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GOOD FOR THE INDUSTRY

# REALTIME with...

IPC APEX EXPO 2021 EXCLUSIVE EVENT COVERAGE

# SHOW & TELL

M A G A Z I N E

*Greetings from*

VIRTUAL IPC  
APEX EXPO



2021

# SHOW & TELL

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# Welcome to the Show (Coverage)

by Nolan Johnson, I-CONNECT007

Welcome to the *Real Time with... IPC APEX EXPO 2021 Show & Tell Magazine*. This special publication is a supplement to our other monthly magazines and brings you exclusive, in-depth coverage of IPC's flagship event.

These pages are packed with tons of great content including event photos, video interviews, attendees' thoughts, reviews from our guest contributors and I-Connect007 editors, interviews with award winners and other industry experts, and coverage of this year's greatly expanded technical track program.

By now, I think it's safe to presume you already know that this year's event made use of a virtual format, a fundamental departure from previous years and a point that I will leave to others to discuss. What I will share, however, is that this move to virtual changed the face of IPC APEX EXPO. Beyond the incontrovertible fact that a virtual event is simply different than a live one, this year's program illustrated the changing faces of IPC's industry volunteers, and of the industry as a whole.

As I hopped from one program to another as easily as if I were teleporting, I began to notice the conspicuous presence of new faces, and some trends: panel discussions moderated by Emerging Engineers program participants discussing how to participate in IPC committee work as a younger professional; the best technical paper authors including an emerging engineer; the Emerging Engineer program represented amongst the recipients of this year's Rising Star awards. Furthermore,

the technical program was clearly aimed at the technologies and the challenges over (or on) the horizon.

As the I-Connect007 editorial team discussed IPC APEX EXPO, we kept using the phrases "succession plan," and "transition." While we've been concerned as an industry about the "gray tsunami" retiring out, it's the rising tide of new talent now so evident in our professional community that will carry us forward.

We hope you enjoy this year's edition of *Real Time with... IPC APEX EXPO 2021 Show & Tell*. I encourage you to take full advantage of the 90-day on-demand access to the show's events, keynotes, papers, and educational tracks. What's nice about this year's virtual event is that you didn't necessarily miss anything if you couldn't be there live. So, please take full advantage! **\$E&T**





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# The Place to Learn, Connect, and Collaborate

by John Mitchell, IPC PRESIDENT AND CEO

IPC APEX EXPO 2021 was an event to remember. For the first time in 20 years, we did not have the opportunity to physically gather as an industry at IPC’s flagship event. However, with the electronics industry being as innovative and resilient as ever, the event was a success in this different modality, and attendees, speakers, exhibitors, and staff responded well to the change. And why wouldn’t they? The electronics industry is defined by change!

As part of that change, we offered new ways for attendees to get the most out of their virtual experience, including the three-track technical program, more professional development courses than we’ve ever provided, and most importantly, on-demand access to content until June 13. For the first time, all professional

development courses offered both live and on-demand are applicable toward continuing education points for MIT recertification.

If I am being totally transparent, we had some concerns about online meeting burn-out after a year of having “normal” face to face meetings limited by the pandemic. We wondered, “Have people just been spending too much time in front of their screens to do it for another week?” I am pleased with our team’s response to this concern—we adjusted the availability of the conference to fit a broader timeline by giving people the opportunity to have access for 90 days after the show! And the industry has responded.

In some ways, this feature of providing the recordings for 90 days made APEX EXPO an even better value than the live, in-person event. At the live event, you are limited in the sessions you can attend, but with the recordings, you

<b>Keynote Presentation</b> by John Mitchell, President and CEO, IPC	Reflow Soldering Process and Influence on Defects – An In-Depth Look	<b>Forgotten Tribal Knowledge</b> with IPC Hall of Fame and Emerging Engineers	ON DEMAND WITH FULL-ACCESS REGISTRATION	
	Design and Assembly Process Challenges for Bottom Terminations Components (BTCs) such as QFN, DFN and MLF in Tin-Lead & Lead Free World		<b>Managers Forum</b>	<b>IPC AT A GLANCE</b>
<b>EMS-Management Meeting</b>		<b>Microvia 1 Reliability</b>	<b>Preventing Manufacturing Defects and Product Failure</b>	
PSMA Packaging and Manufacturability Considerations for Strategic Power Applications				



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can quite literally take advantage of all the sessions and virtually visit any exhibitor over the next several weeks.

The participation by industry was excellent and we expect there will be continued participation after the show has completed. There were a couple of hiccups as some sessions took a few minutes to get up and running, but in the end they all worked and the whole conference was a success. We also added daily video updates to let attendees know what was happening each day.

This year's format allowed us to enjoy some of the creativity of the industry with each of the award winners providing video acceptances. Two specifically come to mind from the Tuesday Awards Luncheon—Audra Thurston and Jan Pederson. Very creative submissions, allowing for a deeper connection even though we are thousands of kilometers apart. There were congratulations and comments in the chat feature of the platform, bringing us all closer together to not only celebrate the wonderful accomplishments of our global membership, but to cheer each other on.

While we could not offer the hands-on STEM event that the IPC Education Foundation hosts at APEX EXPO, we replaced it with a virtual event, "Build Your Future," that included a panel of engineers and business leaders providing detailed information on the benefits of a career in electronics. It was very well attended, and I was thrilled with the number of questions from high school and college students eager to learn about a career in electronics.

We continue to reach out to the next generation of engineers, particularly with the IPC Emerging Engineers program, which shows an increase in participation each year. Our session on "Forgotten Tribal Knowledge" included two Hall of Famers—Bob Neves and



John Mitchell

Don Dupriest—sharing their considerable expertise with an eager audience.

In addition to the educational content and networking opportunities, we launched the ESG for Electronics initiative to develop guidance for electronics manufacturers on an industry-specific approach to ESG (environmental, social and governance) practices and reporting, and to develop aspirational goals that

the industry is working together to achieve. We are engaging electronics industry leaders and ESG experts to provide guidance on key aspects of reporting that demonstrate commitment to ESG principles. As this is an ongoing effort, I encourage even more companies to get involved.

I hope attendees will take a few minutes to fill out the evaluation survey they will receive, as it will help guide us for future events. One of the key questions is around what kind of event we will hold in 2022. Obviously, we are planning to have the traditional face-to-face meeting, but should it be hybrid at the same time? Should we offer the courses digitally for 90 days after the event? We are looking for the industry to guide us as we plan for an exciting return to see one another!

APEX EXPO is usually one of the busiest weeks of the year for IPC; this year, that was true as well, it was just a different kind of busy. We are truly grateful to the dedicated attendees, speakers and exhibitors for sharing their time, their expertise, and their ability to pivot and adjust to a complete change in venue to help us make the first virtual IPC APEX EXPO a success. Frankly, I can't wait until next year. I really miss my interactions with everyone live!

IPC APEX EXPO 2022 will be held at the San Diego Convention Center from Jan 22-27. For more information, visit [www.ipcapexexpo.org](http://www.ipcapexexpo.org).

S&T



# Karen McConnell Hall of Fame Award Acceptance Speech





## Burkle North America CEO on Drilling Trends

Dan Feinberg Interviews Kurt Palmer From Burkle North America

IConnect007  
**REALTIME** with...  
EXCLUSIVE EVENT COVERAGE

Virtual  
**APEX  
EXPO**  
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**Kurt Palmer**  
Burkle America

In this video, Burkle North America CEO Kurt Palmer talks about drilling trends he's seeing in the industry, especially with regard to laser drilling and digital imaging.

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3kW CO<sub>2</sub> peak power = Less number of pulses required  
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## Karen McConnell: Recipient of the IPC Raymond E. Pritchard Hall of Fame Award

Interview by Patty Goldman, I-CONNECT007

The IPC Raymond E. Pritchard Hall of Fame Award is given to individuals in recognition of the highest level of achievement, extraordinary contributions, and distinguished service to IPC and in the advancement of the industry, including the creation of a spirit of mutual esteem, respect and recognition among members consistent with the goals and mission of the IPC on a long-term basis. This is the highest level of recognition that IPC can give to an individual and is based on exceptional merit over a long-term basis, the operative imperative being long term. (Source: IPC.org)

Patty Goldman speaks with Karen McConnell, senior staff engineer CAD CAM at Northrop Grumman Corporation on receiving this year's Hall of Fame award.

**Patty Goldman:** Congratulations, Karen, on your nomination to the Raymond E. Pritchard Hall of Fame, which is IPC's highest honor for their volunteer workers. It's a big deal, as you know, and you are so deserving of this. What

was it like when you got the call from John Mitchell?

**Karen McConnell:** Thank you. I called John Mitchell a miracle worker because when he told me I'd won this year's Hall of Fame Award, I was speechless. I couldn't talk! At one point, John said, "Karen, are you still there? Did I lose you?" That's how speechless I was—and I'm not somebody who goes speechless very often.

**Goldman:** We were talking earlier about your career, which will be in your bio, but please talk about all your IPC involvement. How long have you been doing that? It must be forever!

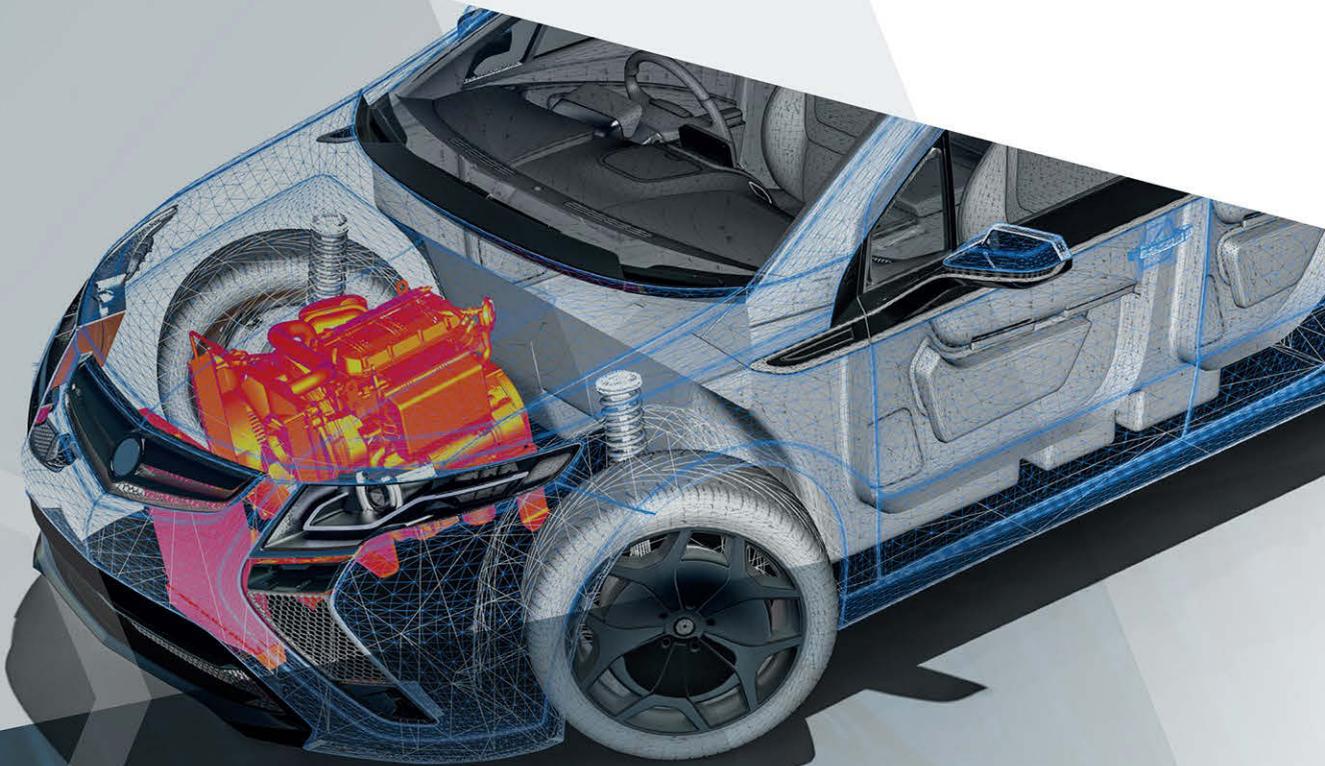
**IPC RAYMOND E. PRITCHARD  
HALL OF FAME AWARD**

**Karen McConnell**  
Northrop Grumman



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## **autolam:** Base-Material Solutions for Automotive Electronics



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**McConnell:** I heard about IPC when I started a new job at UNISYS after graduating college. I moved from ASIC design to printed circuit boards. At the time, in the late '80s and early '90s, there were rumors going around that printed circuit boards were going to disappear, and ASICs were going to take over the world. But something in printed circuit boards fascinated me. I minored in robotics in college as an electrical engineer and the data used to fabricate, assemble and test the boards is actually all robotic language. I was hooked!

It sounds dumb, but I was really hooked. I was hooked on the data and not just the soldering, the hardware, and things like that. I worked for a while as a PCB designer actually trying to figure out how to use all the newer tools that were coming out, the autorouters and things like that. I didn't attend any IPC meetings until I joined Lockheed Martin. My boss was presenting at an IPC meeting. There were a number of us at a Lockheed Martin meeting which was near where the IPC conference was being held. The entire group went for the day, toured the show floor, and that really kind of attracted me to IPC. But what really got me involved was—and I'm going to mark myself with my age—the GenCAM/ODB++ data wars of the 1990s.

You can still search the web and find some articles on that issue. There used to be a quarterly article in trade magazines as to which is better. IPC decided to host the peace talks. I ended up on the management team of the peace delegation. And somehow from that, Dieter Bergman snatched me for the 2-10 and 2-16 committees that were dealing smart data transfer and eventually became the IPC-DPMX (IPC-2581 Digital Product Model Exchange). Often it was just Dieter and me writing the initial document for data with the man from Valor. We would argue, discuss, and compromise, asking continuously "Well, why is that in there?" Valor would say this company needed this and that. That's how I got started with IPC.

Lockheed Martin was very much embedded and linked with IPC and many of their docu-

ments. We actually held joint reviews of IPC documents. I facilitated the Lockheed Martin team that would review design documents and decide, "These are the changes we need to make." Then the changes would go in front of the IPC committees. The committee would accept those changes many times and the documents improved. Because I went to the IPC meetings, the Lockheed Martin IPC Working Group always needed somebody to cover some meeting because everybody was double, and triple booked. With Lockheed Martin, the team prioritized the committees and the meetings.

There was always a high-priority meeting that no one could cover. I had the task to attend those meetings with instructions such as, "Don't let them word it this way. Try and get it worded that way." And they'd give me what I had to do because I was going to assembly meetings, fabrication meetings, and I'm in design, I kind of know the rules. I know what I'm outputting... but at the time I didn't know any of that stuff [laughs].

I'm fortunate that my current company, Northrop Grumman, has encouraged and supported my involvement with IPC, recognizing that our active participation benefits all, especially as we pioneer new technologies and embrace enterprise-wide data.

**Goldman:** So, you've learned a lot, right?

**McConnell:** Well, when you sit at an IPC meeting you do, and I'm not afraid of asking the dumb question. Everybody I have met at IPC cares about the industry, cares that things are done correctly, and cares that it costs their company less. But I would ask these dumb, very basic questions, and by the time everybody explained it to me, whoever was scribing up in the front would say, "You know, guys, I think we just solved this problem that we talked about last week, or last meeting."

Finally, I made my way to committees where I feel very comfortable, but I always belong to a committee where I feel very uncomfortable.

I recently joined the printed electronics committees, in which I have no experience but I'm learning. Even though I'm getting close to retirement, I don't want to stop learning. I find it fascinating that I can wear electronics, and I see where the industry is going.

Just the other night, my husband and I were reminiscing about our careers in electronics and the printed circuit board field. He held up his iPad, and he said, "Remember when you started working and I gave you a tour of the plant?" I said, "Yeah. And you told me to bring along some old clothes and I went in the ladies' room and changed into them before my tour." Because that's back in the day where women usually wore dresses or really nice slacks to work. We're talking last century dress codes right now. Men normally wore white shirts with ties for the engineers. You could tell an engineer from a technician because the engineer had the white shirt on, and the technician had the colored shirt on. The technician might not have the tie on because he was crawling around under the fake floor in the computer room. So, I changed into an old pair of pants, and he gave me a lab coat to put over my blouse. He opened the floor, and we crawled around underneath the computer system. He showed me the wiring. My husband worked at UNISYS and he started at UNISYS working on the last vacuum tube computer that company put out. I joined UNISYS and worked on the last ECL computer that they put out. They went to CMOS after that.

We have seen the change in technology, and we both marvel and hold up our tablets and realize that there's more power in that tablet than there was in the big room of the large mainframes that we worked on. That was the start of our careers.

**Goldman:** Talk about change, right?

**McConnell:** Yes, I've seen a lot of change in my life, in the world, in my career. In the '90s, there were many people in this career that we lost because we had the downturn, they just



left the industry and did something else. There are many who came back, but we've been through ups and downs, and I really do believe that this industry is so vibrant partly because of IPC, and partly because we get together at IPC even if it's meetings, and even if it's now online meetings and conferences. I discovered it's easier when everybody is going through the change together and you have somebody to talk to about it. I really enjoy change, I enjoy the disruptions, but that makes me, I'll say, outside the norm. Most people...

**Goldman:** ...do not like change.

**McConnell:** They do not enjoy change. You know, I look at change as neither good nor bad,

it's an evolution. And if I stick with it, eventually I'll be back to not exactly where I am but back doing something similar because it's a rotation. It's not a sine wave. It's a rotation up a column. We're getting better, but we're kind of doing the same thing around it. If you have ever seen the change circle, it's around the change circle, but it walks you up a column.

**Goldman:** I know what you mean. An upward spiral.

**McConnell:** Within IPC, they manage that change. Being a member of IPC and being on a committee, where we add this word, and then we change that phrase, and we add a comment here, and you massage sometimes just a sentence, and suddenly, it's just there. It's just brilliant. And it's because, at IPC, we get to use our collective brain. Humans were not made to be in a single brain. We were made to be a collective brain, and to me at IPC, that's the best time that we can use it.



**Goldman:** IPC encourages and fosters the cooperation and the consensus on all documents and in meetings; that's the hallmark of IPC: the neutral ground where everybody can meet and discuss.

**McConnell:** At IPC, I witnessed this early on and it was what really cemented that I wanted to be part of this group early in my career. I sat in a meeting, one of those that I knew nothing about—we're talking last century, and we still were not the kinder, gentler workforce we are now. Across the room, these two people were having this violent argument. Papers were being thrown; the table was being hit. This was before we all had computers on our

table. "You're wrong!" "No, you're wrong!" the tempers were rising, and the volume was going up.

**Goldman:** Was it about solder joints? (Laughs)

**McConnell:** Probably. At lunch, I went over to one of the gentlemen who said, "Come sit with us, and we'll try and explain it." We sat there in a calm lunch, and they start joking. I was amazed. At IPC, you can very much disagree in the meetings, but when we leave the room, we're all together, we're IPC. And that argument or disagreement is not carried outside the rooms. The men who were arguing went back in the meeting and resolved the problem. This taught me a couple of lessons. But that's what I find from IPC: you can have a violent discussion with somebody during a meeting—people are passionate about electronics! And then you go out for an ice cream cone or for dinner that evening, or a bar, and you're all friends.

There were mostly men in the meetings in the last century. I've seen the women grow in this industry. It's been really great. We really don't need a women's reception anymore because we're integrated into IPC; IPC was one of the first places where I really felt that. IPC did a really good job of encouraging inclusion and diversity. If you were working as a woman in the less kind, general world of the '90s, IPC was refreshing, because in the '90s. I was used to people carrying the arguments down the hallways at work, and I'll say the language was a lot different back then. I'll word it that way...

**Goldman:** Your companies have always supported you at IPC.

**McConnell:** Yes, always, because they recognized that IPC helps you develop new technology. It also helps you identify where your company is. All my positions have been in support and forward-looking, “Where do I need to encourage my tool vendors to go?” That’s been my job. There has always been a forward-looking IPC committee. Back in my starting days, it was the data transfer, which I am passionate about. If you don’t have the data right, you might as well not do anything else if you can’t keep that data correct and secure. Don’t mess with it too much. Data integrity is something that I still care about today.

Many times, the data transfer committee would discuss the methods to have machines talk to each other. In the ’90s we were talking about this, but we were way ahead of what the industry was looking for. Now, along comes the connected factory (IPC-CFX), and I connected the new people with the people who worked on the previous stuff back in the ’90s, so that the new group didn’t have to start from scratch. I’m a member of that community, and again, that’s data centric.

When IPC decided that committee chairs needed to rotate off committees to bring new ideas and direction to the leadership, I looked around, and I was chair of nine committees. I’m sitting there saying, “Why am I doing all this work?” My first mentee took one of my committee chairs. A friend who was a Lockheed Emerging Engineer took another one of my committees. In fact, after my most recent document gets released, I will not be a chair anymore. I will be stepping down from my final chairing position. I’m still chair of TAEC, but that’s only until the next APEX. I only have a year left on that.

**Goldman:** But you’ll still have a lifetime membership in TAEC.

**McConnell:** Oh yes, I’m a lifetime member of TAEC. My husband said, “What are you going

to do? Can you retire? Every now and then you need a technical fix.” We’d be on vacation for a week, and I’d have IPC with me. He said, “What are you going to do when you retire?” I looked at him and said, “Lots of IPC work!”

I am setting up things now. There’s been a changeover in what I’ve been looking at in the last few years. Whenever I’d go to an IPC meeting, I would go out to my printed circuit board and assembly community, and my producibility community, and say, “I know they can’t send us all, and I know the people they’re sending already have their schedule. So, guys, what aren’t you able to cover that you need somebody to sit down and listen to and see if it’s something we need to pay attention to.” I’ll get two or three papers. That’s been something I’ve done all the time at IPC conferences. But guess what? At my next APEX EXPO, I can satisfy Karen McConnell.

**Goldman:** There you go. You can do whatever you want, right?

**McConnell:** Yes. I’m looking forward to that. I’ve always cared about everything, but I’m looking forward to doing the things that are data-centric, pushing technology and seeing where I can interject my knowledge of design and process. Somehow, for a girl who used to fail in English class, I write a lot of documents now. There are so many things now that I can’t go to. I’m saying, “Ahh, what do I choose?” But I do have a mentee. This will be our second APEX EXPO, and I want to devote some time to her.

**Goldman:** Karen, thank you so much for your time. And congratulations again. I look forward to seeing you at our next meeting of the Hall of Fame Council.

**McConnell:** You’re welcome. [S&T](#)

 [Watch Karen’s Hall of Fame acceptance speech video on page 11.](#)

# APEX EXPO<sup>®</sup> IPC 2021

Watch and listen as industry experts tell our editors about technology advancements, industry drivers, and their focus for 2021 and beyond with our Real Time with... IPC exclusive coverage.

## **Aegis Software, Michael Ford**

### **Developments in Digital Manufacturing**

Michael Ford and Pete Starkey discuss the industry trend towards digital manufacturing, the latest in 3D CAD technology, ontological data and the benefits of the new IPC standard for digital twins.

## **all4-PCB, Torsten Reckert**

### **Distributor Just One of Many Roles for all4-PCB**

Torsten Reckert, president of all4-PCB, discusses his company's role as a distributor, and the technologies available under their representation. Reckert points to via fill as a key technology, as well as lamination, flash-cutting automation, plasma processing, cross-section equipment, wet processing, among others.

## **American Standard Circuits, Anaya Vardya**

### **ASC Focused on Increasing Product Densification**

Anaya Vardya discusses the new and upcoming processes and technologies that ASC is developing to increase product densification, as well as how they are connecting with their customer base through webinars and books.

## **Averatek, Mike Vinson and Tara Dunn**

### **Averatek's ASAP Progress and Online Resource Site Launched**

Mike Vinson and Tara Dunn provide an update on Averatek's ASAP progress. Mike shares the results from his presentation on reliability and signal integrity, while Tara details the newly announced ASAP Community of Interest web resource site.

## **Blackfox, Jahr Turchan**

### **New Online Training Programs Enhance Delivery Options**

Jahr Turchan, Blackfox's Director of Veteran Services & Advanced Manufacturing Programs, discusses how technical training programs pivoted in 2020, and how customers responded to their training needs throughout the year.

## **Burkle North America, Kurt Palmer**

### **Burkle North America CEO on Drilling Trends**

Burkle North America CEO Kurt Palmer talks about drilling trends he's seeing in the industry, especially with regard to laser drilling and digital imaging.

