leader in the PCB and PE world and work with a terrific team driven to be vital in the design and manufacture of future circuits.

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MivaTek Global

Field Service Technician

MivaTek Global is focused on providing a quality customer service experience to our current and future customers in the printed circuit board and microelectronic industries. We are looking for bright and talented people who share that mindset and are energized by hard work who are looking to be part of our continued growth.

Do you enjoy diagnosing machines and processes to determine how to solve our customers' challenges? Your 5 years working with direct imaging machinery, capital equipment, or PCBs will be leveraged as you support our customers in the field and from your home office. Each day is different, you may be:

- Installing a direct imaging machine
- Diagnosing customer issues from both your home office and customer site
- Upgrading a used machine
- Performing preventive maintenance
- Providing virtual and on-site training
- Updating documentation

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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

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- Background in electronics manufacturing
- Soldering and/or electronics/cable assembly experience
- IPC certification a plus, but will certify the right candidate

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- IRA retirement matching contributions after one year of service
- Training and certifications provided and maintained by EPTAC

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- **Engineering**
- **Quality**
- **Various Manufacturing**

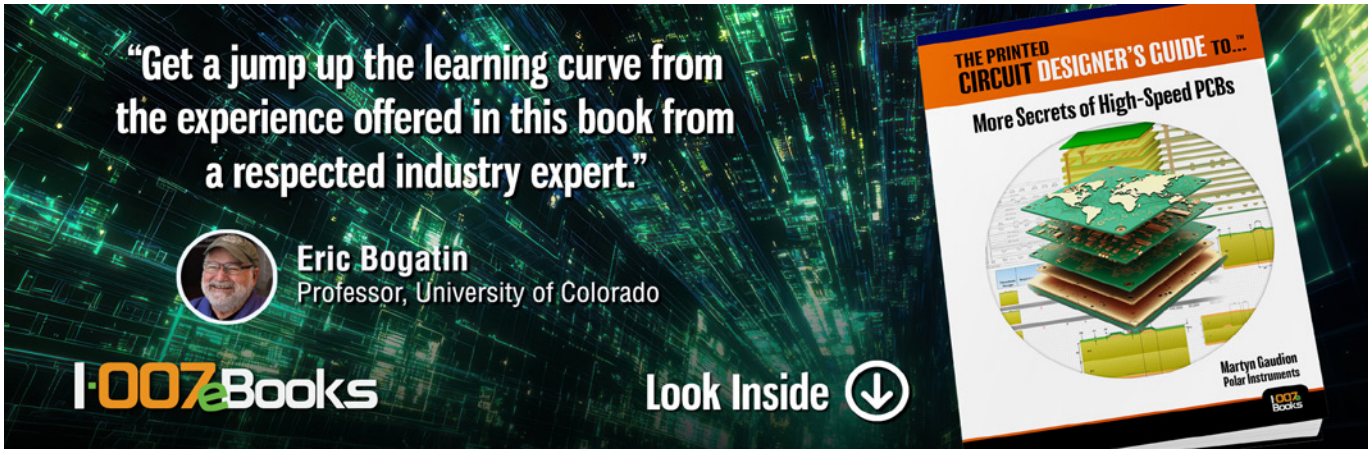
All interested candidates should contact Arlon's HR department at 909-987-9533 or email resumes to careers.ranch@arlonemd.com.

Arlon is a major manufacturer of specialty high-performance laminate and prepreg materials for use in a wide variety of printed circuit board applications. Arlon specializes in thermoset resin technology, including polyimide, high Tg multifunctional epoxy, and low loss thermoset laminate and prepreg systems. These resin systems are available on a variety of substrates, including woven glass and non-woven aramid. Typical applications for these materials include advanced commercial and military electronics such as avionics, semiconductor testing, heat sink bonding, High Density Interconnect (HDI) and microvia PCBs (i.e., in mobile communication products).

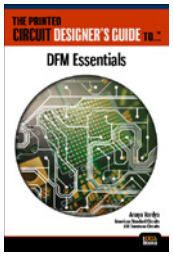
Our facility employs state of the art production equipment engineered to provide cost-effective and flexible manufacturing capacity, allowing us to respond quickly to customer requirements while meeting the most stringent quality and tolerance demands. Our manufacturing site is ISO 9001: 2015 registered, and through rigorous quality control practices and commitment to continual improvement, we are dedicated to meeting and exceeding our customers' requirements.

For additional information, please visit our website at www.arlonemd.com

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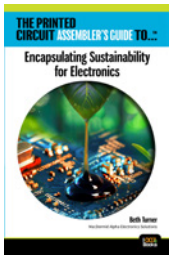
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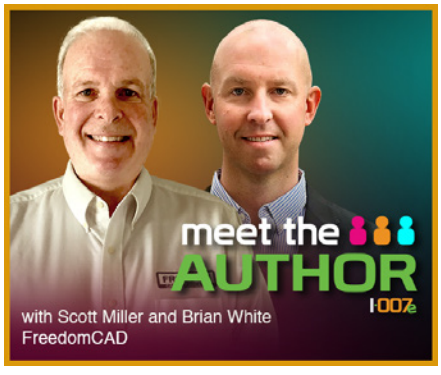
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