## **BTU, Rob DiMatteo**

### **BTU Discusses Time-saving New Technologies**

Nolan Johnson and BTU's Rob DiMatteo drill down into the company's new capabilities in vacuum reflow and new technology for flux management, a system that greatly reduces downtime for cleaning and maintenance, among other benefits.

## **Denkai America, Chris Stevens**

### **Industry Trends—Present and Future**

Denkai is the only electrodeposited copper foil manufacturer in North America. During this conversation, Chris provides his view of present and emerging trends, the need for higher speed digital designs, and overall business conditions over the past year.

## **DownStream Technologies, Joe Clark**

### **DownStream Focused on Rigid-Flex and Embedded Component Support**

Joe Clark of DownStream Technologies talks about trends in design and how that's led to the company's introduction of rigid flex design support for their tools.

## **Eagle Electronics, Prince Kalaria**

### **Eagle Electronics Sees Increase in HDI Work**

Prince Kalaria talks about recent supply chain and industry trends he's seen at the Chicago-based electronics manufacturer, most notably the expanded growth around HDI, specialty materials, and onshoring.

## **Electra Polymers, Shaun Tibbals**

### **The Real Benefits of Inkjet Solder Mask**

Shaun Tibbals, sales and marketing director at Electra Polymers, describes the technical, environmental and economic benefits of fully additive solder mask application by inkjet printing, now becoming accepted as the industry-standard technology for the future.

## **Gen3, Graham Naisbitt**

### **Cleaning is the New Standard**

If you are interested in cleaning and the Process Ionic Contamination Test (PICT), then listen to Graham Naisbitt of Gen3 give his update on this standard.

## **GreenSource Fabrication, Alex Stepinski**

### **Vertical Integration Is on the Rise**

Alex Stepinski of GreenSource shares his thoughts after his presentation in the managers' forum. Alex's presentation focused on the vertical integration trend and zero waste.

## **Heraeus, Manu Vaidya**

### **Heraeus Introduces New, High Reliability Solder Paste**

Manu Vaidya talks about the SMT650 high reliability solder paste Heraeus is showcasing at APEX 2021 in order to satisfy rising automotive demands.

## **IPC, Bob Neves**

### **The Ongoing Need for Tribal Knowledge**

IPC Hall of Fame recipients Bob Neves and Don Dupriest led a special event on the first day of IPC APEX EXPO 2021 called: Forgotten Tribal Knowledge with IPC Hall of Fame and Emerging Engineers. In this interview, Bob discusses the ongoing need to harness tribal knowledge for the benefit of emerging engineers.

## **IPC, Joe O'Neil**

### **Bringing New Talent to Our Industry**

Joe O'Neil, chairman of IPC Education Foundation, talks about the panel discussion with young engineers and how the education foundation is working to attract new students into our industry.

## **IPC, John Mitchell**

### **Thoughts on IPC APEX EXPO 2021**

In this wrap up interview, John Mitchell shares his thoughts on this year's show. Some themes that came up were smart factory implementation and the increased traction for the emerging engineer program.

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# APEX EXPO<sup>®</sup> IPC 2021

Watch and listen as industry experts tell our editors about technology advancements, industry drivers, and their focus for 2021 and beyond with our Real Time with... IPC exclusive coverage.

## **IPC Design, Patrick Crawford**

### **IPC Design Celebrates First Anniversary After Crazy Year**

Patrick Crawford, manager of design standards and related industry programs for IPC, offers an update on IPC Design's progress since it was launched at IPC APEX EXPO one year ago.

## **IPS, Mike Brask**

### **What's Hot in the PCB Equipment Market?**

Mike Brask, president and CEO of IPS, shares the technology customers in the PCB sector are most interested in and discusses increasing market demands.

## **KIC, Miles Moreau**

### **KIC Adds Wave Process Inspection to Product Line**

Miles Moreau, general manager for EMEA, Americas & Australia at KIC, shares some details on the new Wave Process Inspection (WPI) solution that KIC is currently rolling out. This solution brings real-time process control capabilities to wave soldering equipment, adding and extending capabilities.

## **Koh Young, Gustavo Jimenez**

### **Automotive Driving Koh Young's True 3D Inspection**

Guest Editor Michael Ford and Gustavo Jimenez, Koh Young's sales manager for Northern Mexico, discuss some of the company's newest technologies, including true 3D technology for pin inspection, which has proven popular with the automotive segment.

## **KYZEN, Tom Forsythe**

### **Lessons Learned During Pandemic Fuel KYZEN's Customer Support, Growth**

Tom Forsythe shares how KYZEN applied pandemic experiences to their delivery of customer support. The company's R&D has continued, including AquaNox product line formulations for water soluble organic acids, where cleaning has historically not been necessary but now is increasingly required.

## **LPKF, Stephan Schmidt**

### **The Laser World is Rapidly Developing**

Stephan Schmidt, LPKF president, discuss the LPKF laser 14x20-inch depaneling system. The company is also introducing automatic handling solutions, helping to fill the gap in automated SMT manufacturing lines.

## **MacDermid Alpha, Paul Salerno**

### **Solder Paste Innovations and Low-Temperature Assembly**

Paul Salerno, MacDermid Alpha's Global Portfolio Manager SMT Assembly Solutions, discusses no-clean pastes designed to maximize electrochemical reliability with fine-pitch, low-standoff components and describes latest innovations in ultra-low-temperature soldering technology.

## **MacDermid Alpha Electronics Solutions, Bill Bowerman**

### **Best Practices for Metallization of Complex HDI Panels**

Bill Bowerman and Pete Starkey discuss process improvement strategies for the elimination of weak microvia interfaces, and Bill's presentation at the IPC APEX EXPO 2021 Technical Conference.

## **MIRTEC, Brian D'Amico**

### **Advanced Inspection Solutions and Intelligent Factory Automation**

With the benefit of AI to spot the early signs, any trends away from optimum can be resolved before they become problems. Brian D'Amico explains.

## **NovaCentrix, Stan Farnsworth**

### **NovaCentrix Expands Solder Capabilities**

Stan Farnsworth of NovaCentrix discusses how the company has expanded into electronics manufacturing in the past year with its photonic curing and soldering tools.

## **Pluritec, Lino Sousa**

### **It's All About Automation**

Lino Sousa, vice president of sales with Pluritec, reviews the company's specialist equipment ranges and discusses the benefits of automation of drilling, solder mask application and wet processing in small-batch, quick-turnaround PCB production.

## **Rogers Corporation, John Ekis**

### **Bonding Hybrid Multilayer Constructions for High Frequency Applications**

John Ekis, Rogers Corporation Market Segment Director, Aer space and Defense, discusses the SpeedWave™ family of low dielectric constant, ultra-low-loss prepreg materials with excellent filling and bonding characteristics for hybrid multilayer constructions.

## **Super Dry, Richard Heimsch**

### **Expanded Suite for Component Storage Needs**

Super Dry's Richard Heimsch will be showcasing the expanded suite of storage management controls and storage solutions.

## **Taiyo America, Zach Maekawa**

### **Taiyo Does it Right**

Taiyo adds value to the supply chain while driving innovation in solder mask technology. Dan Feinberg inquires about advancements and technology drivers of inkjet solder mask application.

## **The Test Connection, Bert Horner**

### **The Test Connection Focusing on Services for IPC APEX EXPO**

Bert Horner, president of The Test Connection, explains his plans to highlight the company's test services during IPC APEX EXPO. He also discusses the lessons the company learned during the pandemic.

## **Ventec USA, Jack Pattie**

### **Achieving Growth in a Difficult Year:**

### **The Benefits of Global Supply Chain Management**

Jack Pattie, president of Ventec USA, discusses the growth of the business, the strengthening of the operation, quality system accreditations, the advantages of building close working relationships with OEMs.

## **Weiner International Associates, Gene Weiner**

### **IPC Managers Forum: Packed With Useful Information**

Gene Weiner of Weiner International Associates discusses the highlights of the IPC Managers Forum which took place on the first day of IPC APEX EXPO.

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## Taiyo Does it Right

Dan Feinberg Interviews Zach Maekawa From Taiyo America

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**Zach Maekawa**  
Taiyo America

In this video, learn about advancements and technology drivers of inkjet solder mask.

THE INDUSTRY LEADER IN SOLDER MASK PRODUCTION

# THERMO

# COOL

BY TAIYO

The electronics industry continues to innovate. Innovation means more functionality to the consumer in smaller packages. Because the PCB industry is evolving, PCBs are getting smaller, more functional, and in some cases, thicker with copper.

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# Michael Ford: Dieter Bergman IPC Fellowship Award Recipient

Interview by Patty Goldman, I-CONNECT007

From the IPC website: The Dieter Bergman IPC Fellowship Award is given to individuals who have fostered a collaborative spirit, made significant contributions to standards development, and have consistently demonstrated a commitment to global standardization efforts and the electronics industry. Each recipient will be eligible to bestow the Dieter Bergman Memorial Scholarship upon the university or college of his/her choice.

Patty Goldman speaks with Michael Ford of Aegis Software, Dieter Bergman IPC Fellowship Award recipient, about his extensive involvement with IPC on many committees developing standards, especially the CFX and digital twin activities.

**Patty Goldman:** Congratulations, Michael! You are a recipient this year of the Dieter Bergman IPC Fellowship Award.

**Michael Ford:** Thank you very much indeed.



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**Goldman:** That's quite an honor, as you know, and very impressive. What were your thoughts when you first got the phone call?

**Ford:** Disbelief! It was quite a surprise. We have been busy this last year, there have been a lot of achievements in the various task groups that I work with but, compared with the whole range of work that is done within IPC teams every year, I feel just a very small part of what everyone contributes overall.

**Goldman:** I understand. Tell us about yourself and your involvement with IPC, which I'm sure was and is extensive.

**Ford:** I've been working in the industry since the 1980s. I started developing software long before it was recognizable in manufacturing and am basically self-taught in terms of finding solutions for things in the digital domain. That's always been my interest, and I'm fortunate to have had some excellent opportunities and encouragement to create innovation throughout my various roles in the industry. That is what drove my career toward Aegis, with their modern progressive approach. Aegis genuinely wants to create solutions and technologies that help the industry, embracing leadership through example, which fits very well with my personal goals. I've been working as a part of IPC committees now for about six or seven years. I started out with the traceability standard, IPC-1782, which the group completed within record time, and then things have gone from strength to strength. It was a gradual introduction and has developed into a great environment for me to be able to share my thoughts and ideas.

**Goldman:** Very good. What is your current involvement? What kind of committees are you involved with? I know you're with the Connected Factory Exchange.

**Ford:** Yes, the busiest committee at the moment is CFX, the Connected Factory Exchange. For

me, this standard is very significant for the industry. All the way through my career, the bottleneck in creating value with computing has always been the limitation in exchanging data with good communication with machines. Extracting data sounds a simple thing to do in principle, but it is not when every machine has a different mechanism for extracting data and has a different language. The first time that we had a CFX meeting, with all the machine vendors together in one room, I was wondering whether we'd be able to get through the meeting without calling security, because of course historically, the industry is very competitive. I was pleasantly surprised when I looked properly around the room and saw that everybody was looking very positive, it was as if something had fundamentally changed. I guess it was the knowledge of IPC's principles that provided the unique setting. It was realized that competing over data was preventing both customers and vendors from achieving value, and therefore not the best way to go forward.

That represents my inspiration with IPC because there is no other organization that could achieve that. As I started working seriously with the CFX committee, chaired by Aegis, we continued to help conceive and realize the standard we see today. It's been an amazing situation having so many people from many companies all willing to contribute. There are literally hundreds of committee members, mainly from machine vendor companies, pretty much whom at some point or another have been talking to me about their aspirations with CFX. I somehow volunteered to be in the center of the process of gathering ideas, information, and requirements from all the different committee members—a very interesting position to be in. Putting everything together to create the CFX standard document, I was fully expecting people were going to have different opinions, as I am not the expert in every machine technology there is. With every addition that I made, I was expecting pushback, but miraculously, every-

thing started to fit into place naturally, based on the contributions that everybody made. It was so satisfying when we were able to issue the first release of that standard.

**Goldman:** That's great to hear. I know IPC has always done their best to foster an atmosphere of people and companies working together instead of working at odds with each other, but that sounds like it worked especially well in this instance. I'm sure it also has to do with your leadership.

**Ford:** I am interested in getting into the different aspects of things, that ultimately work together. People sometimes need to be guided by examples to see how that works.

The cross-functionality of IPC standards is a great example. As part of the CFX work, I started to work with the IPC-2581 committee on the design data side. With traceability we started to develop into the area of 1782 Secure Supply-Chain, with people who see the synergy in what we are doing. And then there's the IPC-2551 Digital Twin, where the task group has taken on something that has the potential to have a huge effect on the whole industry, extending the principles established with CFX, determining how solutions across the different silos within the industry communicate data between each other.

Cybersecurity has also become extremely important recently, which also has a relationship with the IPC-1782 Secure Supply-Chain and traceability. It's really interesting to see all of these groups aligning to help define the "IPC Factory of The Future," in terms of smart technology. It was my aspiration to do this as a young engineer, though I didn't actually think I'd ever be in a position to play a signifi-

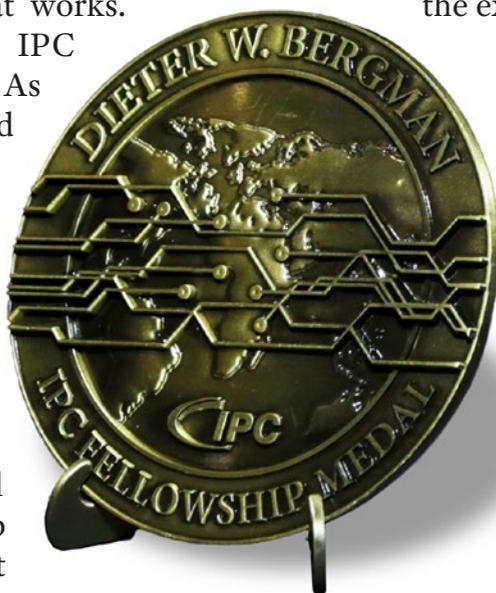
cant role. It is really fulfilling to be able to work with these different committees within IPC.

**Goldman:** And have a significant effect and influence on the created documents—you were not just spinning wheels.

**Ford:** Exactly. There are several individuals across the globe with whom I have been privileged to work, and have very much been "in the moment" of getting things done, being confident in their approach, as well as being open to accept ideas shared within the group and the committee as a whole. It's been really enjoyable to get the standards that we have been working on published in better than the expected time scale.

**Goldman:** You were not just having effect on the industry, but actually making a major contribution to standards and knowledge.

**Ford:** Thank you! The real test is when users of the standards, whether machine vendors or manufacturers in the industry, come up and say, "This has been a problem for quite some time, nobody has been able to address it before." To see companies and people gaining benefit, developing solutions based on the standards, driven by their own subsequent inspiration, in areas such as machine learning and closed-loop feedback, is very satisfying. With preventative maintenance, energy management coming up with CFX v1.3, for example, we continue to broaden the horizon of the use of digitalization in manufacturing. Having lived through the early days of computers in manufacturing, with all the challenges that there once were with early software technologies, it is great to see that it's a completely different situation today. Peo-



ple are now beginning to understand the real potentials of modern digitalization.

**Goldman:** Yes. A great accomplishment. Now, one of the things with the Dieter Bergman Fellowship Award is a scholarship to the university or school of your choice. Have you made a choice yet?

**Ford:** I have. The core of our company, Aegis, comes from Villanova University in Pennsylvania. I thought it would be very nice to give back a little to that university. I really hope that we can use the scholarship to inspire someone who may otherwise find it very challenging. It will be very satisfying to see the advantage being created there.

**Goldman:** That's great. What are your other thoughts on not just the award, but on contributions? How would you advise someone new in the industry or fairly new to IPC who is thinking about getting involved?

**Ford:** It's critically important now to help younger people coming into the industry. Older guys like myself, who have been in the industry for too many years, find it easy to forget exactly how hard it was to get started in our careers. Roles evolve, however, and I would love somebody to be able to achieve in say one, two, or three years, what has taken me 30 years to achieve, in the same way as we today package millions of transistors into an IC. A lot of what we learned over time is now embedded within hardware and software, so the application and further development of

modern technology is the most important, not where it came from. Young people in the industry add value in new ways without having to reinvent obsolete wheels, and therefore represent excellent team members. Having confidence in what has been achieved, we should encourage people to develop their own ideas

on top of ours. Some ideas may be better than others, but all should be given the opportunity and receive an intelligent discussion.

The way I found it works best of all is to put yourself into the position of the people that you are talking to. Quite often we see at meetings that people come along with some incredible ideas, that nobody can understand. To communicate ideas effectively, you've got to really start to understand the perspectives of people that you are

talking to, so that they can see the value in their own terms and context of what you're talking about. If much of your reasoning in what you're trying to say stays in your mind, rather than being positioned simply for others to understand, success depends on the assumption that people will see your idea in the same context as you do, which is most often not the case. It took a bit of trial and error for me to appreciate this, and I would encourage people to really have a think about not only their core original idea, but also to think how best to present it in a way that is going to get the value across, and after that, get into the detail of how it can be achieved.

**Goldman:** One of the things I always believed was whatever you have to say, make sure it's



constructive. And if you've got a problem with something, you need to have an answer before you critique it.

**Ford:** I agree. As I said earlier, I'm a problem solver. I love to use software to solve problems, and you really can't solve a problem until you really understand what the problem is. If you simply aim to take the simplest gut-feeling work-around plan, it often goes wrong, because the challenge is never as simple as you initially think. Everything is related, and there are likely to be a dozen different things that you have to understand in context in order to create a real solution. The pursuit of establishing "best practices" when creating solutions is very, very interesting. Once this is done the constructive discussion can begin.

**Goldman:** I agree. Any closing thoughts for us?

**Ford:** I could mention a whole string of names of people who have helped and supported me within IPC, the committees, and within Aegis. I'd just like to say thank you to everybody who has been part of this on-going process. I am just one person within the different teams, so it is a little humbling. It's great to know that I'm making a recognized contribution. I am grateful to be a part of the IPC process.

**Goldman:** I think maybe you're the driving force, what do you think?

**Ford:** I am not averse to being a little bit of a driver to help get people motivated. That can sometimes mean that you take the initial lead, or perhaps introduce thoughts that may be a little provocative. You have to have the right trigger to then allow people to express each of their opinions—which are the results that we see in the standards, from all of those people who have been part of that process.

**Goldman:** We'll see you at the virtual IPC APEX EXPO. Well, I sort of see you.

**Ford:** It's tricky, isn't it? In all these different events and meetings, you don't really see who's there sometimes; interactivity is a challenge—to read the room for reactions. The virtual APEX EXPO event however is going to be tremendous, probably the highlight of the year, even being virtual as it is. I know a lot of people have been looking forward to this, more than other shows that I've participated in over the last 12 months.

**Goldman:** That's good. I would think that all your committee meetings must have the maximum number of people because anybody can come. All they need to do is turn on their computer to be part of it.

**Ford:** The virtual aspect means that many more people, especially in Europe and Asia, will be joining, staying up in the middle of the night in some cases. That's really nice actually.

**Goldman:** Because they can be there with minimum cost and effort which is really great. I think it's going to change the way committees and subcommittees work from now on. You may still want to come to a meeting, but there could be more virtual stuff going on, say, between the main meetings or even during. There's no reason why you can't be all sitting in a subcommittee meeting and have a lot of people check in virtually. It just makes good sense

**Ford:** Yes, the hybrid meeting is an interesting idea. As long as the communications are working well, then that is a huge value.

**Goldman:** Okay Michael, congratulations again and thank you so much for your time.

**Ford:** Thank you. **SET**



# Emerging Engineers: Raviteja Boyana

## IPC Offers Steady Guidance for Engineering Students

I am a newly graduated mechanical engineer with a specialization in electronics packaging (assembly) and reliability of electronics from the University of Maryland, College Park, USA. I have been associated with IPC for the past two years through their local student chapter at my university. In my first semes-

ter, while I was transitioning myself from the mechanical engineering background to the semiconductor manufacturing industry, I was looking for opportunities to connect and learn from industry professionals about their journey in the electronics industry and how they benefitted by being part of the IPC organization.



Raviteja Boyana

Later I learned that the IPC supports students through their scholarship program. I had enrolled as a student member and had applied for the scholarship program. To be honest, I wasn't expecting to hear back but I was surprised when I received an email stating that my profile was selected among the 30 scholarship winners of all the applicants in 2019. Not only did the scholarship help me reduce the financial burden, but it was also a source of encouragement that motivated

me to explore more opportunities within the organization.

I also took up the leadership role as the secretary of communications for IPC, SMTA and iMaps student chapters at the University of Maryland during the academic year 2020–21. I was asked to share some insights for the new engineers looking to make their way into the electronics industry. Through this [interview](#), I received a lot of engagement from the LinkedIn community, and it helped in building professional relations with experts in similar fields.

During my second semester, I took one course that introduced me to the semiconductor fabrication processes and the packaging industry. The course was slightly overwhelming, yet I was intrigued by the depth of information I was given. During the course, I got involved in the teardown and cross-sectional analysis of different chips used in the iPhone 6. One of these was a front-end power amplifier module by Qorvo, a manufacturer of RF chips and modules. The project helped me gain a lot of insight about the technology being used in the industry.

Later in summer 2020, amidst the pandemic, I was given the opportunity through an internship to contribute my skills at Qorvo's facility in Greensboro, North Carolina. I started working onsite with their advanced packaging team on the latest technology RF solutions for future applications. I was assigned the task of developing a tool that can predict the standoff height of BGA solder balls in a DSMBGA (double side molded ball grid array type package) that connects the module onto the customer's main PCB. Using the tool, the organization was able to significantly cut down the time and expenses which were otherwise required in manufacturing physical builds and for testing them. It was a real challenge to develop something from scratch with limited resources, but I was really happy with the results. I received a lot of appreciation both from my manager and the director of packaging at Qorvo.

After the internship, I was looking for motivation to overcome the challenges of the final semester as well as the hassle of finding a full-time job. I realized that IPC's scholarship application and the Emerging Engineer program applications were open. I applied and was selected again! I am probably one of a very few applicants who received the IPC Education Foundation Scholarship consecutively for two academic years, 2019–20 and 2020–21. This helped build my confidence to pursue the career path that I was interested in. I knew this is what I wanted to do.

Through this mentorship program I was assigned to my mentor, Gen3 President Graham Naisbitt. I have been reaching out to Mr. Naisbitt for his support and suggestions regarding the job search, benefits of networking, and many other day-to-day accomplishments. He has been really kind and an approachable person. I still recall a conversation we had about whether I plan on being a small cog in a big wheel or a big cog in a small wheel. I realized that I am still in the very early stage of my career and there are many things I have to learn. To accomplish this, I have to start from being a big cog in a small wheel then build my way to be a valuable member in a bigger organization. Once I complete my job search, I am looking forward to learning more from Mr. Naisbitt and his experiences in the electronics industry.

I graduated from the University of Maryland, College Park in December 2020 with a master's degree in mechanical engineering and a minor in electronics packaging. At the moment, I am actively seeking an entry-level full-time opportunity for the roles of packaging engineer, reliability engineer in the semiconductor/electronic industry where I can contribute my skills and knowledge towards building the future.

If any of you are looking for a potential candidate for your organization, feel free to reach out to me via [rboyana@umd.edu](mailto:rboyana@umd.edu) and I would be happy to share more information about my background and experiences with you. **S&T**

# Technical Conference— Balancing **Conventional** and **Disruptive** Technologies

by Matt Kelly, IPC

As I have reminded myself throughout this global pandemic, it's not what happens to you that's most important, rather it's how you react to a situation that matters most. I was reminded of this again when we learned last year that IPC APEX EXPO 2021 would need to be delivered virtually due to ongoing COVID-19 safety requirements. I remember at the time wondering how this would be possible. How could we create a virtual event that would be valuable to attendees when so much emphasis is placed on sharing and meeting face to face? It was something our team had never done before. It felt like an enormous challenge, to say the least. After seeing other industry associations take their conferences online, it was now IPC's turn to tackle a fully virtual technical conference. After some time to think about the best path forward, the choice was clear—we had to build the strongest technical conference we could, offering content that mattered most to attendees during this time of unprecedented change.

Now that the show has ended, here are some of my thoughts and observations from the experience. IPC APEX EXPO 2021 was built from the ground up and was intended to be future-focused while continuing to drive the industry

forward. We built a strong five-day program consisting of three technical tracks with more than 70 presentations, 29 professional development courses, and three keynote speakers. Virtual delivery of the event consisted of recorded presentations to ensure a successful delivery of content and live Q&A sessions. We chose to use recorded content not only for seamless delivery, but also because IPC APEX EXPO 2021 was designed to be portable, available to attendees for 90-days post show, March 15 through June 13.

It is clear that the electronics manufacturing industry is officially in the early stages of Industry 4.0. Our industry is now beginning to move beyond awareness into actual implementation of new technology adoption and new ways of working, requiring next-generation technologists with next-generation skills. We saw this during the call for participation and throughout the event, with a significantly large number of Factory of the Future abstracts submitted—which enabled us to create a full 24-presentation track spanning smart manufacturing advancements, data analytics, cybersecurity, powering IoT, 5G, and digital twin. I was particularly interested to listen to industry leaders from Europe showcasing how far along they are in their digital transformation journey, estimated to be five to eight years ahead of the rest

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Matt Kelly

of the industry. The key message for me here is that companies need to pay serious attention to Industry 4.0 first movers to remain competitive. They need to begin preparing their own strategies and modernization implementation plans if they have not done so already. Failing to act now risks being left behind and limits a company's competitiveness, agility, and resiliency moving forward.

I thought the three keynotes given by IPC President and CEO John Mitchell, *Industry-Week* Editor-in-Chief Travis Hessman, and IPC Chief Economist Shawn Dubravac, were spot on. They all spoke to the fact that the way products are conceived, designed, manufactured, and used is changing rapidly. While the keynotes had different focus areas, I noted an important similarity—they all underscored the need for increased industry collaboration to help bring the factory and supply chain of the future to life. No one single company or subset group of companies can do this all on their own. It will take the larger electronics manufactur-

ing ecosystem to work and advance together to unlock the true value of what Industry 4.0 approaches have to offer.

While it is absolutely necessary to continue being future focused, I think my biggest observation from IPC APEX EXPO was the strong demand for PCB technology advancements and knowledge sharing. Throughout the week we saw well-attended and highly interactive technical conference sessions spanning a wide range of topics including embedded technology for HDI applications, HDI signal integrity, microvia reliability, weak microvia interface, and PCB reliability/advancements. To explain this ongoing demand, we do not need to look very far—new products are continually being designed and built to be smaller, faster, lighter, and with all-in-one functionality. This driving force, in turn, is creating many new challenges to overcome regarding PCB design, signal/power routing, material selection, and fabrication methods. These product trends explain the reason why these sessions were in such demand. We are thrilled that we were able to connect the industry's leading experts with attendees to share the very latest research and know-how. This year's IPC APEX EXPO Best Paper exemplifies this. The award went to IBM Corporation's Sarah Czaplewski, Roger Krabbenhoft and Junyang Tang, for their paper titled "Signal Integrity, Reliability, and Cost Evaluation of PCB Interlayer Crosstalk Reduction." Outstanding!

New advancements within conventional hardware technologies remain an important element of IPC's technology stack and roadmap. For example, this year's conference incorporated new advancements into several professional development courses offered on Monday, Tuesday, and Thursday including Power Electronics in Manufacturing, Design and Assembly Process Challenges for Bottom Terminations Components (BTCs); Designing with HDI Technology; and Low-Temperature Soldering, Assembly, Inspection and Defects—Causes and Cures. As highlighted by

this year's future-thinking call for abstracts, technical conference sessions held Wednesday through Friday focused on new advancements within conventional technologies. Many excellent sessions were held including automotive electronics development and advances, electronic thermal interface materials, e-textiles, and failure analysis case studies to name a few.

To conclude, what I learned most at this year's event was that strong demand continues for knowledge sharing focused on solving today's toughest technology challenges, primarily led by miniaturization, increased functionality, and reliability of electronic systems. I learned that balancing conventional technologies and new disruptive technologies is critical to ensure the greatest value to attendees who need to solve today's problems/issues, while at the same time begin implementing new modern solutions within their business. Finally, I learned that while today's challenges often take priority, it is more important than ever to be future focused to ensure that you are

not left behind as the electronics manufacturing industry continues its digital transformation—as we officially have entered this fourth industrial revolution.

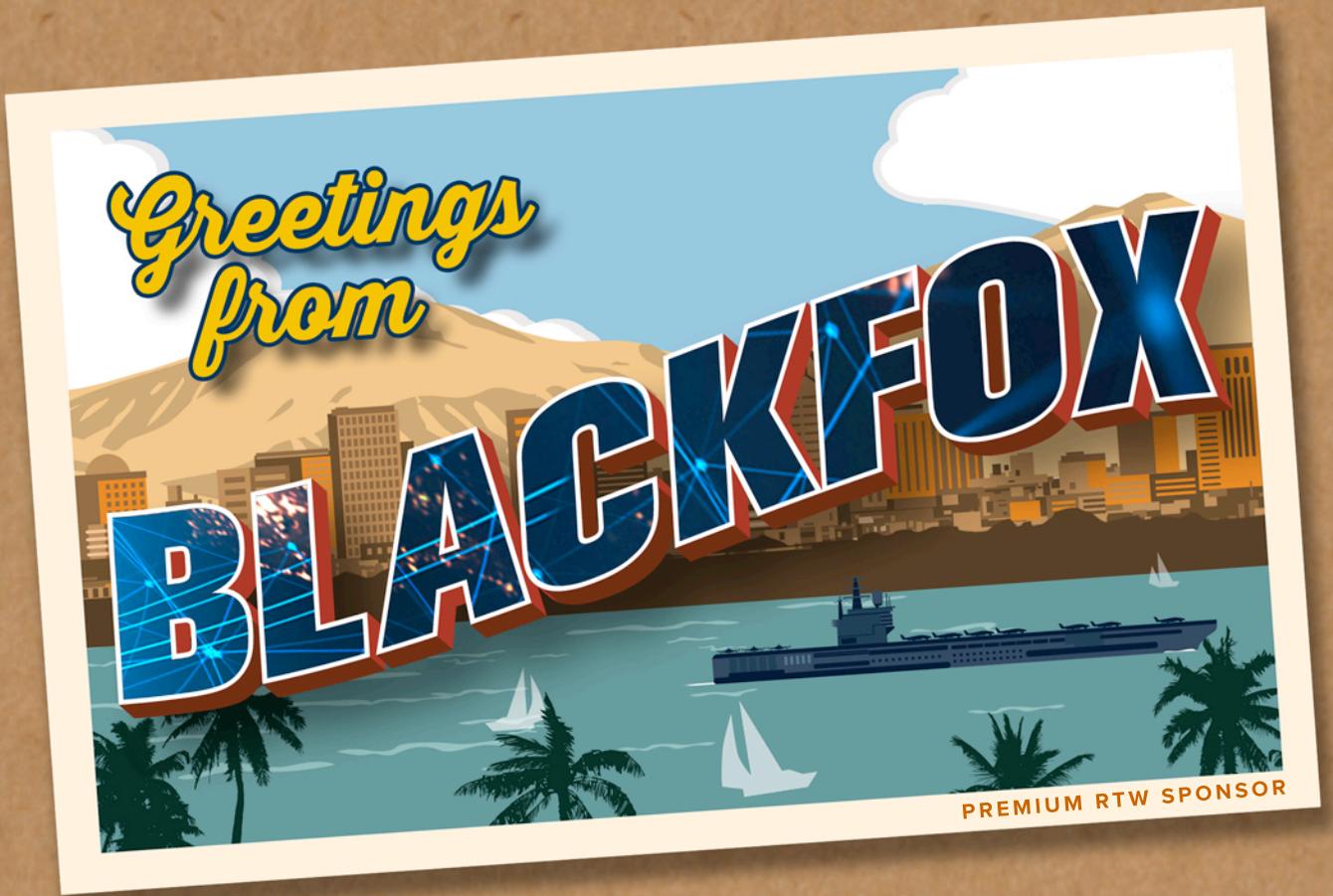
I want to thank our industry partners MTC, PSMA, AIAG, HDP, iNEMI, AFFOA and the Defense Industrial Base for their contributions, expertise, and ongoing support of IPC APEX EXPO. In addition, I extend my gratitude to all our speakers, instructors, session moderators, IPC Technical Planning Committee members, and IPC staff; without your tireless efforts, this conference would not have been possible.

If you would like to access on-demand conference content, [click here](#), available until June 13, 2021. If you have ideas or suggestions on new technical content you would like to see added for the 2022 conference, or how we can make next year's event even better, feel free to contact me at [MattKelly@ipc.org](mailto:MattKelly@ipc.org). Your input is welcomed and important. **S&T**

**Matt Kelly** is IPC Chief Technologist.

## I-Connect007 Video: A Salute to the Industry





## New Online Training Programs Enhance Delivery Options

Nolan Johnson Interviews Jahr Turchan From Blackfox

A video thumbnail with a dark background. On the left is a portrait of Jahr Turchan, a man with glasses and a beard, wearing a grey suit and tie. In the top left corner, the text "IConnect007 REALTIME with... EXCLUSIVE EVENT COVERAGE" is displayed. In the top right corner, a blue box contains the text "Virtual APEX EXPO IPC 2021". A green play button icon is centered in the lower half. The background features a blue globe with a network of lines and dots.

In this video, Jahr Turchan discusses how technical training programs pivoted in 2020 and how customers responded to their training needs throughout the year.



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# Polar Instruments Driven by Customer Demand

Interview by Andy Shaughnessy, I-CONNECT007

Andy Shaughnessy recently spoke with Geoffrey Hazelett, vice president of sales for Polar Instruments, about the virtual IPC APEX EXPO and the eventual return of live trade shows and conferences. They also discussed some of the company's newest releases, many of which came about through customer demand.

**Andy Shaughnessy:** Geoffrey, IPC APEX EXPO is wrapping up, but I understand that you still have a few committee meetings to attend.

**Geoffrey Hazelett:** Yes, I was not working the virtual booth. I've got the D-21 High-Speed High Frequency Design Subcommittee, and the D-24d High-Frequency Signal Loss Task Group, which I co-chair with Xiaoning Ye, a nice gentleman from Intel.

**Shaughnessy:** And I know that Polar has been working on a lot of things throughout the pandemic.

**Hazelett:** Yes. This last year with COVID and everything, despite that, our engineers and engineering team have been working really hard. Just with Speedstack alone, last year, we had six releases bringing out new features, and we're releasing right now our third release of Speedstack this year, which has brought forth

some really great features that some of our customers have been asking about for a while. Other customers are really excited to see these new features, because they haven't asked for them, but they wanted them. They didn't know that they wanted them yet, specifically the shielding materials.

Our library was released last month, and this month the Tatsuta materials will be included in the library. Additionally, we also have some exciting new features, like the ability to apply plating colors so that you can assign different colors within Speedstack for whether a layer is plated or not.

**Shaughnessy:** You could just glance at it and see whether it was a plated layer?

**Hazelett:** Funny enough, last year a lot of our customers were building boards in the four- to 12-layer range, and our wizard for generating stackups had a cap of 64 layers, a pretty thick board. Last year, due to customer demand actually, we had to increase that to 128 layers because we had some customers building boards that were that complex. Our customers today are doing some incredible things, where customers are focusing in the 16–18-gigahertz ranges and doing 56-gigabit channels, and even pushing 112-gigabit channels. So, it's really exciting seeing how some of our customers are really pushing the boundaries of what's possible in a printed circuit board and what tech-

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Geoffrey Hazelett

nologies they're using to build some of these boards.

**Shaughnessy:** During the pandemic, innovation barely slowed, at least in our industry.

**Hazelett:** Yes. Everyone was nervous that society might collapse, but within the tech sector, it was booming for our industry. I remember when the pandemic hit trying to find a Logitech webcam, and they were going for a markup of 200%, and I thought that's crazy. People were selling used ones for \$400 and up.

At Polar, we've upgraded a bunch of our network stuff so we could work from home. And I'm sure we're not the only ones who have

been rolling out tech upgrades during this time to facilitate their employees to continue working. That then feeds back into the cycle of the increased demand for tech, which then helps our business, our industry.

**Shaughnessy:** Did you notice a change in the way that your users used your tools over the pandemic? Did it change anything?

**Hazelett:** Yes. Just a lot more IT problems and figuring out how to make it work. Clarifying licensed contract stuff that maybe they didn't have access to before. We worked with a lot of our customers to make it so that part was contractually easier. I think the biggest thing that I've noticed is that I don't get as many phone calls from people anymore. I get a lot more emails. And I think that's been the most noticeable. I feel like we lose a bit of connection and touch with our customers in that way.

**Shaughnessy:** Yes, you miss that. That's the one thing that a virtual show just can't do: re-create that whole person-to-person experience.

**Hazelett:** And it's in those situations that I'll have a customer come up and say something that they wouldn't have said in an email or a phone call. I'm thinking of last year at APEX EXPO when it was in-person, and I had a customer come up and show me a stackup and tell me his customer was trying to get him to build a board like this. And then, it was that quick back-and-forth that occurs. It's like, "Geoffrey, can I ask you about this?" And they pull out a napkin, and they draw it out. And then we have a chat about it.

**Shaughnessy:** Let's hold a good thought that we can get back to live events.

**Hazelett:** I'm not going to look forward to live events if they're behind plexiglass. But that is the next step, and that is better than nothing. It's better than the virtual show, which is better than nothing.

**Shaughnessy:** Well, I hope so. There are people that I've known for 10 or 20 years that I've never seen outside of a trade show. So I'll be glad to get that back.

**Hazelett:** I call those "location-based," "event-based," or my "trade show friends." Do you ever hang out with them outside of trade shows? No, but that doesn't make them any less enjoyable people. I remember meeting someone at APEX EXPO last year who retired from the industry, and he came to the show with his wife so she could meet all his trade show friends. He's out of the industry, but he still came back, saying, "I wanted to introduce my wife to the people I've worked with for the last 30 years."

**Shaughnessy:** If I retired, I'd probably still go to trade shows. Hopefully, this year we'll get back to live events.

**Hazelett:** And if not, definitely next year. Next year seems to be a much more promising prospect. It looks likely that we'll have APEX EXPO in-person in 2022.

**Shaughnessy:** All right. Thanks for talking with me.

**Hazelett:** Thank you, Andy. **S&T**

## The Test Connection: Service, Equipment, and Expertise

### Andy Shaughnessy Interviews Bert Horner From The Test Connection

Bert Horner, president of The Test Connection (TTCI), discusses test services and trends in testing. Through new partnerships with leading AOI equipment providers, as well as companies who specialize in software and programming technology, TTCI is positioned to analyze companies' overlap and gap and provide expert advice.

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Virtual  
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**Bert Horner**  
The Test Connection



# An IPC APEX EXPO Like No Other Comes to a Close... and Opens On Demand

by Barry Matties, I-CONNECT007

The online live IPC APEX EXPO has closed, and the on-demand content will carry on until June 2021.

There is no real substitute for the in-person trade show, we all know that. The metrics we use for the virtual trade show will not be the same measure as the in-person event, nor should they be. The two events are very different. All that said, it still requires an enormous amount of effort to put together a meaningful online virtual event and our congratulations go to the entire IPC team for making IPC APEX EXPO 2021 the best it could be. It's not to say everything went perfectly but the IPC team was there working long hours to make it a meaningful event.

The success of an event comes from all the people who volunteer their time to organize, support, and take part in the educational programs and meetings. People from all around the world took part in sharing their



Charlene Gunter du Plessis and Aaron Birney.

thoughts, expertise, and commitment to our industry. And for the attendees, there were several opportunities to take part in management meetings, technical conferences, professional development, keynotes, and more.

As we jumped from one virtual room to the next, there was a lot of thoughtful information being presented, including exhibitor new product presentations.

It was also great to see so many emerging engineers taking part in the event. I especially appreciated the great education initiatives update session from Charlene Gunter du Plessis, senior director, IPC Education Foundation, and Aaron Birney, program manager, IPC Education Foundation.

Their work is vital to the future as they are reaching out to the upcoming talent for our industry. During the session, the results from the 2020 strategy were shared (Fig. 1). A very impressive report and this is an effort that is worth supporting.

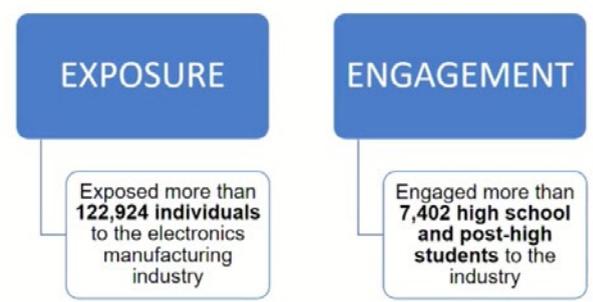


Figure 1: Results from the 2020 IPCEF strategy.

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# IPC Student Chapters – Our Chapters



- Chapter Stats:
  - 40 Student Chapters
  - 350+ Active Student Members
- COVID-19 significantly impacted chapter engagement, recruitment, and growth
  - Decrease in facility tours, speakers, chapter events
  - Increase in virtual offerings



Figure 2: A sampling of the IPC student chapters globally.

When they shared the number of colleges, universities, and tech schools that now have IPC student chapters (Fig. 2), I noted that it is a very impressive list. Many in our industry

may not be aware of the work IPC is doing to ensure a bright future for our industry and if you have a chance, I recommend that you access [this 1:25 hour presentation on demand](#); you

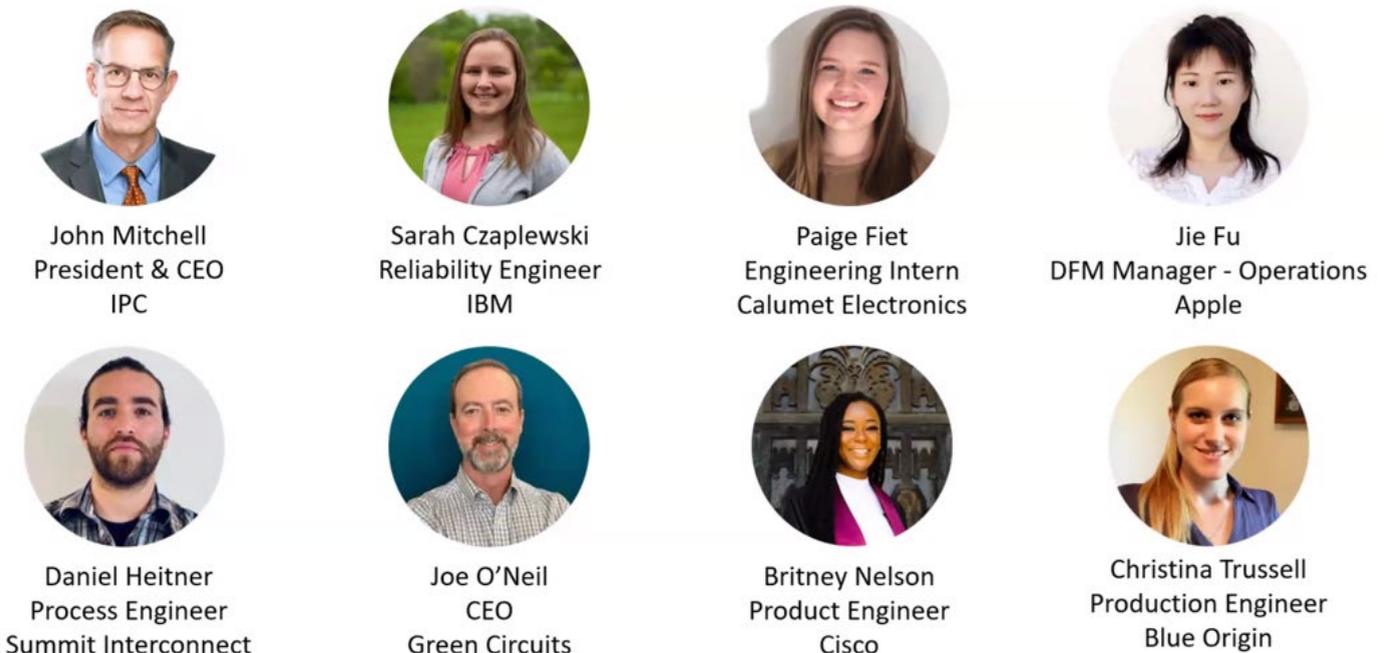


Figure 3: A panel of young engineers participating in a discussion.

will be impressed. This session and others will be available online until June 13, 2020.

To extend this conversation, there was a panel discussion on Friday with young engineers sharing their journey into our industry (Fig. 3). The stories were very interesting how each set out on one path and then landed in our industry. Each participant also offered great advice for others starting off in their career paths.

So, the show is the same in name, but different, especially for the exhibitors. They could not see halls filled with people walking down the aisles, kicking the proverbial tire. They had to be more creative to get the most out of this online format. That said, this plat-

form does not have the same feeling that the in-person event provides. We all know that, and we are now looking forward to January 25–27, 2022, when we all gather, in person, at the San Diego Convention Center for the next IPC APEX EXPO.

At I-Connect007, our team worked to bring you the industry's best coverage of the event. We conducted many audio and video interviews, published thoughtful reviews of the keynotes and presentations, and shared your stories with the industry. We at I-Connect007 thank and appreciate all who participated in our event coverage. We look forward to seeing you in person at the next event. **S&T**

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# Bringing New Talent to Our Industry

## Barry Matties Interviews Joe O'Neil From IPC

Joe O'Neil, chairman of IPC Education Foundation, talks about the panel discussion with young engineers and how the education foundation is working to attract new students into our industry. This effort provides resources to educators and helps young engineers advance their careers.



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EXPO  
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Taylor Swanson, MSc.

Career  
Production Engineering Manager, Digital Instruments, Inc.  
Engineer Recruiter/Trainer, Express Employment Professionals

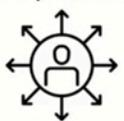
Expertise  
Electronics Packaging, Design and Electronics Manufacturing

Education  
• B.S., M.Sc., Rochester Institute of Technology (RIT)



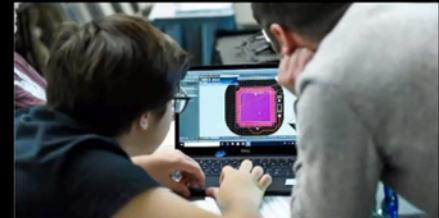

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### IPC Student Chapters

<p>Education</p> 	<p>Projects</p> 
<p>Industry Connections</p> 	<p>Scholarships</p> 

### Chapter Program Overview

The IPC Student Chapter Program helps advance careers for engineering and technical students by delivering online industry-standard education, in-person and virtual access to industry professionals and creates paths with scholarships and projects.



## Audra Thurston Rising Star Award Acceptance Speech



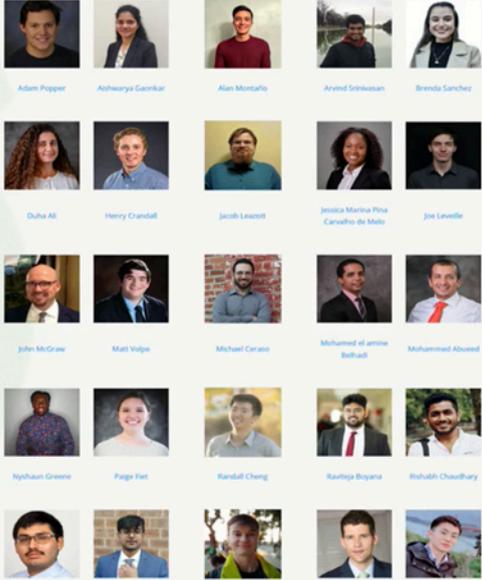
IPC  
Rising Star Award  
presented to  
Audra Thurston

For your leadership role and support of IPC, your technical skills, ability to overcome adversity and dedication to lifelong learning. Your positive attitude and hard work will inspire others to reach their full potential. We are proud to have you as a member of the IPC community.

0:20 / 0:30



The IPC Education Foundation aims to award up to \$50,000 in **Student Scholarships** for Academics and Leadership



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- Industry Competitions (virtual/ in-person)
- Webinars (Online)
- Campus Fair (virtual/in-person)
- Chapter Events (virtual / in-person)
- Participate in event of another club/organization on campus (in-person)
- Volunteer to judge a competition or scholarship program



Japan Unix IPC President's Award Acceptance Speech

JAPAN UNIX

Yusaku Kono

Web

Japan Unix Zoom Room1



# My Thoughts From the Virtual Show

by **Patty Goldman**, I-CONNECT007

Gosh, I sure missed the live event.

I listened in on several technical sessions, the awards ceremony, the keynotes, and the Hall of Fame management session. I tried a couple of professional development courses but got the frownie face on my screen and didn't go back in. I have almost 90 days(!) to browse them to my heart's content, so what the heck.

There were good points and a few not so good things about this first ever virtual conference. You probably experienced some yourself.

The management session was outstanding. HoF'er Gene Weiner almost singlehandedly put together a fabulous lineup of speakers from both large and small companies. Most of the talks were prerecorded but the Q&A was live. The big advantage: no trouble getting speakers who were too far away or couldn't spare the time—they just had to put together a talk, record it, and then be available at a specific time for the Q&A. No hours or cost spent traveling. The main downside I saw was that this was the first session of the week and there were a few technical glitches—mostly on my end. But then, I can go back and see them all again, so I'm not too upset.

The quality of the papers and speakers in the technical sessions was very good. Some people had chosen to prerecord their talk

while others were live. The advantage of prerecording was no risk of the speaker losing connection during their talk. Otherwise, not a lot of difference. Everyone was live and visible for the Q&A at the end of their talk. There seemed to be plenty of good questions and discussion—questions sent in via chat box and discussion between moderator and speaker. It worked.

The neat thing about the awards ceremony was that all the awardees had a moment in the sun, so to speak, via recorded comments (usually this was limited to just the Hall of Fame and corporate awardees). Unlike most years, everyone attending any part of the conference/show could watch this. Usually, the awards are presented at luncheons that must be purchased. Which of course was the sad part for me—no luncheon! No sitting with a group of people that you may or not know and discussing the morning's sessions or committees or what have you.

Which brings me to my big disappointment of APEX EXPO 2021: no people! No seeing your industry friends, no catching up on a year's worth of happenings, no discussions, no hugs, no smiles. Our industry and IPC are, for sure, all about the people and there was just no way to actually talk to anyone. No one's fault, just made it rather lonely. IPC meetings are always a recharge time for me.

On Thursday afternoon, I thought to “walk” the show floor, see what was there... Well, of course there were no booths, just small websites. No faces, no names, just products. No way to walk down the aisle for an ice cream and never get there because you stop and talk to 10 people and end up going in another direction. No way to catch up with old colleagues, say hi, see who is working where now. I would have loved it if the websites had shown a photo of the company booth from years past, or some faces and names. Who is on the other end of the “chat” anyhow? Can I tell them to say “hi” to so and so, and ask how business is going?

All in all, virtual had a big advantage in an excellent program, including the keynotes (see

Pete Starkey’s review) along with the full 90 days to revisit and review the technical sessions, absorb all the info, submit additional questions, etc.

How much has this conference changed the way it will be structured from now on? Time will tell, but I think recording the tech sessions and the 90-day review window are definite keepers. I think having the virtual show in addition to live could work and help bring in more people who cannot spare the time or cost to attend. But I’m sure I’m not alone in missing the live, energizing event that IPC APEX EXPO has always been. Looking forward to San Diego next year! [S&T](#)

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## Achieving Growth in a Difficult Year: The Benefits of Global Supply Chain Management

**Pete Starkey Interviews Jack Pattie From Ventec USA**

Jack Pattie, president of Ventec USA, discusses the growth of the business, the strengthening of the operation, quality system accreditations, the advantages of building close working relationships with OEMs, and how a well-managed global supply chain has overcome some of the challenges and frustrations encountered during the past year.

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Jack Pattie  
Ventec USA



## Emerging Engineers: Audra Thurston

### Virtual IPC APEX EXPO a Successful Format

To be honest: I was skeptical when I first heard IPC APEX EXPO 2021 was going to be virtual. We have all attended too many Zoom meetings that are not engaging, and it is easy for virtual events to fall into this stereotype. However, after attending this one I am a full supporter of the virtual format and hope the IPC considers a hybrid format for future conferences!

I see the virtual format as a solution to increasing participation, especially for engineers. It can be hard to justify sending your entire engineering team to an event like IPC APEX EXPO, especially for manufacturers like Calumet Electronics where engineers are needed around the clock to keep the wheels turning. Typically, the most senior engineers end up going to these conferences, which limits the participation of younger engineers. The committee meetings, technical sessions, and professional development courses have been critical in my development as a young engineer and using the virtual format to make this content more accessible would be invaluable to our industry in building up the next generation of engineers. If the event offers virtual content next year, I think we would definitely have all of our engineers participate virtually while still

sending some representatives to the live conference.

The All-Access Pass of the virtual conference also allowed me to attend more courses because they are available for 90 days after the live event. I have been able to go back and watch meetings based on my schedule, which has increased my exposure to topics that I would have otherwise written off as low priority. Again, as an early career engineer looking to expose myself to as much as possible, this on-demand availability has been valuable.

I hope that IPC considers a hybrid model for future APEX EXPO events to make the conference more accessible to more people, particularly early career engineers like myself. With IPC's focus on the Factory of the Future, which includes some aspects of virtual reality, I'm sure we can figure out the best hybrid conference model in the world and set the standard (pun intended) of what virtual events can be. **S&T**

**Audra Thurston** is a process engineer at Calumet Electronics Corp.

*Watch Audra's Rising Star Award acceptance speech on page 48.*



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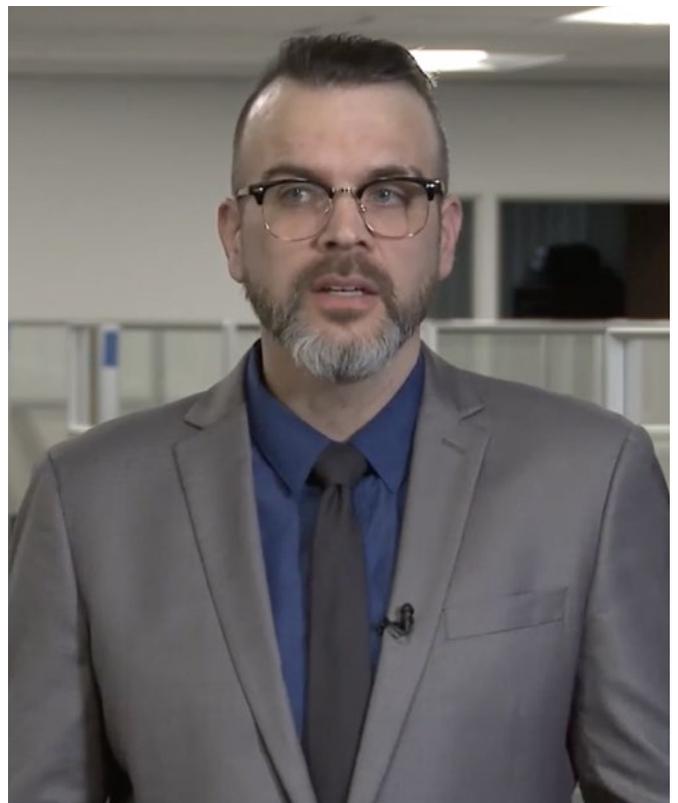


# IPC APEX EXPO 2021 Keynote: **Travis Hessman** 'The Great Digital Transformation'

by Pete Starkey, I-CONNECT007

Wednesday's Premier Keynote at IPC APEX EXPO 2021 came from Travis Hessman, editor-in-chief of *IndustryWeek*, "a website and magazine dedicated to manufacturing leadership, operational excellence and the technologies that make it possible."

An energetic and animated presenter, a powerful storyteller and visibly passionate about digital manufacturing, Hessman made it clear at the outset that his goal was not to hype an already over-hyped industry, nor to focus on the technologies themselves, but to walk-through the process of transformation. He stated that he was a process guy, and it was process, not "gee-whiz amazing tech-toys" that would transform our industry. Reasons why companies had got it wrong and failed in their attempted digital transformations became





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apparent as he outlined methodologies and processes adopted by companies that had used them successfully.

Shrewdly avoiding the need to hide behind a mask—by standing in an empty hall at his Cleveland editorial office—he declared that to talk about the future he needed to consider the present and recognise the revolution that was already unfolding.

All the way through his talk he emphasised that this “great digital transformation,” which offered the first real hope of overcoming the brutal environment of the present, was about solving manufacturing problems. But the solutions were not as simple as throwing AI or IoT or robots at the problems, and he was not going to bore us with lengthy discourses on theory and change management. His approach was to demonstrate what was possible by looking from the inside at some manufacturing operations where the thinking and the processes were sound. His extreme example of what was possible with a fully realised digital strategy was Intel’s wafer fab, which did indeed employ all the “gee-whiz amazing tech-toys,” generated six billion data points per day and achieved “near-perfect results nearly every time” with the smart use of smart technologies.

Statistics and case studies of fully realised digital strategies could send confusing messages, and they suggest to the industry at large

that the technology was the solution. Hessman made it clear that it wasn’t that easy! Although all the potential gains were realisable, no amount of spending could make them happen overnight. And he showed some much more realistic figures, indicating, for example, that 84% of companies were still stuck in pilot mode after a year, and that 60% of projects were shut down at the proof-of-concept stage.

Everything was about process, and the issue with digital transformation was that technology was becoming divorced from the actual manufacturing processes it was designed to serve. And if investment in technology was not part of an overall process, it became a bomb thrown into the operational heart of the organisation. The technologies and tools could achieve great things, but not unless they were integrated into the underlying process. The technologies themselves were not to blame for the failure of IoT projects; it was the framing and the strategy.

Hessman had been working with manufacturers to develop a new frame of thinking about technology. The overall concept was to prioritise the business over the technology, leading with the problem, not the solution; focusing on the problems, then examining the technologies that could solve those problems, looking on them as “tools to help you do what you do better.”



### 3. Nibble at the Edges

- “By showing the success and value of early initiatives, companies can set the basis and direction for an ever-growing IoT strategy bearing greater results based on early [proof of concept] assumptions and actual results.”
- Test, experiment at the edges.

*“Ever tried. Ever failed. No matter. Try again. Fail again. Fail better.”*

He outlined a five-step strategy for success, beginning with a shift in perspective:

1. An evolution of underlying business practices with incremental smart upgrades and improvements, not a revolution.
2. Define a value proposition: making sure the mission was clear by answering three key questions about the problem: “what intelligent information was needed to solve it, what data was needed to create that intelligence and finally, what technology was needed to gather that data and create the intelligence?”
3. “Nibble at the edges”: start to experiment with low-risk, high-yield projects that would demonstrate the effectiveness of the intended solution without risking any core functions or products. The outcome would set the basis and direction for an evolving digital strategy based on early proof-of-concept and result in process-changes that would develop into means of addressing core problems. Another outcome would be the creation of home-grown experts capable of leading subsequent larger edge-nibbling projects.
4. Develop a roadmap for implementation, building inward from the nibbled edges.

5. Once all four steps had been completed, most “new” skills, processes and protocols would be already in place to enable the digital strategy to be properly deployed without it having the effect of a “bomb thrown into the operation,” as previously alluded to, and to become a structured activity to make the company stronger. Effectively it was an evolution of what the company had been doing all along and the fact that it had been “digitally transformed” hardly even mattered, although the problems had been solved.

Looking at how it worked in the real world, Hessman took two case studies. His first referred to a maintenance programme for Toyota Material Handling—keeping their forklifts in operation and their customers happy. There were some major challenges, such as the lack of appropriate sensors on their older trucks, and the lack of facility to handle the enormous amount of data that these sensors, once fitted, would generate. The value proposition was based on artificial intelligence and predictive analytics. But the company had no experience of artificial intelligence and were wary of committing to the technology. They began to “nibble” by processing inspec-



Pete Starkey and Travis Hessman

tion data with artificial intelligence in a single welding cell in a single plant. The system analysed tens of thousands of welds and identified one welding robot as drifting slightly off-optimum although still well-within limits and not detectable by normal human inspection. The offending machine was rectified long before it could cause problems downstream, and the company recognised the benefits of artificial intelligence and machine learning without having taken any risks or made major investment.

Intel's wafer fab told a similar story of simple beginnings: to meet growing demand, they had switched from eight-inch wafers to 12-inch, which were too heavy to move by hand so they had to employ robots. It was then no longer safe to have human workers to inspect and maintain the systems, so artificial intelligence was employed. And that's where their digital revolution began—by solving a real problem in the smartest and most efficient way possible.

Hessman recalled a mid-sized EMS company he had visited in 2018, that had experienced a “brutal” year when a world seemingly obsessed with IoT was looking to cram everything with electronics, resulting in a battle for component availability, and designers having to be innovative in their desperation to work around such com-

ponents as could be sourced. They reckoned that the situation couldn't get worse—but it did! At the beginning of 2021, the world shortage of semiconductors had effectively stopped production in the automotive industry! Whatever, Hessman had recently revisited the company, and was delighted to learn that they had resolved many of their problems with digital solutions. Their COO modestly admitted that he was no expert on Industry 4.0, then detailed a massive data integration project that effectively connected the whole operation from design to final delivery and provided managers and engineers with the intelligent information they needed.

But none of this had been done in the name of “transformation” or for the sake of technology. The company had been trying to solve real problems, and it needed better data on its stock and its operations to make smarter decisions. Nibbling at the edges had given positive results and led to a progression of more ambitious nibbles. Hessman made it clear that this had not been a digital transformation project but a manufacturing process of solving the right problems by asking the right questions, and constantly working to improve the use of the data using available technology, making sensible investment decisions within a culture of continuous improvement. “Digital transformation is the result of good work to solve real problems. It's not the driver. No Industry 4.0 experience required!”

The parting words in Hessman's concluding slide summarised the essence of his message: “Put the problems in front of the solutions and develop processes not disruptions!” His inspirational presentation put a rational and realistic perspective on the potentially daunting challenge of digital transformation.

S&T

**The Great Digital Transformation:**  
*The Conclusion*

- Put problems ahead of the solution.
- Develop processes, not disruptions.

1. Think Evolution
2. Define the Value
3. Nibble at the Edges
4. Develop a Roadmap
5. Deploy



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Super Dry's Richard Heimsch showcased the expanded suite of storage management controls as well as some long-term storage solutions at this year's event.

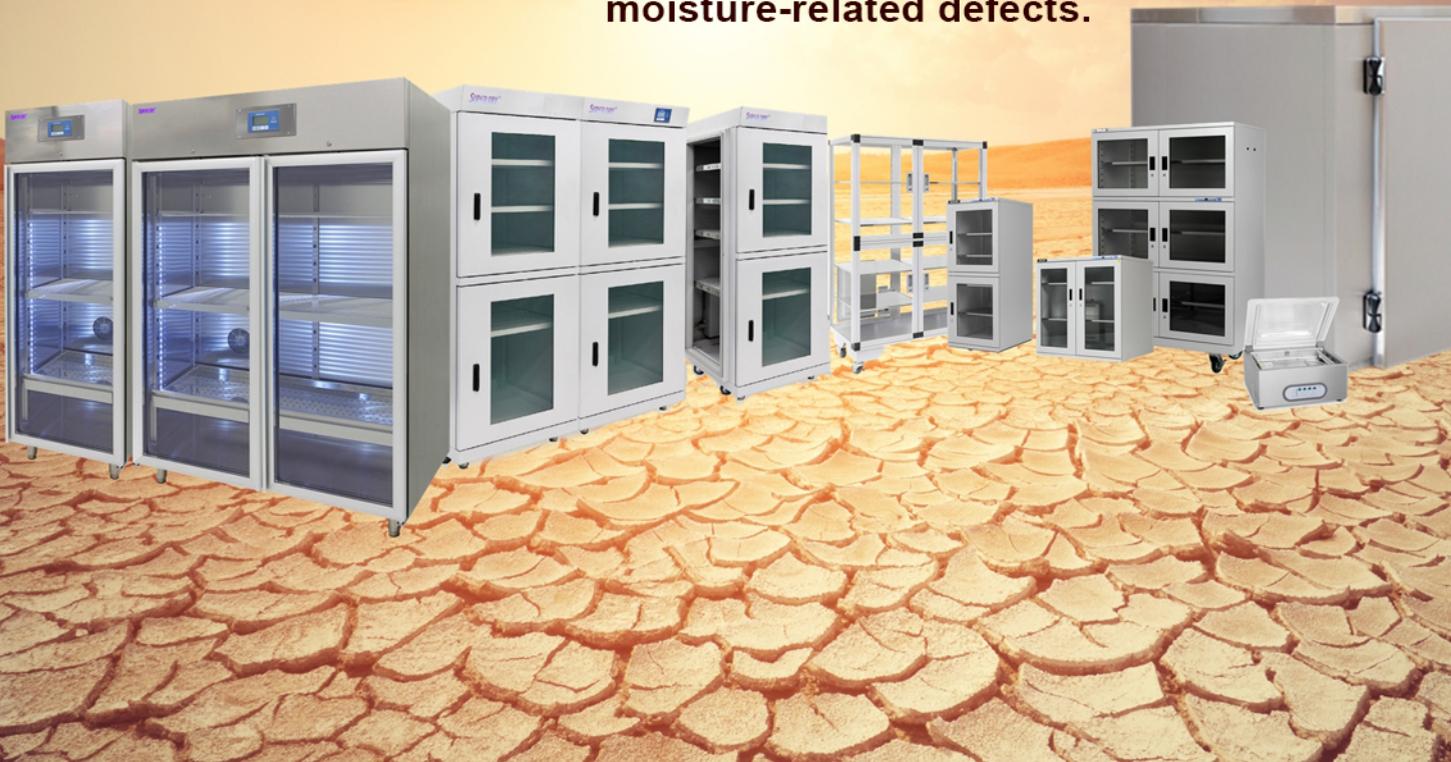


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## Best Technical Paper at IPC APEX EXPO 2021 Selected

The best technical conference paper of IPC APEX EXPO 2021 has been selected. Voted on through a ballot process by members of the IPC APEX EXPO Technical Program Committee, the paper authors were recognized during show opening remarks on Tuesday, March 9.

Taking top honors, the winning paper is, “Signal Integrity, Reliability, and Cost Evaluation of PCB Interlayer Crosstalk Reduction” by Sarah Czaplewski, IBM Corporation. Her co-authors were Roger Krabbenhoft and Junyang Tang, IBM Corporation. This paper was presented during Technical Conference Session 14 (BF5-PCB Design–HDI and Signal Integrity Considerations) on Thursday, March 11.

This year, two papers were selected in the honorable mention category. Honorable mention goes to “Board Thickness Effect on Accelerated Thermal Cycle Reliability” by Joe Smetana, Nokia. His co-authors included Richard Coyle, Nokia; Eric Lundeen, BAE Systems; Iulia Muntele, Sanmina; Scott Danko, TTM;

### Signal Integrity, Reliability, and Cost Evaluation of PCB Interlayer Crosstalk Reduction

by Sarah Czaplewski, Roger Krabbenhoft and  
Junyang Tang, IBM Corporation



This paper was presented during Technical Conference Session 14  
(BF5-PCB Design - HDI and Signal Integrity Considerations)

Neil Hubble, Akrometrix; and Bev Christian, HDPUG. This paper was presented during Technical Conference Session 9 EE3 (HDP Projects Progress) on Wednesday, March 10.

Honorable mention also goes to “Analyzing Printed Circuit Board Voiding and other Anomalies when Requirements Covering the Anomalies are Vague” by Wade Goldman, The Charles Stark Draper Laboratory, Inc. His co-authors were Hai-ley Jordan and Curtis

Leonard, The Charles Stark Draper Laboratory, Inc. This paper was presented during Technical Conference Session 3 EE1 (PCBA Quality, Reliability, and AI-based Inspection) on Wednesday, March 10.

The papers were evaluated on their technical content, originality, test procedures and data used to deduce conclusions, quality of illustrations and the clarity and professionalism of writing as well as value to the industry.

Visit [ipcapexexpo.org](http://ipcapexexpo.org) for more information on how to access the technical session for 90 days after the show. **S&T**

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# IPC Releases Free Presentation: **Smart Factory** for Electronics Manufacturing

By Happy Holden, I-CONNECT007

The IPC APEX EXPO 2021 Technical Program features a track on the “Factory of the Future Implementation,” March 10-11. As part of that program, IPC has made available a free presentation and video from the Manufacturing Technology Center (MTC), a CFX Program member. The presentation is titled “MTC’s Implementation of CFX with Legacy Equipment.”

In this presentation, Barry Maybank—along with Naim Kapadia, MTC technology manager—explains the background of the MTC, one of seven high-value-manufacturing technology catapult centers established in the UK.

The other six are:

1. Advanced Forming Research Centre (AFRC)
2. Centre for Process Innovation (CPI)
3. Nuclear Advanced Manufacturing Research Centre (NAMRC)
4. Advanced Manufacturing Research Centre (AMRC)
5. Warwick Manufacturing Group (WMG)
6. The National Composites Centre (NCC)

MTC’s role is to provide support, consulting, implementation examples, and leadership in the effort to introduce and implement the smart factory into UK industries, in this case, electronics assembly (Figure 1).

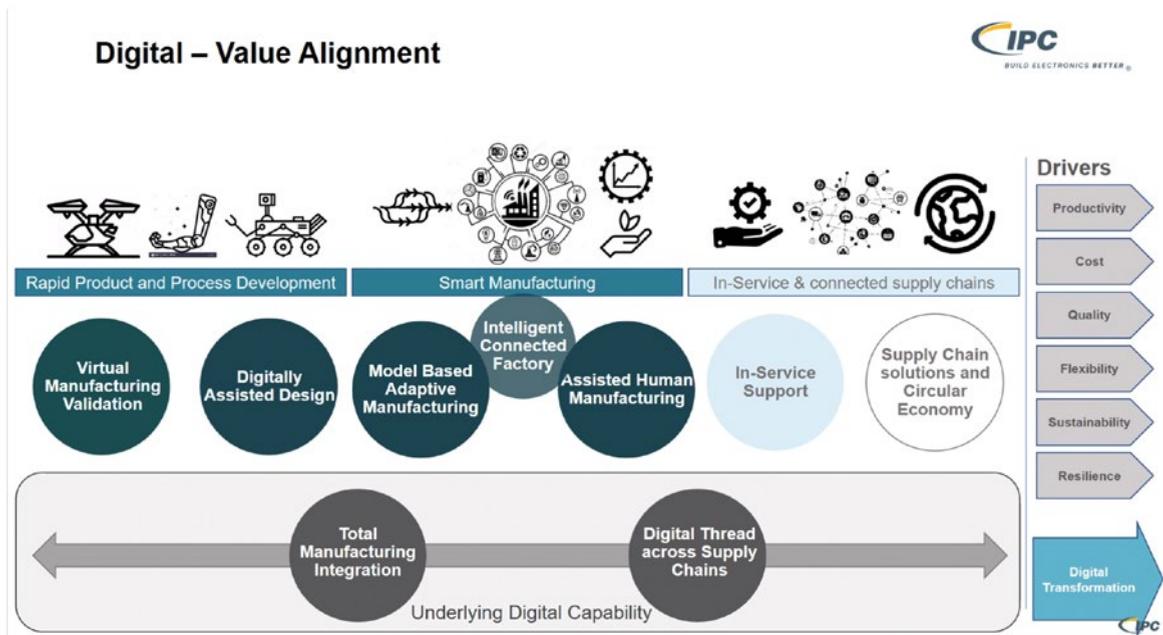


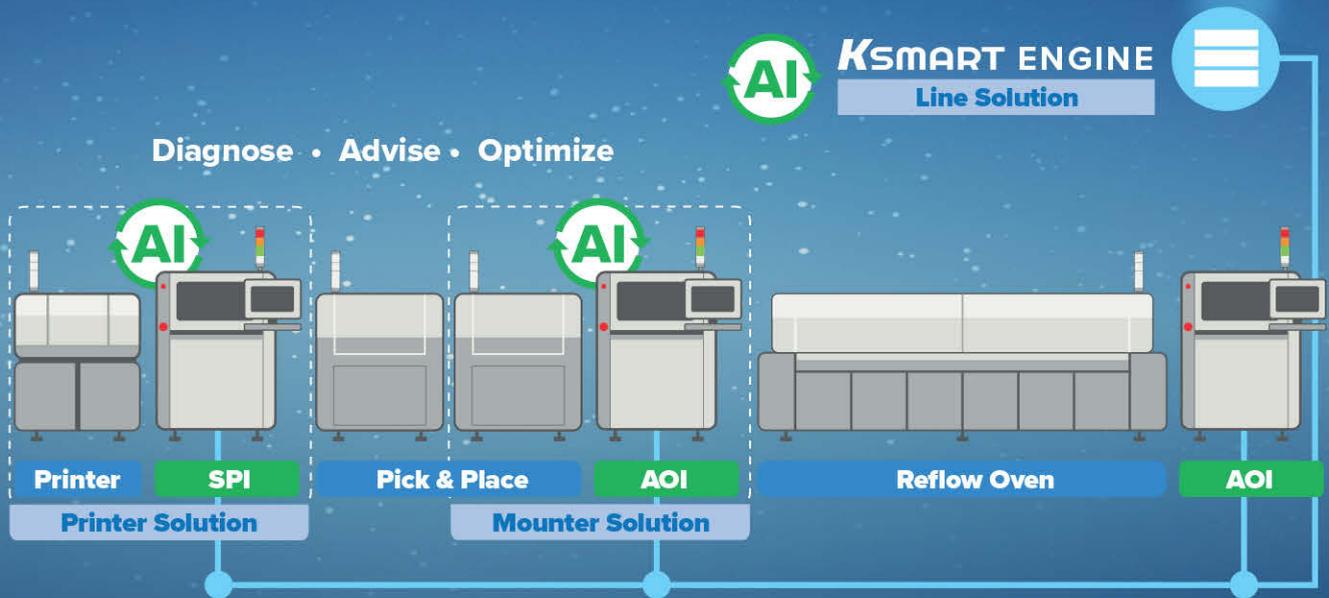
Figure 1: The digital-value alignment and drivers for electronics manufacturing. (Source: IPC & MTC)



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Barry discusses MTC's vision and journey enabling smart factory for electronics manufacturing for a low-volume, high-mix environment using legacy equipment by implementing IPC-CFX. Barry and Naim share why MTC chose this path and what they see as the future for IPC-CFX as part of their goals and vision for their smart factory initiatives.



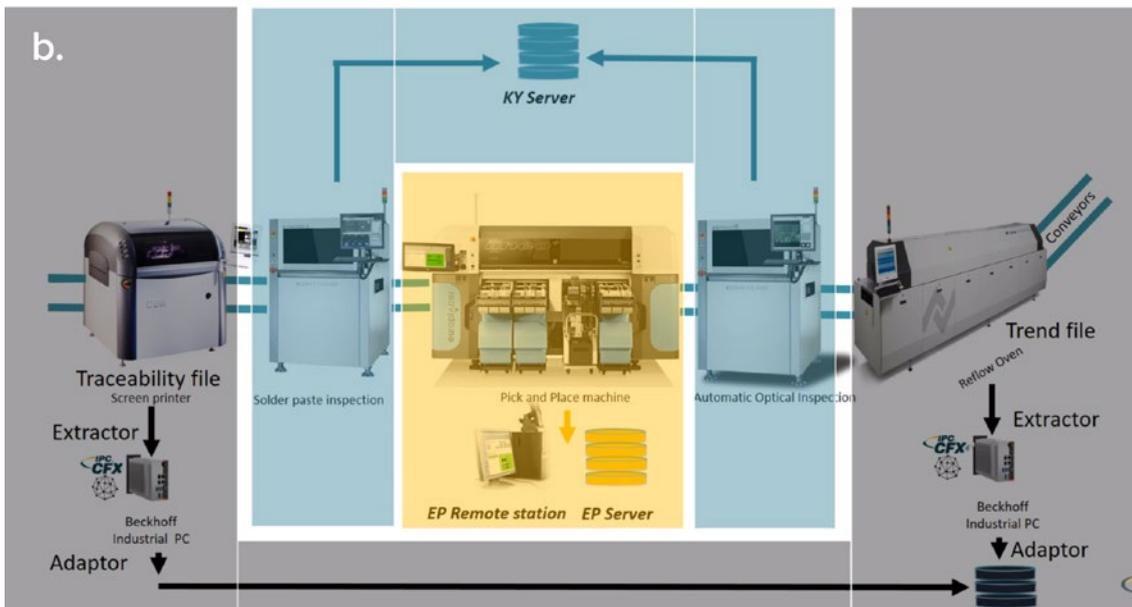
Barry Maybank



Naim Kapadia

Figure 2 shows the SMT line at MTC and the current networking. Three networks are involved in running their SMT line, and each machine has its own industrial PC or PLC on that respective network, shown as “grey,” “blue,” and “yellow” (Figure 2b). MTC wanted

to bring the two legacy machines, the solder paste printer and the reflow oven, into the modern CFX network of the solder paste



Courtesy of YJ link, ASM, Koh Young, Europlacer, Ersa & Omr

Figure 2: MTC's Smart Factory a) SMT equipment; b) SMT line Smart Factory architecture. (Source: IPC & MTC)

## MTC Hardware Setup – Implementing IPC CFX

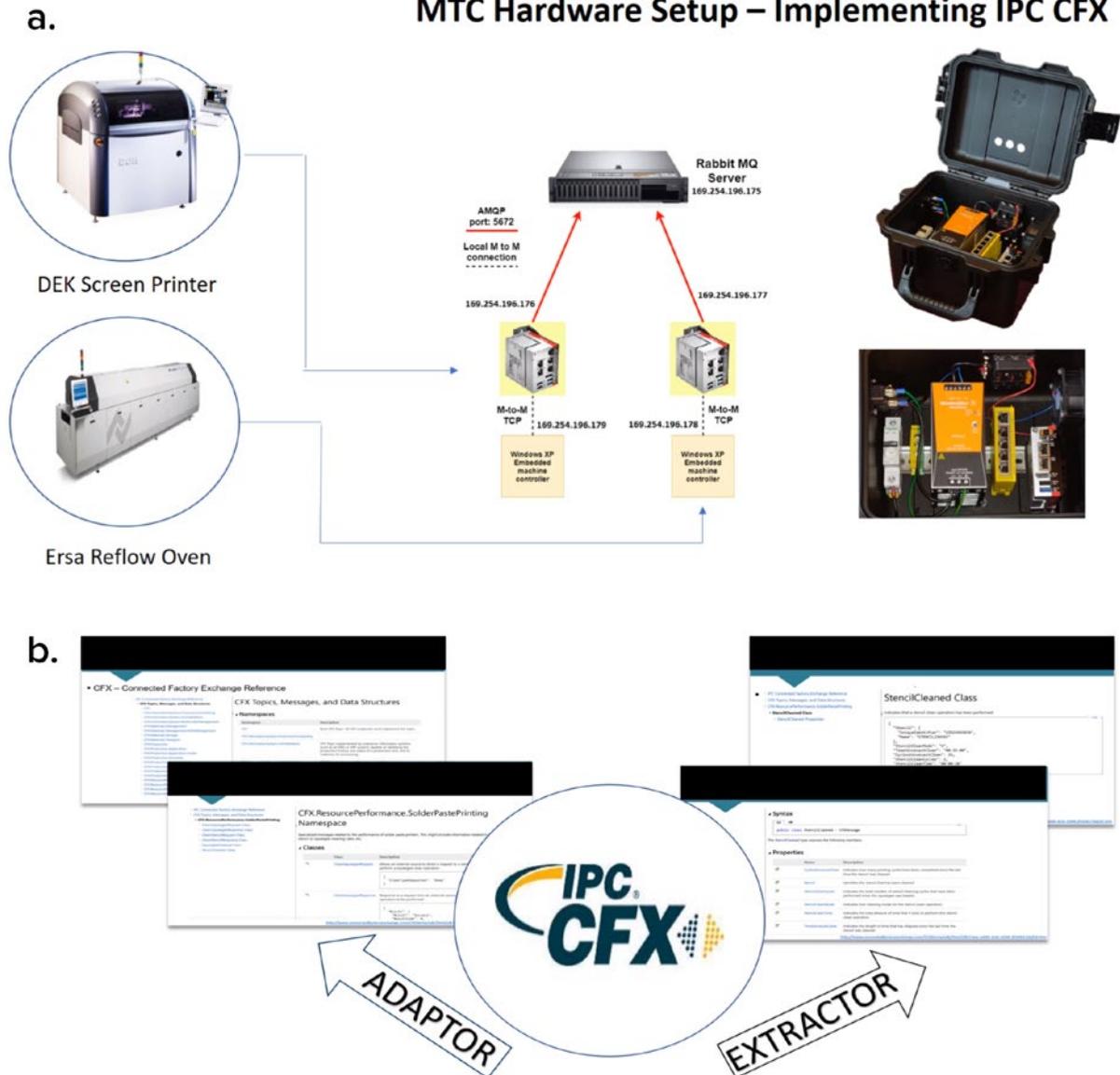


Figure 3: a) Hardware setup for implementing IPC CFX; b) software setup from the SDK for IPC CFX. (Source: IPC & MTC)

inspection, pick-and-place machine, and the automatic optical inspection unit.

They started by adding an industrial PC (a Beckman PC w/Windows 10) to each of the legacy machines' embedded controller. Then these PCs were connected to the Rabbit MQ server that also communicated with the CFX compatible machine controller (Figure 3a).

Figure 3b shows the software setup. Using the SDK software from IPC, a script was written in C for each PC, called the EXTRACTOR. Its job was to take standard log files from each

machine and move it to the CFX program ADAPTOR in the server. Typical data from the solder paste printer is shown in Figure 4a. This data now provides traceability and trends, as well as alarms to the CFX Network. By adding a shareware visualization program called Thinkboard, it was possible to create Real-Time Dashboard (Figure 4b).

MTC then presented a five-minute video of their plans for PHASE 2 Smart Factory: cyber security for OT, augmented reality for machine maintenance and co-bot robotics to carry out multi-tasking in the assembly process.

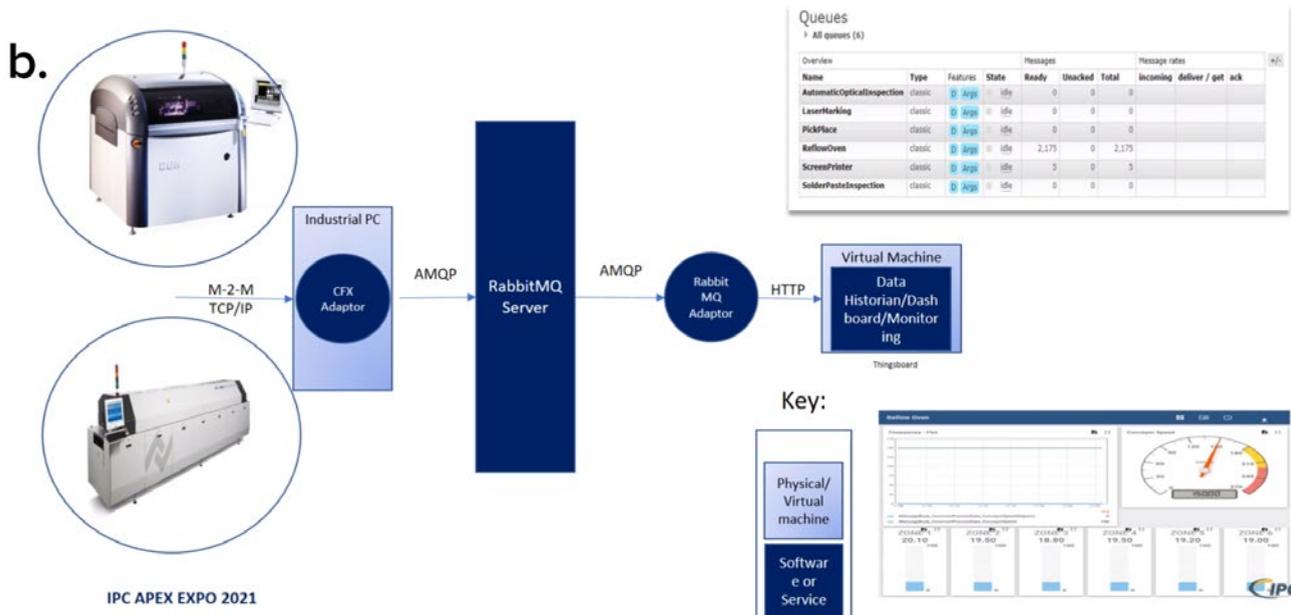
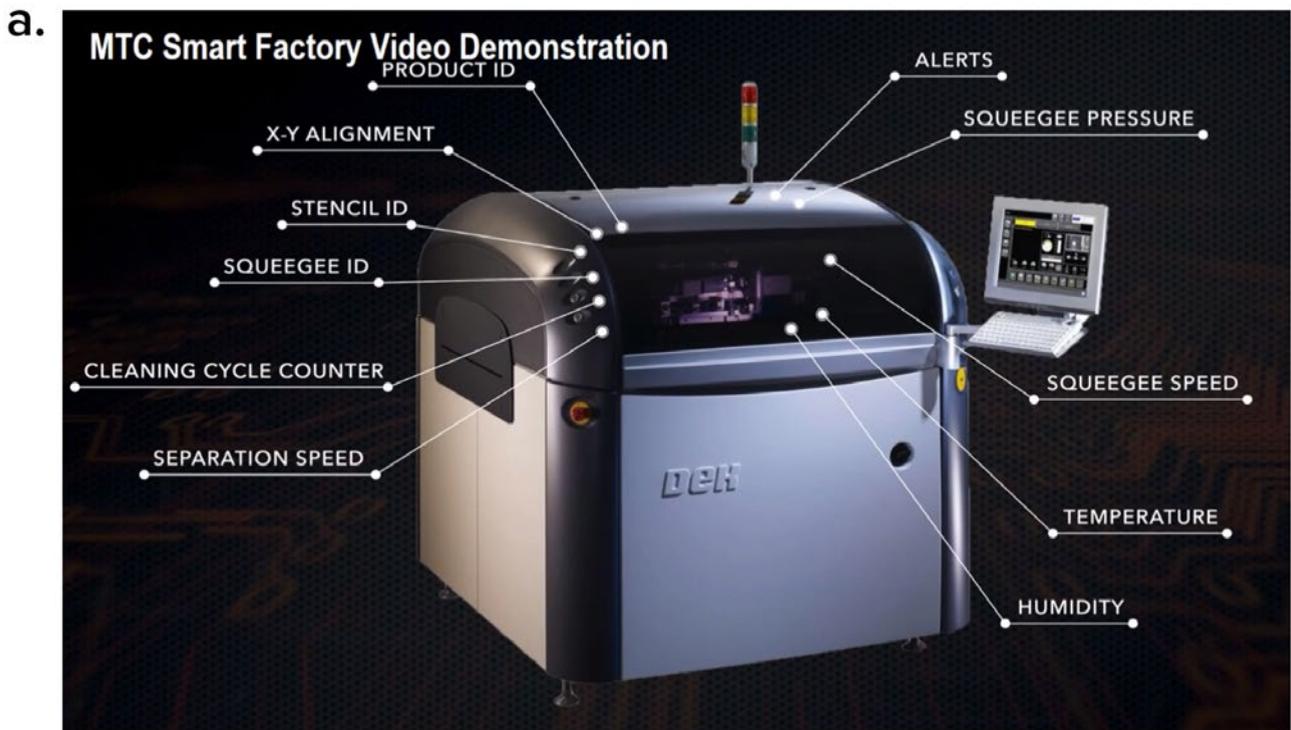


Figure 4: a) Solder paste printer sensors; b) implemented software setup for traceability and trends. (Source: IPC & MTC)

Other highlights of this presentation include:

- The Role for Automation and Robotics in Electronics Manufacturing, presented by: Mike Wilson, MTC
- Working with the Augmented Reality/ Mix Reality in Electronics Manufacturing, presented by David Varela, MTC
- Advanced, Non-real Time Uses of Machine Data for Factory Operational Improvement
- Industry 4.0 Predictive Feeder Maintenance Case Study in 10+ Factories
- Flex Implementing a Global Machine Data Collection System. S&T

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# Jan Pedersen: Dieter Bergman IPC Fellowship Award Recipient

Interview by Patty Goldman, I-CONNECT007

From the IPC website: The Dieter Bergman IPC Fellowship Award is given to individuals who have fostered a collaborative spirit, made significant contributions to standards development, and have consistently demonstrated a commitment to global standardization efforts and the electronics industry. Each recipient will be eligible to bestow the Dieter Bergman Memorial Scholarship upon the university or college of his/her choice.

Patty Goldman speaks with Jan Pedersen of Elmatica, Dieter Bergman IPC Fellowship Award recipient, about his extensive

involvement with IPC on many committees developing standards, especially the automotive and medical addendums to IPC-6012 and 6013.

**Patty Goldman:** Jan, congratulations on this award; it's a big deal as you know and a great accomplishment. How did you feel when you got that phone call?

**Jan Pedersen:** That was amazing. John Mitchell called me, he wanted a five to 10 minutes call and I thought, "What did he call me about?" He told me about this. I said, "Wow! It's not possible. Who recommended me?" That was



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Elmatica CEO Didrik Bech (left) posed as a FedEx delivery person to hand a special envelope to Jan Pedersen, senior technical advisor at Elmatica, in this creative video.

really a surprise, but I'm honored and really flattered that they wanted to recognize me.

**Goldman:** Tell us a little bit about yourself and your involvement with IPC.

**Pedersen:** If I tell something about myself it would be starting as a very young boy because my father had a PCB factory. I started as a child worker (laughs). I normally joke about that. When I came into my 20s, we bought another factory, and I was leading that factory as a production manager. Then I came to Elmatica in '92, and from here I've been more or less handling technologies, suppliers, and today I'm senior technical advisor. On the way, I was engaged into IPC, I think it was 2014. Then it was Lars Wallin who asked me to come to Germany and join a meeting where we

were discussing starting an automotive addendum to the IPC-6012. It was just like when you show up as a parent to your child playing football or whatever, and you're the only one that comes and you take all the jobs.

Nobody wanted to be the chairman. I said, "Okay, I can do that." So that was the start, actually, when we began working with IPC, and of course it was the automotive addendum the first couple of years. Then I got this idea about the medical. I asked IPC if they were interested in

creating a medical addendum to IPC-6012 and IPC-6013, and that is now going to be completed. We did 6012 last autumn and the 6013 addendum is in the works because IPC-6013E is going through ballot now and we need to wait for that. But during that period, I've been involved in a lot of committees and task groups for press fit and quite a lot for automotive, also.



Jan Pedersen and Didrik Bech at the finish of the video shoot in Oslo, Norway, where the company is headquartered.

**Goldman:** Are all your committees related to automotive or medical?

**Pedersen:** Yes, mostly automotive and medical related, but others as well. There have been a lot of committees, and one of them—I call it my baby—is to connect and have a better overview of the IPC-6010 series, or what is called D-33a, which is about the performance of the PCBs: IPC-6012, IPC-6013, IPC-6018, and all the addendums. My idea is we are creating addendums, but

how does that correlate with the mother document? We are implementing requirements, tolerances, and so on into the addendums that probably should have been in the main document for them, and right now we are discussing ultra HDI PCBs. That's an interest-group across quite a few of the committees, involving design, and performance, and it's being led by myself and Herb Snowgren. We are discussing PCBs with the tracks and gaps down to 10 microns.

**Goldman:** That's pretty small.

**Pedersen:** It is, yes. The technology's out there.

**Goldman:** Okay, so back to your regular job; how do you fit it all in?

**Pedersen:** Evening time (laughs). It's a full day job, or more than full day. Guro is listening here. She is always asking me to go into LinkedIn and write some articles and so on. That's nighttime as well. So, there's a lot of evening time.



Jan Pedersen proudly showing off the Dieter Bergman Award medal.

**Guro Krossen [Elmatica employee]:** He is doing a very good job. He's always on. I think it's like a 24/7 job for him; even if I'm sitting up late until 1:30 and thinking nobody else is there. He's always very dedicated.

**Goldman:** So, when you say it's your baby, it's really your baby—you feel like a 24/7 parent.

**Pedersen:** It is. I'm quite passionate about getting the standards right and also getting them up to date. Like if you saw some of the guys in IPC were writing just two years ago that in the U.S. you had very few designs below 3-mil track and gap. Today, we are working with 1 mil. I get calls from California, from South Africa, people talking about, "Hey, we really need that 1-mil or a 25-micron track and gap boards."

**Goldman:** What would you say to some young engineers and people getting into IPC? What is your advice to them?

**Pedersen:** My advice would be to engage with other people across the world, and make sure

that you are connected. For me, a very good way to be connected was to join IPC. You get a lot of connections with people thinking not necessarily the same as yourself, but they're working with the same topics. If you're into electronics with manufacturing design, PCB manufacturing, assembly, or test, there are lots of people connected to IPC that are willing to share with you and discuss. I think that's the best way to be on top of what's going on.

**Goldman:** Yes. Now, one of the things with the Dieter Bergman Fellowship Award is a scholarship to the university or other school of your choice. Have you made a choice yet?

**Pedersen:** Yes, I have chosen two students working on a medical project at the University of South Eastern Norway. There are three reasons for choosing this project: it is medical, it needs miniaturization, and I have a close relationship to the electronics industry in this area, the "electronic coast." We use the university's premises when we meet, discussing PCBs in harsh environments and IPC standards.

The project is called "Arm neuroprosthesis equipped with artificial skin and sensorial feedback" (ARMIN), and the two students are Saad Rabbani and Samarbir Singh. Funny enough, none of them are Norwegians. One of them is from Pakistan and the other from India, and their hometowns are on the opposite sides of Kashmir—but the conflict has not stopped the friendship between these two students!

Saad and Samarbir are both masters in micro- and nano-systems technology, working on their master's theses related to the ARMIN project. Both are working on research that is very central to this project.

Since we are giving the scholarship to two students, Elmatica has decided to double it to \$2,000 USD. Inspired by IPC, we plan to take this opportunity and make the scholarship into a yearly Elmatica event.

**Goldman:** That's great to hear. Thanks Jan, and congratulations again. S&T

## Jan Pedersen Stars in Dieter Bergman Award Acceptance Video



# REALTIME with... IPC APEX EXPO 2021 *Virtual*

*The top 5 things  
you need to know about...*

- ▶ *Solder Masks*
- ▶ *Direct Imaging*
- ▶ *Moisture Management*
- ▶ *Manufacturing Training*



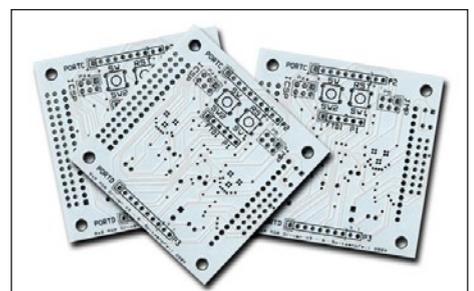
## The Top Five Things You Need to Know About

# SOLDER MASKS

by Taiyo America

The main function of solder mask is to insulate and prevent the copper surface from oxidizing/corroding and prevent solder bridging. While these are the main objectives for solder mask, in the electronics industry there is a misconception that all solder masks are alike.

- 1 Selecting the Right Solder Mask**
- 2 Solder Mask Applications Evolve**
- 3 Advances in Solder Mask Imaging**
- 4 To Flex or Not to Flex**
- 5 Solder Masks Are Not Only Green**



## 1 Selecting the Right Solder Mask

In the world of electronics there are multiple industries each with their own requirements when it comes to solder mask. For the automotive sector, solder masks are required to withstand harsh environments. In the aerospace industry, solder masks must meet out-gassing requirements. Over the years, white solder masks have been developed that provide a high degree of reflectivity for the LED market.

## 2 Solder Mask Applications Evolve

Solder mask and the methods by which they were applied have evolved over the years. When non-photoimageable solder resists were introduced to the printed circuit board (PCB) industry, silk screen printing was the common method of application. As the demand for real estate on PCB designs increased, photoimageable solder masks were developed. The popularity of photoimageable solder masks introduced new application systems such as double-sided screen printing, curtain coating and spray systems. These methods of application have been around for many years and are still being used today. In the past five years, several other application processes have been reintroduced to the market including ink jet and photoimageable dry film.

## 3 Advances in Solder Mask Imaging

As technologies advance and offer more functions, PCBs have become more populated with the miniaturization of key components. The advancements have pushed the boundaries on image registration using conventional exposing units. Over the years, direct imaging (DI) systems were introduced to the PCB industry to help alleviate the challenge. The DI systems provide different wavelengths in comparison to conventional exposing units. Solder mask manufacturers, working side-by-side with equipment manufacturers, developed DI solder masks that are better suited for these types of imaging systems.

## 4 To Flex or Not to Flex

Solder masks have some degree of pliability. Thinner PCBs that are not categorized as a flex build can sometimes encounter a degree of bending due to handling or manufacturing processes. Depending on the amount the substrates are bent, they can exhibit a degree of fracturing. Fracturing of the solder mask is not the same as corner cracking caused by exposure to harsh environments. In cases such as this, PCB manufacturers and contract electronics manufacturers (CEM) should consider the use of a flexible solder mask.

## 5 Solder Masks Are Not Only Green

Solder masks have evolved from green to several other colors over the years. The most common colors besides green are black, blue, red, white, and yellow—all of which fall in the family of primary colors. Colors were developed and brought to market at the request of original equipment manufacturers (OEMs). Colored solder mask can be used for identifying prototypes, revision changes, manufacturing facilities, or for cosmetic reasons. Colored solder masks can also be combined in measured amounts to create a vast number of other colors such as orange, purple and brown. Solder masks can also have various surface finishes such as matte, glossy, or somewhere in between, depending on customers' requirements.



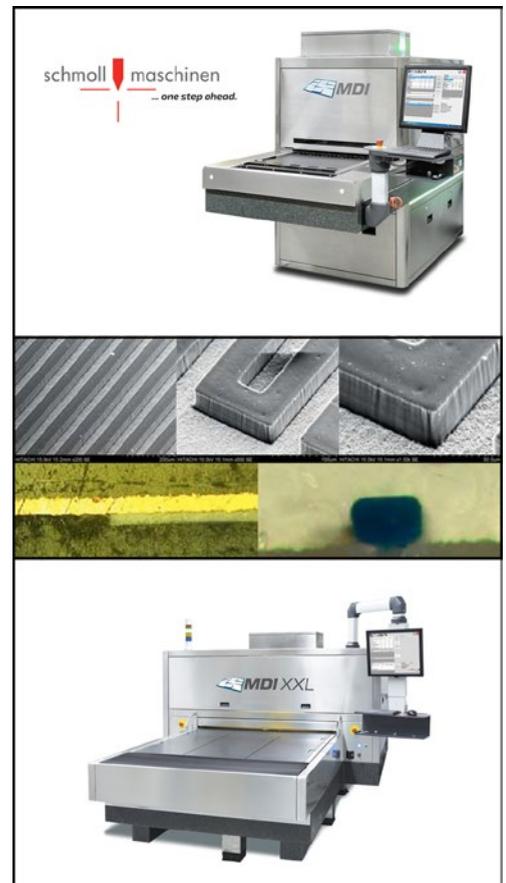
Established 30 years ago, Taiyo America Inc. is a subsidiary of Taiyo Holdings Co. Ltd., the world's leading manufacturer of specialty inks and solder masks for printed circuit boards. Taiyo offers conductive inks for manufacturing printed electronics. Visit us online at: [Taiyo-america.com](http://Taiyo-america.com).

## The Top Five Things You Need to Know About

**DIRECT IMAGING**by **Burkle North America**

Digital direct imaging (DI) was first introduced in the early 1980s and is now an industry-accepted technology for fine line circuit boards. Here are five things to consider when selecting a direct imaging system.

- 1 Resolution/Capacity Trade-off**
- 2 Choosing a New DI Machine?  
Test It on Your Work First!**
- 3 Will More Light Engines Increase  
Productivity?**
- 4 Floor Space and System Platform**
- 5 Environment, Data Collection  
and Support**



## 1 Resolution/Capacity Trade-off

The machines of today are capable of fine line resolutions that were unfathomable just a few years ago. But it's important to understand the trade-off between fine line capability and high production. A direct imaging machine with two types of light engines—a “hybrid” machine—can offer the best of both worlds.

## 2 Choosing a New DI Machine? Test It On Your Work First!

Every design is different. Dry films and solder masks are different. And claims made by equipment manufacturers vary wildly. Don't just look at a spec sheet and assume you'll get the same results. Test your work on the machine before you commit. Be aware that production processes greatly influence the outcome and could even potentially limit the capabilities of a new DI machine.

## 3 Will More Light Engines Increase Productivity?

A common myth about laser direct imaging is that more light engines increase productivity proportionately. It is important to understand that the exposed area (or image field) needs to be distributed well over the width of your panel size to give optimum exposure speed.

When adding further light engines on a multiple head system, it should be considered that these still cover the area of your panel, as you wouldn't see any gain in capacity if one light engine exposes in the “empty” areas.

## 4 Floor Space and System Platform

Cleanrooms may allow only a limited amount of space for the integration of new DI equipment. Ideally, it should replace older contact exposure units or LDI equipment from the previous generation. However, it is unlikely that the old equipment will be removed before installation of the new; therefore, a space-saving machine design which still offers all capabilities is a good choice as it won't require high infrastructure costs on your side.

## 5 Environment, Data Collection and Support

Controlling the environment in your direct imaging area is key to optimum machine performance. Since this digital technology provides the ability to log all relevant machine and production data, it makes direct support and preventive maintenance easier and plannable. Don't just look for a good equipment manufacturer; look for a partner that can guarantee good, long-term support for the equipment while supporting the progress of your process capabilities.



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# The Top Five Things You Need to Know About MOISTURE MANAGEMENT

by Super Dry Totech EU

Moisture and surface mount components do not mix. This includes PCBs. The risks fall into two categories: solderability and encapsulant damage. How best to meet this continuously growing challenge? Here are five suggestions:

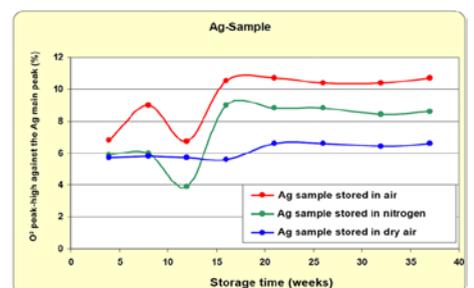
**1** When Component Moisture Levels Become Critical, Encapsulant Damage Can Occur During Reflow

**2** Components are Rated With a Moisture Sensitivity Level (MSL) Which Dictates Available Floor Life

**3** Oxidation Will Occur When Components Are Improperly Stored, Compromising Solderability

**4** If the Floor Life is Exceeded, it is Possible to Restore it Under Carefully Controlled Conditions

**5** Dry Air Atmospheres Stop Oxidation Better Than Nitrogen



## **1** When component moisture levels become critical, encapsulant damage can occur during reflow.

Plastic/epoxy resin packaging material is permeable to moisture (as are PCBs). Components should be delivered in properly prepared moisture barrier bags. Once the bag is opened, components absorb moisture from the atmosphere. If moisture levels become critical (0.1% water weight), damage occurs during reflow as the moisture attempts to escape too quickly, exceeding the elastic limit of the encapsulant.

## **2** Components are rated with a moisture sensitivity level (MSL) which dictates available floor life.

The moisture sensitivity level (MSL) of components is identified by the manufacturer in one of six levels as defined in J-STD-020, displayed in J-STD-033D. This identifies the available safe floor life of components (time out of MBB). For instance, MSL 3 components have a floor life of 168 hours. Tracking the exposure time is critical to preventing defects.

## **3** Oxidation will occur when components are improperly stored, compromising solderability.

Oxidation will also occur on components stored in ambient RH. This negatively affects solderability. The same safe storage conditions

(<5%RH) that will stop moisture absorption by encapsulants will also stop oxidation. A level of <5% RH provides unlimited safe storage time, thus “stopping the clock” on the MSL floor life. This is particularly significant for low-volume high-mix operations.

## **4** If the floor life is exceeded, it is possible to restore it under carefully controlled conditions.

Expired floor life can be restored by reducing absorbed moisture to safe levels. Traditional high temperature (125°C) baking reduces moisture but induces oxidation and intermetallic growth, increases wetting times, and compromises solderability. Lower baking temperatures (40-60°C) combined with ultra-low RH (1%) will rapidly restore floor life without reducing solderability, and unlike high temperature, this process can be safely repeated.

## **5** Dry air atmospheres stop oxidation better than nitrogen.

Nitrogen was a traditional method for safe storage. However, dry air is much less expensive and provides lower RH%. X-ray data of numerous alloys proves low %RH air stops oxidation better than N<sub>2</sub>. This is because water is the more aggressive bearer of oxygen than tightly bonded O<sub>2</sub> molecules. Removing the moisture removes the catalyst and prevents the corrosion process.



Super Dry Totech EU® [www.superdry-totech.com](http://www.superdry-totech.com) is a moisture management specialist, providing hardware and process control software for safe storage, floor life reset and automated tracking of moisture sensitive components and materials.

# The Top Five Things You Need to Know About **MANUFACTURING TRAINING**

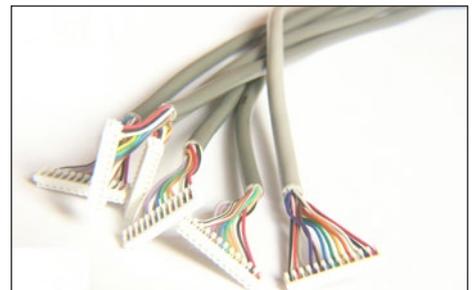
by **Blackfox Training**

Electronics manufacturing companies need skilled and certified workers to perform the intricate and important tasks required to build modern electronic equipment. Here, we explain five ways to gain these workers:

**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 Offer Self-Paced Learning for Soft and Technical Skills (Available 24/7)**



**5 Hire U.S. Military Veterans Who Have Already Completed Immense Training**

## **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 electronic 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 Offer self-paced learning for soft and technical skills available anytime**

Self-paced learning that is delivered in consistent, small snippets will have a higher retention level than content delivered through other methods. When employees can convert non-productive time into learning time, that employee becomes more valuable to the company, and in turn, the company benefits. Self-paced learning for your workforce will increase engagement, productivity, and positive morale.

## **5 Hire U.S. military veterans who have already completed immense training**

Now more than ever, highly skilled and efficient employees are needed in manufacturing. The U.S. military invests an enormous amount of training in our soldiers. They are equipped with a framework of skills and attributes such as loyalty, integrity, leadership, and excellent work ethic. They know how to learn new skills quickly and adapt to changing environments, which are highly desirable qualities for manufacturing.



Blackfox is the worldwide leader in providing IPC certification and custom training systems to the manufacturing industry's top companies. Blackfox provides solutions for the manufacturing industry and for veterans seeking employment.

Visit us online at [Blackfox.com](https://www.blackfox.com).



## Happy's Play-by-Play of IPC APEX EXPO

by Happy Holden, I-CONNECT007

This was the first time IPC had a virtual APEX EXPO. It went well, but I missed seeing everyone. On the other hand, all this material being available for 90 days certainly allows it to fit anyone's schedule. I spent all week intently listening to the presentations.

Unfortunately, a virtual conference does not allow you to chat in the aisles, visit old friends during breaks, or have a Starbucks together. So, a successful virtual conference is difficult to compare to a live in-person conference.

To help you take full advantage of the 90 day on-demand availability, I've included summary information for a portion of the program. This is not an exhaustive list, as I had not yet been able to watch them all by the time this went to press.



### Managers Forum: Managing Challenges in Periods of Transition

The show kicked off with a greeting from IPC President and CEO John Mitchell, followed by Gene Weiner, Hall of Fame council program chair. Gene was his usual "cheery" self as he introduced IPC VP of Global Government Relations Chris Mitchell, who spoke on "Seizing the Moment."

Chris made several good points:

- The PCB industry is not well known to the government compared to semiconductors and prominent electronics products
- IPC has done an excellent job as an advocate for electronics manufacturing
- COVID-19 has heightened the awareness of our supply chain for electronics manufacturing



- IPC has been prominent in developing CFX and supporting legislation for capital investment legislation

Chris was followed by a management forum and an EMS forum.

Mark Wolfe moderated an EMS panel titled “Lessons Learned in Times of Crisis.” Each presenter shared their thoughts on lessons learned before engaging in a general discussion and specific questions.



Mark Wolfe

Dave Patterson of Cirtronics Corp., for example, shared four items that topped his list of lessons learned: frequent communication during a crisis is critical, identify one trusted source for guidance, have a contingency plan with depth and specificity, and don’t go it alone.

Barb Jorgensen of AsperCore gave examples of two companies’ response and actions during the pandemic, while Katherine Ducharme of General Dynamics spoke about how DoD has been preparing for supply chain disruptions for the past few years.

Jonathan Rowntree of Rogers Corp summarized his company’s response as a focus on employee health and safety, as well as becoming agile enough to ensure business continuity. Finally, Brad Bourne of FTG Group passed on what they saw from customers and suppliers, and how the company adjusted its internal operations.

The panel discussion was followed by a presentation from Harald Ahnert, president of electronics at Atotech Group.

Harald provided a report on how Atotech prioritized tech support and employee safety during the pandemic. They had to quickly adjust to the new normal and switch to working from home. This resulted in short video calls instead of visits and proved to be very efficient.



Harald Ahnert

They have prioritized AR/VR as a new tool to help customer solve problems and do expedited installations. What’s next? More digitization!

Harald was followed by Anaya Vardya, president/CEO, American Standard Circuit, Inc., whose remarks were titled “Going Forward.”

Anaya related that their response involved a focus on investments: their people, processes, and products. What technologies and processes will support their customers and future customers? He provided an example of their investment in A-SAP and the resulting look at photoresists, AOI, and testing. Priority is now on quality and reliability checking to leverage their investment.

John Mitchell delivered a keynote and as always, it was right on the mark. For a detailed review of his keynote, [click here](#).

The afternoon was filled with discussion about Factory 4.0, supply chain disruptions, and vertical integration strategies:

Norman Weiss, CEO, German Industry 4.0 Campus, and Sebastian Schaal, founder, Luminovo GmbH, “Transitioning to Factory 4.0—How Up-Skilling and AI Can Help.” Norman and Sebastian discussed how education and up-skilling is important to Industry 4.0. Software will play a greater role for smart processes as well as the cloud, automation and big data.



Norman Weiss

Katherine Ducharme, director, and Cheryl Van Dyke, senior manager of supply chain management, General Dynamics Missions Systems, “Managing the Supply Chain During Periods of Uncertainty.” Katherine and Cheryl provided an explanation of their activities to analyze risk in their supply chain. This was a very useful and informative detailed look at how they manage their supply chain.

Alex Stepinski, managing director, AWP Group and VP, GreenSource Fabrication presented a very interesting session on the topic involving OEM purchasing PCB fabrication

technology for their vertical integration strategies. Our own Pete Starkey has detailed that for you here.

Diane Maceri, supply chain director, Schweitzer Engineering Laboratories, Inc., and Jessi Hall, senior director for vertical integration, Schweitzer Engineering Laboratories, Inc., provided details of the alternatives, and pluses and minuses of going into PCB fabrication.

Jeff Leblanc, director of operations for plating fabrication, Vicor Corporation, also detailed their analysis of future options and how they decided to add a modified PCB fabrication facility to their new expansions.

Joe O'Neil, CEO, Green Circuits, presented "Challenges and Changes." Joe provided the wrap-up for the day by discussing COVID, market and technology. Standardization is key, niches can be a growth area, and vertical integration is back on the agenda.



Alex Stepinski



Joe O'Neil

## Technical Track: PCB Fabrication and Materials Tech Sessions

**SO2-1:** Mike Vinson, Averatek, "Semi-Additive PCB Processing: Process, Reliability Testing and Applications." Mike provided an overview of semi-additive PCB processes for ultra-high-density PCBs of 15 microns feature sizes and below. The A-SAP process is a Liquid Metal Ink™, a few nanometers-thick palladium coating that allows a thin, uniform, and dense electroless deposit. It is capable of <15-micron t/s capability with suitable photolithography and etching. Mike provided the process flow, examples of finished geometries and applications that allow use of much smaller packages and reducing layer count. Reliability has shown improvements to microvia metallization and high-aspect through-holes. Also presented was RF and SI analysis for high-frequency performance.

**SO2-2:** Manoj Kakade, et all, pSEMI Corp., "Thermal Improvement in 3D Embedded Module Using Copper Bar Vias." Manoj discussed the use of copper bar vias in substrates to improve thermal performance. The application is intended for embedded component integrated into modules. After introducing the process, a thorough thermal analysis was discussed including the simulation using Ansys FEM tools. Results indicate that bar vias have lowered Tj by 10°C.

**SO5-1:** Gerry Partida, Summit Interconnect, "Microvia Weak Interfacial Fracture of Microvia Designs-Comparing the Reliability of Graphite-based Direct Metallization and Conventional Electroless Copper." Summit Interconnect and RBP Chemical Technology conducted a joint project to provide additional insight into the weak interface defect in stacked HDI microvias by processing in either graphite-based direct plate or conventional electroless copper on a specially designed test vehicle. The test vehicle (IPC D coupon) had 3-, 4-, 5-, 6- and 8-mil via, and blind vias on two different dielectric thicknesses. All were tested to IPC-TM-650 method 2.6.27B and OM Testing. Results indicate that DM process performed equal to or better than conventional electroless copper. The paper provided detailed reliability performance.



Gerry Partida

**SO5-2:** Jerry Magera, Motorola Solutions, "The Complete Path to Least Resistance Investigating the Source of the Weak Microvia Interface." Jerry was one of the first to discover the "Weak Microvia Interface" and report on it. He successfully created a test that is now an IPC Test Standard and has done extensive experimentation looking for the root causes. This is a long and detailed paper on the experimentation and results for the last two



Jerry Magera

years on investigating the WMI. Jerry summarizes all the results to date and provides recommendations for containment and further experimentation.

**SO5-3:** William Bowerman, MacDermid Alpha Electronics Solutions, “Process Improvement Strategies for Weak Microvia Interfaces.” Bill discusses the results of a two-Level DOE experimentation on the metallization process for stacked blind microvias tested to IPC test methods 2.6.26A and 2.6.27. The well documented paper concludes that proper target pad preparations and cleaning of lasered via are essential. Best practices must be followed for electroless copper deposition to gain copper recrystallization across the interface.



William Bowerman

**SO8-1:** Maartin Cauwe, IMEC/ESA, “Microvia IPC/ESA TV Introduction.” Maartin recapped the HDI qualification program for the European Space Agency carried out over the last two years. This was done in two phases: a basic HDI architecture and a complex HDI structure, utilizing two materials, rigid polyamide glass, and Panasonic MEGTRON 6. Working with IPC, a high-performance FR-4 was also tested: Hitachi 679F(j) using a 26-layer TV with four-different test coupons to be tested to IPC to 2.6.7.2C, 2.6.26A-method A, 2.6.26A-method B and 2.6.27B. Test results are presented in three papers.



Maartin Cauwe

**SO8-2:** Bob Neves, Microtek Labs China, “IPC/IMEC/ESA Microvia TV HATS<sup>2</sup> Test Results.” Bob introduced the HATS<sup>2</sup> test vehicle and testing strategy. This is a “single via coupon” used by automotive to detect onset of microvia failure. Also tested were the IPC “D” coupon daisy chains. All used a maximum



Bob Neves

of 230°C reflow temperature for the tin-lead assembly process of the ESA. All coupons performed well with the staggered via structures outperforming the stacked via structures. The final report is 160 pages long!

**SO8-3:** Jason Furlong, PWB Interconnect Solutions, “IPC/IMEC/ESA Microvia TV IST Test Results.” Jason described in detail the Test Vehicle coupons for IST testing and the test equipment. No failures occurred in this standard testing, but six coupons were selected for continuous extended testing to 5% fail at 190°C. Testing continues today.

Jason Furlong

**SO8-4:** Kevin Knadle, TTM Technologies, “IPC/IMEC/ESA Microvia CITC Test Results.” Kevin introduced the CITC Coupon developed by IBM, a small, simple, single-net of vias in-line. Results were excellent with the staggered microvias outperforming semi-stacked and full stacked, from maximum reflow temps of 230°C, 245°C and 260°C. Kevin provided Life Reliability calculations.



Kevin Knadle

## Technical Track: Factory of the Future Implementation

**S10-1:** Barry Maybank, MTC, “MTC Vision Strategy and Digital Journey Implementing IPC CFX Using Legacy Equipment.” In this presentation, Barry Maybank explains the background of the MTC, one of seven high-value-manufacturing technology catapult centers established in the UK. The other six are:



Barry Maybank

- Advanced Forming Research Centre (AFRC)
- Centre for Process Innovation (CPI)
- Nuclear Advanced Manufacturing Research Centre (NAMRC)

- Advanced Manufacturing Research Centre (AMRC)
- Warwick Manufacturing Group (WMG)
- The National Composites Centre (NCC)
- Manufacturing Technology Center (MTC)

MTC's role is to provide support, consulting, and implementation examples and leadership in the effort to introduce and implement the smart factory into UK industries; in this case, electronics assembly.

Barry discussed MTC's vision and journey enabling smart factory for electronics manufacturing for a low-volume, high-mix environment using legacy equipment by implementing IPC-CFX. Barry and Naim will share why MTC chose this path and what they see as the future for IPC-CFX as part of their goals and vision for their smart factory initiatives. Three networks are involved in running their SMT line, and each machine has their own industrial PC or PLC on that respective network, shown as grey, blue, and yellow. MTC wanted to bring the two legacy machines, the solder paste printer, and the reflow oven into the modern CFX network of the solder paste inspection, pick-and-place machine, and the automatic optical inspection unit.

They started by adding an industrial PC (a Beckman PC w/Windows 10) to each of the legacy machines embedded controller. Then these PCs were connected to the Rabbit MQ server that also communicated with the CFX compatible machine controller.

Using the SDK software from IPC, a script was written in C for each PC, called the EXTRACTOR. Its job was to take standard log files from each machine and move it to the CFX program ADAPTOR in the server. Typical data from the solder paste printer is shown in Figure 4a. This data now provides traceability and trends, as well as alarms to the CFX Network. By adding a shareware visualization program called Thinkboard, it was possible to create a Real-Time Dashboard. MTC then presented a five-minute video of their plans

for PHASE 2 Smart Factory: cybersecurity for OT, augmented reality for machine maintenance and co-bot robotics to carry out multi-tasking in the assembly process.

**S10-2:** David Varela, MTC, "Working with Augmented Reality in Electronics Manufacturing." David supplied a simple definition of augmented reality (AR) and how it can help a highly automated electronics manufacturing facility with tasks that are still manual. It is implemented using multiple sources into the manual process. The system architecture was very useful in seeing how a "pulled PCB design file" and AOI results can be integrated to use in AR for manual tasks.



David Varela

**S10-3:** Mike Wilson, MTC, "The Role for Automation and Robotics in Electronics Manufacturing." Mike was reporting on MTC projects in automation and robotics to support the UK supply chain. He explained the difference that robotics use in the UK would be from Asia, especially for high-mix, low-volume production. As an example, he illustrated their typical use of co-bots in their automated SMT line as well as other developments planned.



Mike Wilson

**S13-1:** Timothy Burke, Arch Systems, "Advanced, Non-Real-Time Uses of Machine Data for Factory Operational Improvement." Tim presented how to collect machine data for use in the complex EMS factory. The data is either tactical or strategic. Tim emphasized that a central, strategic system is needed and discussed the five main steps in implementing.



Timothy Burke

**S13-2:** Dr. Thomas Marktscheffel, ASM Assembly Systems, "A Structured Approach for Providing well-formed Maintenance Data

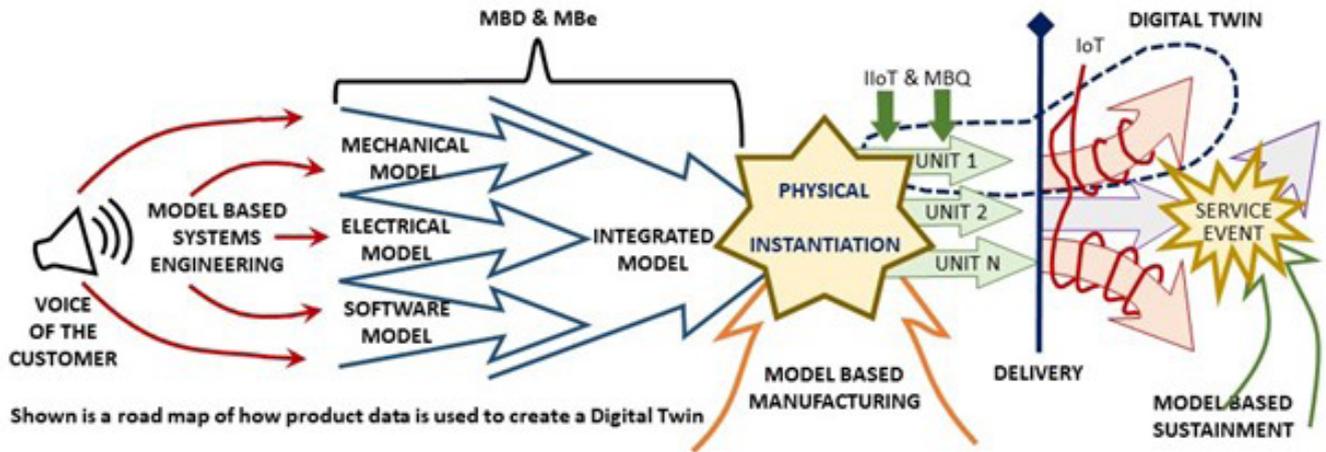


Figure 1: A digital twin model.

for SMT Machines.” Thomas explained how collecting data from SMT machines can lead to a better maintenance approach. Maintenance in general was discussed and different approaches analyzed, with conclusions for benefits. IPC-2591 CFX v1.3 provides a maintenance data model and necessary messages for smart maintenance.



Dr. Thomas Marktscheffel

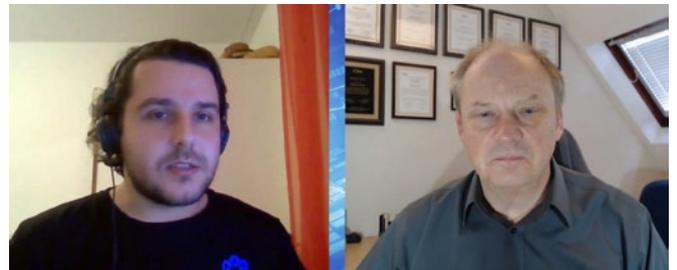
## Technical Track: Factory of the Future Implementation

S22: Michael Ford, Hemant Shah, Thomas Marktscheffel, and Radu Diaconescu, “The IPC-2551 Digital Twin Standard—A Glimpse into Values and Benefits.” This is an important new standard. The digital twin is an essential part of Industry 4.0 and the smart factory. It provides the predictive engineering outcomes

S13-3: Myckel Haghazari, Digital Factory, “Implementing a Global Machine Data Collection System Across Many EMS Factories.” Sorry, but I did not get to listen to this presentation-I will pick it up later!



Myckel Haghazari



Radu Diaconescu and Michael Ford

# The IPC-2551 Digital Twin Standard A Glimpse Into Values & Benefits

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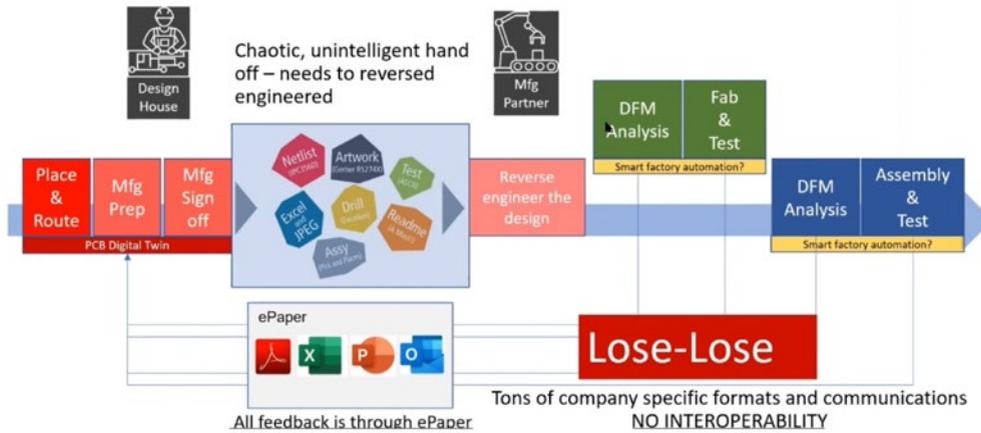


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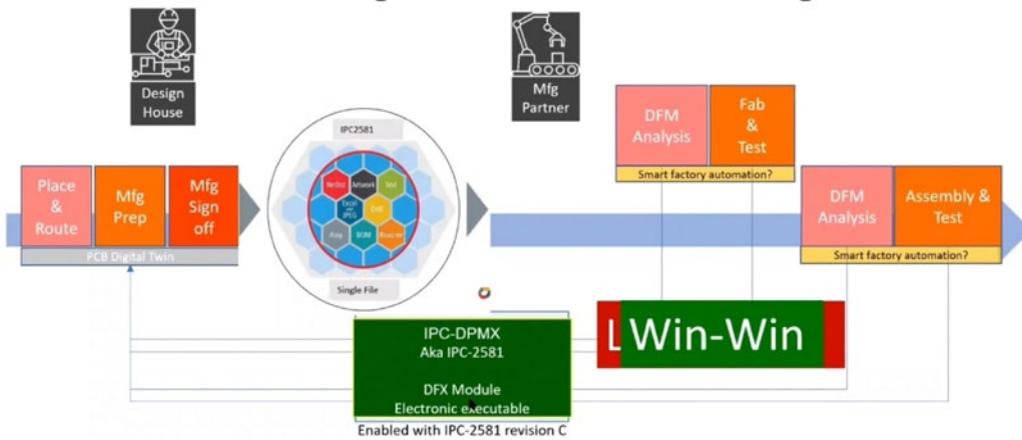


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## Manufacturing Hand off & Feedback Challenges



## Bi-directional DFX Exchange Win-win for Design House & Manufacturing Partner



about products from a smart factory. Currently, there are none available, but everyone is working on them. Without this standard, each will be different and potentially non-interchangeable. But with an IPC Standard, it is now possible that there will be commonality among digital twins.

Michael Ford started the session with an explanation of IPC-2551 and the need for interoperability and the interoperability framework.” This framework must have three essential features: product, manufacturing, and lifecycle. The basis for this framework is existing IPC standard IPC-2581 DPMX; a secure supply chain, IPC-1782/ 1782A; and the connected factory exchange (CFX) IPC-2591.

Hemant Shah explained the DT Product part based on the IPC DPMX Product Description

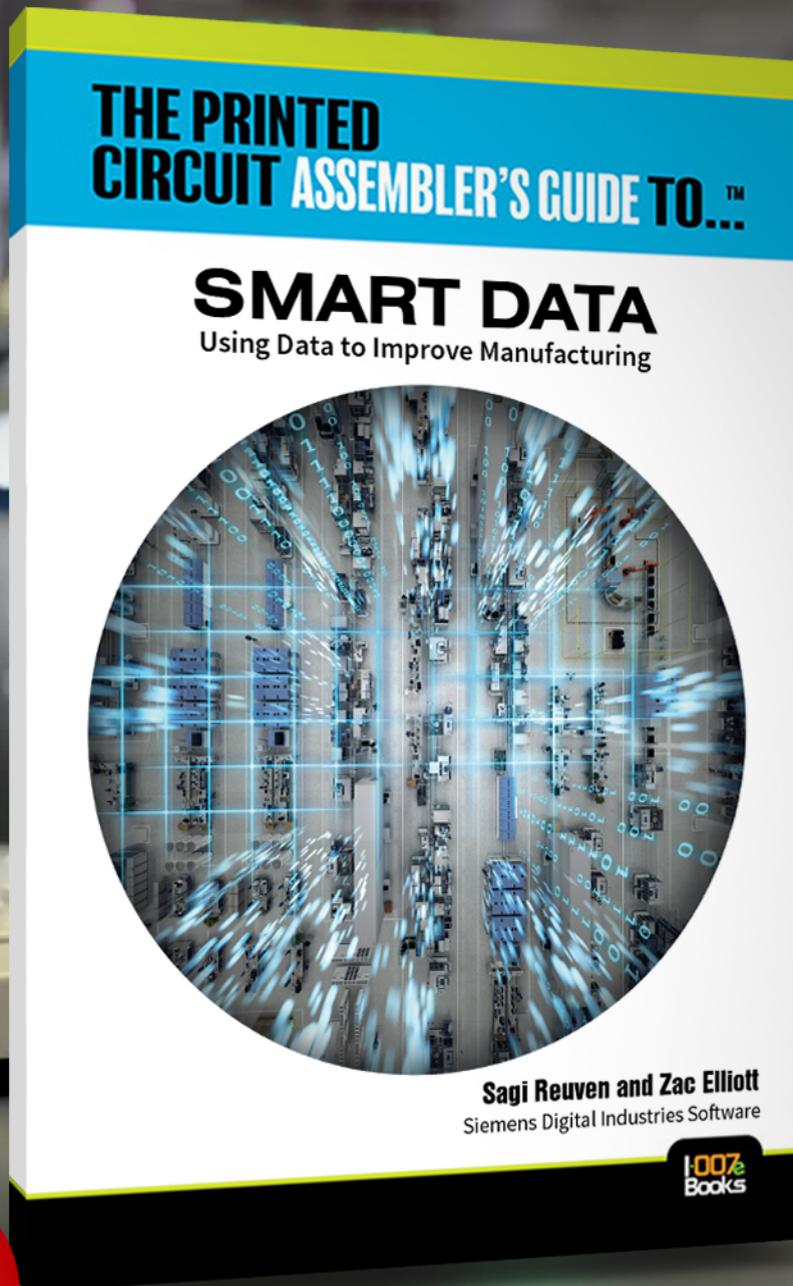
Data Standard. This standard defines a PCB and assembly, how it is to be built, its materials, features, and testability.

Thomas Marktscheffel explained the DT Manufacturing part based on site configuration, work order information and product traceability, in addition to equipment and tool used and material storage locations.

Radu Diaconescu explained the DT Lifecycle part based on the supply chain, usage characteristics/environments, repair and maintenance, subassemblies, revisions, recycle, and end-of-life management. In total, the “Digital Twin Lifecycle closes the loop between the complex physical world and the digital allowing for the assessment of complex scenarios and interactions,” he said. S&T

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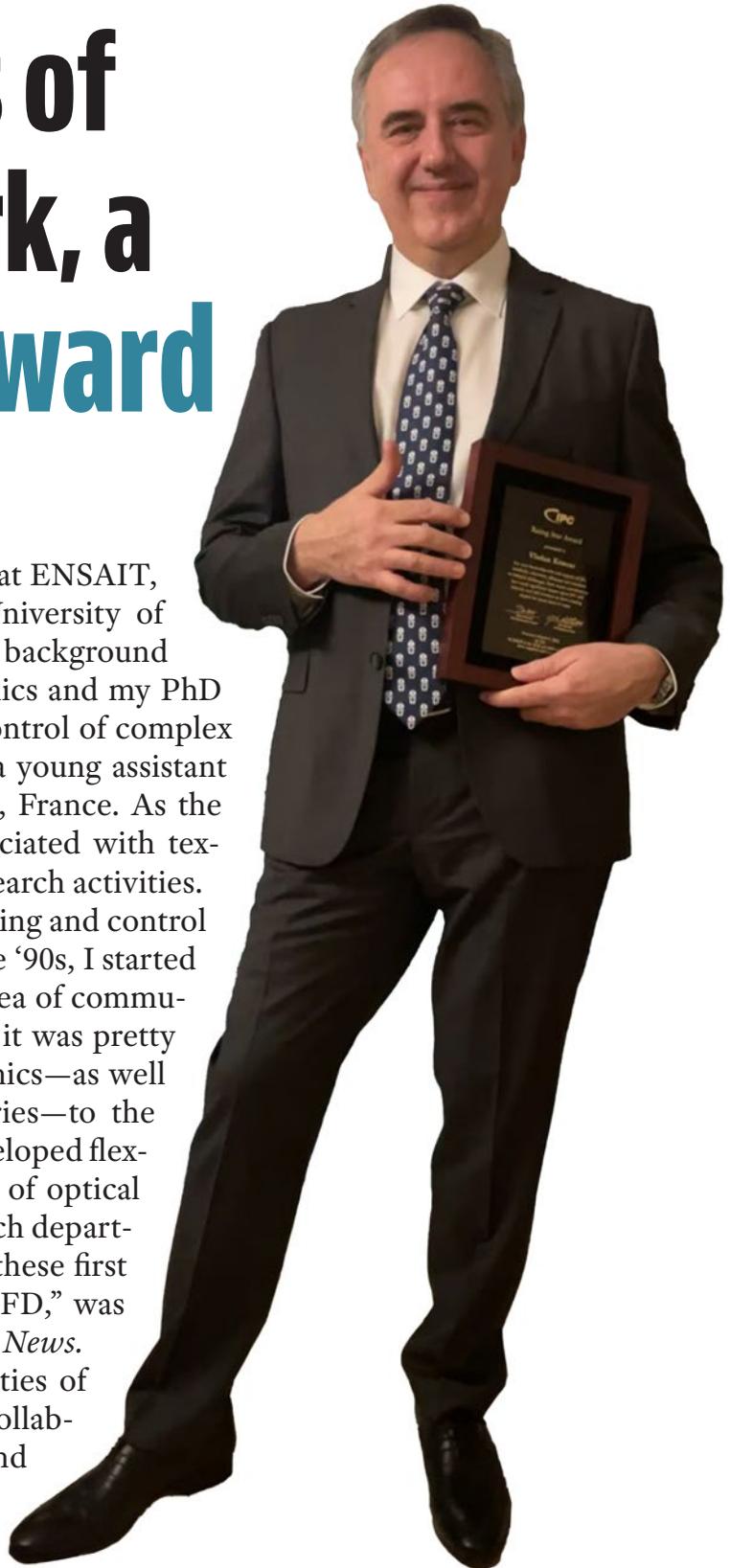
# After Decades of E-Textiles Work, a Rising Star Award

by Vladan Koncar

I am currently a distinguished professor at ENSAIT, the textile engineering institute at the University of Lille, in Northern France. My scientific background is related to electronics and microelectronics and my PhD thesis was focused on the decentralized control of complex systems. I started my academic career as a young assistant professor at ENSAIT in 1991, in Roubaix, France. As the main application field of ENSAIT is associated with textiles, I had to adapt my courses and my research activities.

For the first time, I focused on the modeling and control of complex textile processes, and in the late '90s, I started to develop my scientific activities in the area of communicated textiles, even though at that time, it was pretty unclear to me how to connect the electronics—as well as the control and communication theories—to the textile structures. In the beginning, we developed flexible textile displays based on the weaving of optical fibers for France Telecom, and their research department. In April 2005, an article describing these first displays, “Optical fiber fabric display—OFFD,” was published in the journal *Optics & Photonics News*.

Currently, almost all the research activities of my group are focused on e-textiles. Many collaborative and B-to-B projects with French and EU companies are ongoing, and this activity has a steady growth rate.



Almost 25 years after I started working on e-textiles and developing my first e-textile prototypes and structures, I realized that no matter how good our laboratory prototypes are, they will never really be able to hit the market without following the norms and standards, including well-defined testing methods, for the critical characteristics and stresses they may undergo. The problem? These norms and standards were (and are) still missing.

Also, because the word e-textiles encompasses electronics and textiles, it was very important to find a way to help these two industrial sectors better understand one another. This led me to begin collaborating with IPC two years ago.

After decades of work in my field, I was awarded the Rising Star award during IPC APEX EXPO 2021. I would like to thank my research team, all the colleagues from the D-75A-EU E-Textiles Wearables Standard Task Group in Europe, Chris Jorgensen from IPC, and Sigrid Rotzler, the Task Group vice-chair. Last but not least, I would like to express my thanks to IPC CEO John Mitchell for this award.

Our collaboration with IPC continues to grow, and I am sure that the IPC-8981 Quality and Reliability of E-textiles Wearables standards will be soon published and utilized by both textile and electronics companies.

Our collaboration with IPC, which began back in 2018 before the pandemic, offered us excellent preparation for the remote work we all must embrace today with the lockdown. Because many members of the subcommittee under my chair live in different countries, we must use videoconferencing software for remote meetings.

I very much enjoyed IPC APEX EXPO 2021, with its technical conferences and application-focused professional development courses, in a virtual format. I particularly appreciated the IPC Annual Meeting and Awards Hall of Fame Personal Recognition chaired by an inspired John Mitchell, who expressed his thanks to me in French, saying, “Merci beaucoup!”

Finally, I hope that this difficult period will soon be behind us and that we will all meet at the next IPC APEX EXPO in San Diego in 2022. Once again, merci beaucoup! \$&T





# Top Five Takeaways from IPC APEX EXPO 2021

by Chris Mitchell, I-CONNECT007

IPC APEX EXPO 2021, which went all virtual this year, exemplified how the electronics industry has responded to the COVID-19 global pandemic: with resiliency, agility, and an unwavering commitment to build electronics better. APEX EXPO featured great content and robust discussions on topics of critical importance to the global electronics industry.

From my vantage point leading IPC's government relations programs, here are my top five takeaways from this year's event.

## 1. Factory of the Future Grabs the Spotlight

What a difference a year makes! At last year's APEX EXPO, Matt Kelly had just assumed his new role as IPC's chief technologist. A year later, he is implementing IPC's bold, new Factory of the Future initiative, which he developed in concert with IPC members, and which will help guide the industry through the next industrial revolution. Presentations by Matt, *IndustryWeek's* Travis Hessman, and others reinforced the promise of the factory of the future (F2),

but also the challenging, incremental progress necessary to achieve this vision.

While Matt is focused on helping the industry leverage F2 solutions to address various business challenges, the IPC government relations team is making the factory of the future the centerpiece of our industry's advocacy. Policymakers around the world are deliberating on new industrial policies to strengthen their economic competitiveness. F2 offers a path to stronger manufacturing, and governments have an opportunity to implement policies that accelerate that migration. IPC is already carrying this message to the Biden administration and the European Commission, encouraging them to better support our industry's R&D and capital expenditures.



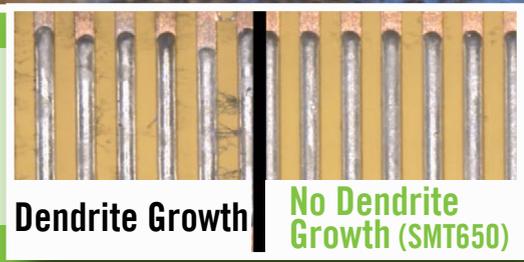
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## 2. Rave Reviews for This Year's Technical Conference

I spoke to more than a few APEX EXPO participants who said this year's **technical conference** was among the best, if not the best ever. A lot of great content on big issues like cybersecurity, data analytics, traceability, assembly materials and design, but a special nod to the interest generated by those sessions focused on reliability. The high attendance in these sessions spoke volumes; the industry is facing rising expectations about the reliability of electronics products and services. High-reliability systems often involve miniaturized commercial electronics function 24/7 in harsh-use environments. And they must meet these requirements even as the industry moves away from the use of lead, introduces new laminate materials, and leverages innovative manufacturing technologies to support smaller vias on higher density designs.

The industry's intense interest in reliability should be a wake-up call for policymakers, many of whom have ignored the need for heavier investments in R&D and capital equipment in assembly and PCB manufacturing, even as they have deployed billions to support the semiconductor and microelectronics industries. It is past time for governments in Europe and North America, in particular, to adopt a more holistic approach to the industrial ecosystem that supports electronics manufacturing. The ecosystem's strength relies on meaningful investments across its many sub-sectors if we are to realize goals around resiliency, security, and innovation.

## 3. IPC Launches ESG for Electronics Initiative

A recent online poll found that only a quarter of the executives who responded felt their organizations' leadership had a strong understanding of ESG, the acronym for Environment, Social and Corporate Governance. ESG is the new approach to corporate social responsibility, premised on the notion that companies that integrate ESG into their business decisions and operations are stronger by having accounted for concerns that create liabilities or risk. The financial services community is increasingly relying on ESG ratings and rankings to steer investments. Today, many IPC members that are public companies have ESG programs and are performing ESG-related data collection and reporting. In many cases, reporting obligations are increasingly flowing down to their suppliers.

At the suggestion of our members, IPC decided greater leadership was necessary to help our industry navigate this new terrain. In his APEX keynote, IPC CEO John Mitchell announced the launch of a new ESG initiative that, in the short-term, will develop guidance that advances an industry-specific approach to ESG practices and reporting. A working group of electronics manufacturers is being formed, and the industry can expect to see the products of their work as early as this summer. In the longer term, the initiative will aim to marshal IPC's extensive resources and capabilities—in standards, workforce, research, and advocacy—to achieve industry-backed ESG goals.





## 4. IPC launches Thought Leaders Program

During APEX EXPO, IPC announced the creation of its Thought Leaders Program (TLP). Chaired by IPC Hall of Famer Mike Carano, the TLP will bring together experts inside and outside our industry who have insights to share on matters related to electronics manufacturing. Check out IPC's [announcement](#) to see who is in the TLP's inaugural class, and look soon for their content on everything from tech trends and trade to cybersecurity and market analysis.

## 5. Optimism and Anxiety as We Look Beyond COVID

IPC Chief Economist Shawn DuBravac, in his APEX presentations, shared a positive outlook for the industry in 2021 and beyond. Vaccines are promising to bring COVID infection rates down, and many countries are advancing recovery and aid packages that are having the intended effect: stimulating consumer demand and economic growth. Despite the optimism, anxiety remains on many fronts: geopolitical tensions, parts shortages, shifting supply chains, inflation, uncertain manufacturing policies, and the likelihood of increased regulatory demands in the U.S. and Europe.

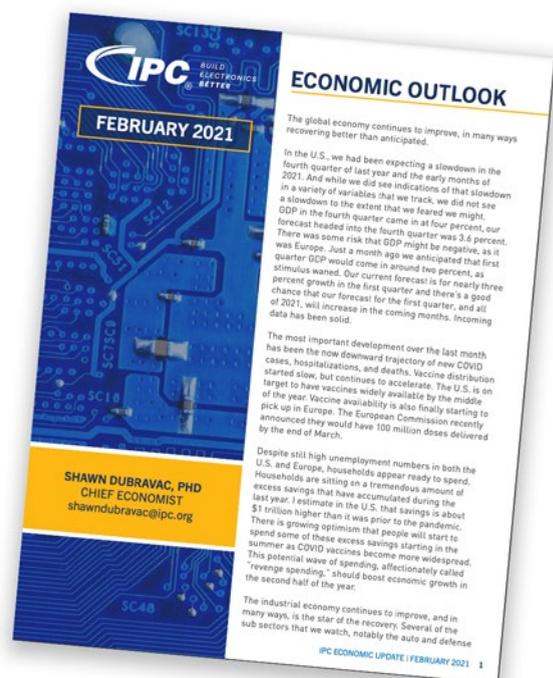
Visit [www.ipc.org/economic-reports](http://www.ipc.org/economic-reports) to delve into Shawn's Monthly Economic Reports.

The good news is that IPC, across many fronts, is bolstering its capabilities and resources to address the industry's needs in this dynamic global environment. Our best asset is and has always been you, our mem-

bers. I encourage you to reach out to IPC to contribute your opinions and ideas, and to get involved in IPC's government relations program. A good place to start is [www.ipc.org/ipc-advocacy](http://www.ipc.org/ipc-advocacy).

APEX EXPO has concluded, but you have a continuing opportunity to enjoy and learn from all the great content it generated. All of the sessions at APEX EXPO were recorded and are available to the [registered](#) and [not-yet-registered](#) for 90 days after the show. On behalf of all of us at IPC, I invite you to check out this content to understand how the issues and challenges discussed at APEX EXPO are guiding our efforts, from your shop floors to the halls of government across the planet. **S&T**

Chris Mitchell is IPC vice president, global government relations.





## IPC APEX EXPO 2021 A Show Full of Opportunities

by Tara Dunn, AVERATEK

Looking back to my notes from IPC APEX EXPO 2020, I noticed one of my comments: There were so many interesting sessions that I often found myself in the position of choosing between several that I wanted to attend in the same timeslot. This year was not any different in that regard. I am purposely glossing over the fact that I, like many of my friends, missed the camaraderie and opportunity to catch up in person while attending these technical sessions, and I look forward to being able to do that next year.

Focusing my time on the technical conference for this event, I was excited to be able to attend several interesting sessions. I am con-

flicted about how much to share since these are online for the next 90 days. I would hate to spoil the ending for anyone!

I started my participation in the conference by attending the “Embedded Technology for HDI Applications” track. Mike Vinson kicked this off with his presentation “Process, Reliability and Testing, and Applications,” which was followed by Manoj Kakade of pSemi, presenting “Thermal Improvements in 3D Embedded Modules Using Copper Bar Vias.” Both sessions were very well attended with strong audience engagement. In fact, time ran out before all the questions could be addressed.

Later that day, I attended the Automotive Electronics session to see Lenora Clark present

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Electroless & Electrolytic plating



**Final  
Processes**

Solder mask coaters spray and screen print  
Developers, ovens  
Final finish: HASL, ENIG, immersion silver, OSP,  
electrolytic Au  
Electrical test flying probe and grid





## 'JOIN LENORA CLARK AT IPC APEX VIRTUAL EXPO 2021'

'Addressing the changing landscape of automotive electronic designs: Improving performance and robustness through proper material choice'

Wednesday, March 10th at 1.30 pm Central Time  
'Automotive Electronics' technical conference session

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Director of Autonomous Driving and Safety



her paper, "Addressing the Landscape of Automotive Electronics Design: Improving the Performance and Robustness Through Proper Material Choice." I think one of my favorite things about attending this conference virtually was the ease of moving between conference tracks. As Lenora finished her presentation, I was able to quickly hop over to the Microvia 1 Reliability track to listen to both Gerry Partida of Summit Interconnect and Jerry Magera with Motorola Solutions as they gave us an update on their tireless work on microvia reliability.

Other technical sessions I attended include the Microvia 2 Reliability track, the PCB Reliability track, PCB Design: HDI and Signal Integrity Considerations, PCB Advancements, and the Defense Industrial Base Technology Roadmap. While I have attended several during the live portion of the IPC APEX 2021 conference, there are still several that I intend to go back and listen to.

A couple things stand out to me about this year's conference. First, whether live or virtual, IPC APEX EXPO provides stellar technical content and for many reasons, the virtual conference allowed me to attend a greater number of sessions than I would have been able to attend if the event were live and in-person.

IPC APEX EXPO is typically one of the busiest and most fun weeks of the year, with breakfast meetings, lunch meetings, dinner meetings, networking events, the technical conference, and the vast exhibit hall. While I did have a chat or two while online in the technical conference, I greatly missed the camaraderie and energy that comes from the live event and I am already looking forward to attending live and in-person as soon as we are able! **S&T**

**Tara Dunn** is the vice president of marketing and business development for Averatek.



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#3 Processes are Being Redefined by Data	An Explosion of Data Requires New Processes	

# Benoit Dagenais Rising Star Award Acceptance Speech





## IBM Awarded Best Technical Paper at IPC APEX 2021

Nolan Johnson and Happy Holden talk with Sarah Czaplewski, whose team at IBM won the Best Technical Paper award at this year's IPC APEX for "Signal Integrity, Reliability, and Cost Evaluation of PCB Interlayer Crosstalk Reduction."

**Nolan Johnson:** Sarah, you and your team were selected as the best technical paper for IPC APEX 2021. Would you be so kind as to start us off with an introduction to your team?

**Sarah Czaplewski:** Sure. There are three of us on the paper. Besides myself, there is Junyang

Tang and Roger Krabbenhoft. Junyan Tang is an IBM signal integrity engineer based in Austin, Texas, and was primarily responsible for the signal integrity modeling and analysis portion of the paper. Roger Krabbenhoft is an IBM STSM and lead PCB technologist located in Rochester, Minnesota. Roger contributed the PCB supplier cost and yield impact section and suggested the items we evaluated as part of the IBM PCB roadmap. I am a PCB qualification and reliability engineer, and I was responsible for the reliability portion of the paper.

**Johnson:** What motivated this research?



Sarah Czaplewski

# BENDING THE POSSIBILITIES

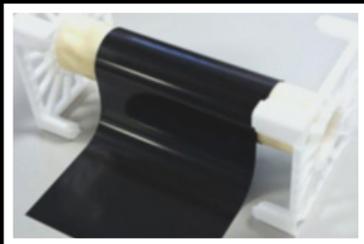


BY TAIYO

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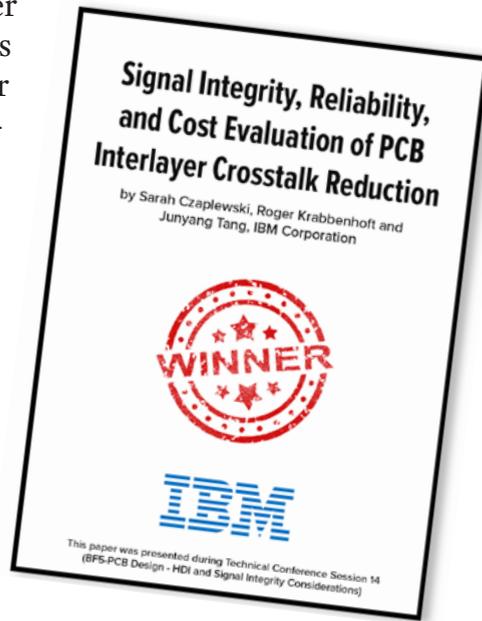


**Czaplewski:** We're working on the next generation of products and we need a little bit more signal integrity improvement. One of the levers to pull is to make some adjustments within the PCB design. So that's why we evaluated at reduced layer-to-layer misregistration and reduced antipad diameter around backdrill PTHs. This research is preparing us for the future product generations.

**Johnson:** Walk us through the paper, which is titled, "Signal Integrity, Reliability, and Cost Evaluation of PCB Interlayer Crosstalk Reduction."

**Czaplewski:** The push for higher data rates and more functionality is leading to higher density in PCBs, which increases the opportunity for crosstalk. We're looking to mitigate that. We modeled the signal integrity impacts of reducing layer-to-layer misregistration from five mils, down to four and three mils. We also looked at reducing the antipad diameter in the backdrilled regions of PTHs from 30 mils on a 10-mil finished PTH to 28 mils. As one reduces the antipad diameter on the backdrilled holes, there is an increased risk of exposing the planes during the backdrill operation, which can cause a wide range of reliability issues. In the reliability portion of the paper, we sought to understand that by intentionally exposing the planes. We had some of the backdrilled holes filled with resin to evaluate if that would have an impact on reliability. These reduced layer misregistration and reduced antipad diameter are going to impact the yield at the PCB manufacturer. So we also conducted manufacturer polling to get a relative cost impact of our two proposed changes to create a cost benefit analysis.

**Johnson:** I found it quite interesting that the two different solutions—misregistration as well as reducing the diameter of the antipads—are both intended to get more precise and more condensed board fabrication. You're pushing tolerances closer to zero in both cases.



**Czaplewski:** Correct.

**Johnson:** Walk us through what you found.

**Czaplewski:** I'll start with the reliability part because that's my expertise area. I expected to have electrochemical migration or some sort of corrosion forming between biased planes within the backdrilled holes, but surprisingly we did not detect any fails in the unfilled holes. We actually had some fails in the filled holes, which was opposite of what we were expecting. We're still investigating this, but we're thinking it's related to the hole fill process and potentially the hole clean process before resin fill. That was an interesting finding and something that needs to be investigated more before implementing reduced antipad diameters, which, with manufacturing tolerances, can result in plane exposure.

**Johnson:** Looking at your data, it seems that reducing misregistration did bring improvements, but the big winner was, in fact, the antipad diameter.

**Czaplewski:** Yes. From the crosstalk reduction standpoint, reducing the antipad diameter had more benefit than reducing the layer-to-layer misregistration. However, you must take into consideration that reduced antipad diameter, in this case, is only useful on backdrilled layers. If there are not many signal traces running near backdrilled holes or on backdrilled layers, the benefits will be limited. The misregistration

reduction is more comprehensive. It affects every signal layer in the board.

**Johnson:** There more chances to improve a little bit when you're optimizing misregistration and then pretty big gains in specific ways with antipads depending upon how your board is implemented. I've got to tell you, at the start I expected misregistration to deliver the more benefit than the antipads. What's the effect achieved by reducing the antipad to reduce crosstalk?

**Czaplewski:** It's similar to the misregistration effect, but it's maybe a little bit harder to visualize. You can think of it this way: there is a signal layer with reference layers above and below it. The reference layers have antipads around the PTHs. The bigger that antipad is, the more open space for crosstalk to occur. There is less ground coverage of the signal layer. Basically, the larger the antipad, the more opportunity for the signal layers to be exposed to each other and therefore have crosstalk. It's the same situation when you have misregistration, layers are shifting, exposing the traces to each other. Having more ground coverage between signal layers is beneficial for crosstalk reduction.

**Happy Holden:** Yes, antipads are kind of the Rodney Dangerfield of design rules; they get no respect. People ignore it and, in fact, they want to increase it without realizing the effect that increasing the antipad, and reducing the current return path and power, has on the multilayer. As pitch goes down and you're going to use mechanical drilling and layer-to-layer misregistration, it's tougher and tougher to keep from hitting that power or ground layer. The tendency is to try to make the antipad larger. But that has the potential to change capacitive effects to other parts of the

circuit. It's juggling all these balls and that's what I think the whole paper is about: trying to get performance, reliability, and cost with shortening rise times and sensitivity, signal integrity is a tough question.

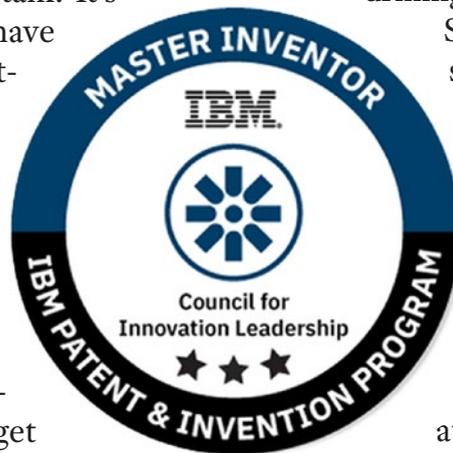
**Johnson:** Right. And how did this impact the yields? Was there a yield cost to this?

**Czaplewski:** We polled several PCB manufacturers about the impact of reduced layer-to-layer misregistration and reduced antipad diameter on yield and cost. Based on collected registration data, we found that yield really varied by supplier. Three PCB manufacturers had little to no yield impact and could meet the reduced misregistration requirement. But then there were three other PCB manufacturers that would have significant yield loss and obviously cost uplift with reduced allowable misregistration. We also found that reducing the antipad diameter around backdrilled holes too much could also reduce yield due to broken drill bits from drilling through more copper layers.

Since we did this investigation, some of the manufacturers have made significant improvements in controlling layer-to-layer misregistration. I think that presenting this idea to the industry is going to drive improvements, and the four-mil maximum layer-to-layer misregistration should be attainable. Then there may even be a desire to drive to even lower misregistration allowances.

**Johnson:** It sounds, then, like some of your suppliers learned something and were able to make some improvements.

**Czaplewski:** We saw significant improvements from one supplier, in particular, which initially estimated a 50–70% yield loss at four mil max layer-to-layer misregistration. Two



other suppliers estimated a 5–15% yield loss and we think that there are opportunities to even improve that as well. In the long term, there are more advancements that need to be made to minimize layer-to-layer misregistration such as better modeling of scale factors to improve prediction of movement of the layers during lamination. Another potential avenue is expanding the use of tack welding during layup to improve layer alignment.

**Holden:** Were you limited to North American fabricators? IBM is worldwide so they could virtually use anybody in the world to examine?

**Czaplewski:** Correct. We looked at several different geographies. It was not limited to North America. There were North American as well as Asian fabricators polled.

**Johnson:** With that information, and what you learned from the testing, what's the payoff? By effecting these sorts of changes, tightening the tolerances and making sure that you can deliver on them, what does that afford you as a design team?

**Czaplewski:** Our recommendations were to move from five to four mil layer-to-layer misregistration and reduce the antipad from 30 to 28 mils on a 10-mil finished PTH. The registration aspect gives us about four to six percent improvement in signal-to-crosstalk ratio, and then the reduced antipad diameter aspect can provide about another seven to eleven percent

improvement. That's the initial estimated benefit that we're receiving from it, and we'll be evaluating that with the specific designs as they become more mature.

**Johnson:** Is there something about the research or about your research process that came as a surprise?

**Czaplewski:** The great story here is that this was a cross-functional effort within IBM. It was brought together people from the signal integrity team, the hardware development team, and supply chain engineering team so that we can be more proactive about understanding our supplier capability and what we need for the next generation or products so that we can better deliver on the needs of our clients.

**Johnson:** Sarah, have you submitted papers to IPC APEX before?

**Czaplewski:** This was my first one to IPC APEX.

**Johnson:** What was your experience like?

**Czaplewski:** It's been good. It's been interesting because the conference was virtual this year instead of being in person. It was different to pre-record my presentation, but I think IPC has made the most of the virtual platform.

**Holden:** You need to prepare something for next year so you can go to San Diego with the rest of us.

**Czaplewski:** I'm in the second year of the Emerging Engineers program, actually. Last year was my first time at IPC APEX, and I got to go to San Diego; I have one more year in the program, so I will be there next year, for sure, and hopefully with another paper.

**Johnson:** Sarah, thanks!

**Czaplewski:** You're welcome. **SET**



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200 kW Power Electronics Inverter

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IPC APEX EXPO 2021



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A Retrospective & Roadmap for Electronics Manufacturers

Chris Michael, VP, Global Government Relations, IPC  
March 8, 2021

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0:02 / 3:00



## Highlights on a Rousing Virtual IPC APEX EXPO 2021

by Pete Starkey, I-CONNECT007

What a week that was! I didn't get to endure the 11-hour flight each way, neither did I need my comfy old shoes, but it certainly was a marathon event. And real-time-plus-six-hours gave me a few late nights, but it was such a meaningful experience, and well worth the effort!

After my first clumsy attempts to navigate the IPC APEX EXPO website, I soon settled into a practised routine and became reasonably competent at finding my way around the vast array of options and an agenda running in as many as 11 parallel tracks. Thankfully, IPC has now made the content accessible on-demand so I can go back and review whatever I choose during the next 90 days.

After a welcome from IPC President and CEO Dr. John Mitchell, Programme Chair Gene Weiner did a splendid job of keeping the EMS Managers meeting and the IPC's Raymond E. Pritchard Hall of Fame Managers Forum running smoothly. There was so much to take in.

The Managers' Forum theme of "Managing Challenges in Periods of Transition" was relevant and appropriate, all circumstances considered, with an impressive array of top industry names discussing strategies for thriving during times of crisis. I made a special point of attending the session on vertical integration, kicked off by Alex Stepinski describing his journey, "From inventor to contractor in several steps

of vertical integration," as he looked back over the previous eight years and forward into the future. An inspirational lesson in creative and innovative problem-solving from a true industry pioneer. I took copious notes and spent a few hours distilling them down into a realistic review article.

Another inspirational event was the "Great Digital Transformation" keynote from Travis Hessman. I admit to having been a bit apprehensive, concerned that most of the content would probably go way over my head. But the way that Hessman presented the story avoided



Travis Hessman

hype and technological sensation by walking through the process of transformation, with emphasis on process, from a rational and realistic perspective. He outlined the methodologies adopted by companies that had

used them successfully and explained why companies who had gotten it wrong had failed in their attempted digital transformations. "Put the problems in front of the solutions, and develop processes, not disruptions!"

Maybe for reasons of personal familiarity, I was keen to attend the session presented by the Manufacturing Technology Centre (MTC), a high-value-manufacturing technology catapult



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based in my hometown, Coventry, UK. MTC specialises in robotics and autonomous systems, and is recognised for developing and proving innovative manufacturing processes, with a general policy of “thinking big, starting small, and scaling fast.” It was interesting to hear MTC’s views on factory-of-the-future advancements and, in particular, the strategy for implementing IPC-CFX with legacy equipment—not everyone can afford to start with brand-new equipment—and envisage a smart factory for electronics manufacturing in a low-volume, high-mix environment.

A significant “headwind” encountered by Alex Stepinski in starting-up a new PCB fabrication plant in the U.S. had been in addressing the challenge of a “missing generation” of skilled labour resulting from downsizing of the industry over the last decade. Dr John Mitchell was clearly very much aware of the urgent need to maintain succession, as he discussed IPC’s endeavours to bring young engineers into the industry through its participation in college and high school programmes and STEM projects, and its commitment to transferring knowledge and capability to the incoming generation.

The need to pass on the “forgotten tribal knowledge” was emphasised in the special event led by IPC Hall of Famers Bob Neves and Don Dupriest with a group of emerging engineers. I would have liked to sit in on the IPC Emerging Engineers Roundtable on Wednesday, but as a consequence of parallel tracks, it coincided with the live Q&A session with Travis Hessman that I had been pleased

to be asked to moderate. That was an energetic hour—the questions kept coming, and Hessman responded to them all with lucid and pragmatic logic.

Because I found the Managers Forum and keynote sessions so absorbing, I probably didn’t spend enough time attending product introduction presentations. Under normal circumstances I would have spent a fair proportion of the day, when not engaged in Real Time with... interviews, making the rounds of the exhibition hall. However, it’s good to see exhibits presented online; in many cases more effectively in terms of clarity of presentation and certainly involving a lot less hauling of heavy freight! But what about the face-to-face conversations with exhibitors and the old and new acquaintances I would bump into in the aisles and at the keynotes and receptions and social events? That’s inevitably what was missing, although all credit to the IPC team for making the most of the digital experience. And, as an educational opportunity, the event was mind-blowing!

One lasting memory? The creative “thank you” video message from Elmatica in Norway, showing Senior Technical Advisor Jan Pederesen being notified that he had been honoured with the Dieter Bergman IPC Fellowship Award by a message in a bottle he fished out of the icy water, and the award itself being delivered from the same icy water by tough-guy Elmatica CEO Didrik Bech, clad in his swimtrunks and masquerading as a FedEx man!

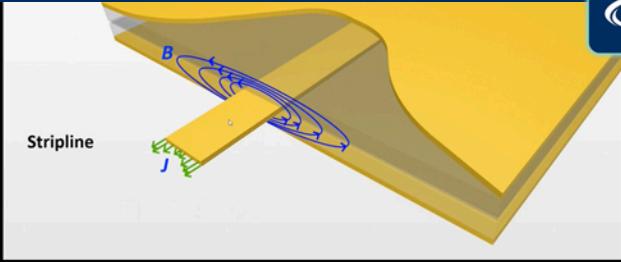
What about next year? Provided we are free to travel and visit in person, would it be a realistic proposition to run a mixed event, a fusion? Split the action—place the professional development courses and the technical conference online, accessible on-demand, and still run a traditional physical exhibition complete with keynotes, receptions and social experiences. The best of both worlds? It remains to be seen! **S&T**



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# Emerging Engineer: Jesse Vaughan

## Emerging Engineer Program Offers Well-Rounded Curriculum

Interview by Andy Shaughnessy, I-CONNECT007

**Andy Shaughnessy:** Jesse, we just wanted to get your feel for this year's virtual IPC APEX EXPO. Why don't you start off by telling us a little bit about yourself and your company?

**Jesse Vaughan:** I'm the manager of design services at ACDi, based in Frederick, Maryland. We are a contract manufacturer, but we started out as a layout services bureau, and that's how we grew. Our president, Bill Hornbaker, started in a garage in Gaithersburg, I believe, and that grew into ACDi. Then we got into the assembly side; we actually bought Patapsco Designs, which used to do all of the CCA manufacturing for certain cities in the local area.

I started out at what was DDi, which is now TTM in Sterling, Virginia. My father has been in the industry forever, so I've been around the industry for as long as I can remember. I have the PCB manufacturing experience. And then I was with my father's company for some time as a manufacturer's representative for several U.S.-based PCB houses.

And obviously, part of my role at ACDi is managing a group of 10 designers and draftsmen. With the background that I have in CCA manufacturing, I'm able to capture programs at the design level and see them through to the main manufacturing side.

**Shaughnessy:** I saw you online during virtual IPC APEX EXPO this year. You're in IPC's

Emerging Engineer program, so what did you think about the show and the format?

**Vaughan:** Honestly, I think that they did a great job. Nobody knew what to expect. Recently, I've done some online courses and stuff like that, so I'm more used to that kind of learning environment. Now, obviously, I was in the Emerging Engineers program, so a lot of the logistics of that were already in place. That was handled smoothly and all pretty much in place.

I had a full schedule throughout the whole week. They put the committee meetings before and after the actual conference, which was really forward thinking; it allowed anybody who had an all-access pass the opportunity to take full advantage of the schedule throughout the week. And yeah, technology-wise, I didn't have any buffering or screen issues, or accessibility issues. All presenters were on time. I would say for a first shot, it was handled tremendously well.

**Shaughnessy:** Yeah. I think IPC did pretty well, especially considering the calendar. They didn't decide until late in 2020 that it was going to be virtual, if I recall.

**Vaughan:** Yes, it was probably October, and I was wondering, "Am I getting on a plane, or what?" Then I saw the notification.

**Shaughnessy:** Right. So, were there any presentations or speeches that really stood out? Anything that you'd like to mention?

**Vaughan:** I always enjoy the keynotes, in general, and especially John Mitchell's keynote about the factory of the future. And then I really liked Sean DuBravac's keynote. For our Emerging Engineer track, we were required to take four professional development courses, and I think two of them had to be in the Factory of the Future track. I really like to get that high-level explanation of where IPC sees that going, and the steps to get there.

But as far as the conference, PD16 really stands out. Ben Jordan presented "A Beginner's Guide to RF and Microwave PCB Design and Prototyping" parts 1 and 2. He was excellent. You could tell that this wasn't his first time doing online teaching. I'm a sort of visual, a kinetic learner. Ben presented visuals within his slide shows, and he had his stylus out, writing live on the screen.

Ben was putting things out that are generally at a very technical level, difficult to grasp on a first pass. He was putting it in layman's terms, so you weren't having knowledge overload. I never felt like, "Oh my gosh, I don't know if I'm going to remember anything." I would say, they were all good presentations, but that one certainly stood out to me, where you could tell that he had been teaching before. I got a lot out of Ben's course, especially. He just had stuff flying everywhere!

**Shaughnessy:** As part of the Emerging Engineer program, IPC schedules certain classes that you need to attend. Isn't that how it works?

**Vaughan:** Yes, it certainly helped. They provide us with what's called a passport every year. They encourage us to do as much as we can, but it gives you the minimum requirements so you can say that you've met that year's initiative. It's a three-year program. Since they had moved the committee meetings outside of the conference time, anything that was a requirement was an automatic plug in the calendar. And then from there, it was just a matter of looking at the remainder



Jesse Vaughan

of the schedule and determining where I had blocks of time.

**Shaughnessy:** Good. Were there any changes that you would suggest? Any recommendation for IPC?

**Vaughan:** One of our requirements was to do some virtual booth visits and that process was a little bit more cumbersome. And now when you're throwing in vendors from all over the world, all kinds of different server set-ups and schedules, that part of it was a little bit more difficult to nail down. But once you were able to get in there and figure out how to get to the virtual booths, it was great. Overall, it went off better than you could have imagined, absolutely.

**Shaughnessy:** Hopefully, next year APEX EXPO will be an in-person event.

**Vaughan:** Sure. IPC did an awesome job, but I would assume that this is not going to be the way of the future because there's something to be said for actually going to shows. **SET**



# Conference at a (Backward) Glance

## On-Demand Through June 13th 2021:

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### Monday Events

- Welcome Message
  - EMS Management Meeting
  - Managers Forum: Managing Challenges in Periods of Transition—*Presented by the Raymond E. Pritchard Hall of Fame Council*
  - Professional Development Courses
  - Keynote Presentation by *John Mitchell, President and CEO, IPC*
  - EMS Management Meeting
  - Managers Forum: Managing Challenges in Periods of Transition—*Presented by the Raymond E. Pritchard Hall of Fame Council*
  - Professional Development Courses
- 

### Tuesday Events

- Welcome Message
  - Professional Development Courses
  - Exhibitor New Product Presentations
  - IPC Annual Meeting and Awards Ceremony
  - Professional Development Courses
  - Exhibitor New Product Presentations
- 

### Wednesday Events

- Welcome Message
- Keynote Presentation by *Travis Hessman, Editor-in-Chief, IndustryWeek*
- Technical Conference Sessions

- Forgotten Tribal Knowledge with IPC Hall of Fame and Emerging Engineers
  - IPC Emerging Engineers Roundtable
  - Exhibitor New Product Presentations
  - Live Q&A with *Travis Hessman, Editor-in-Chief, IndustryWeek*
  - Technical Conference Sessions
  - Exhibitor New Product Presentations
  - Technical Conference Sessions
- 

### Thursday Events

- Welcome Message
  - Keynote Presentation by *Shawn DuBravac, Chief Economist, IPC*
  - Professional Development Courses
  - Exhibitor New Products Presentations
  - Technical Conference Sessions
  - IPC Education Foundation: Looking Ahead
  - Technical Conference Sessions
  - Exhibitor New Product Presentations
  - Professional Development Courses
  - Technical Conference Sessions
- 

### Friday Events

- IPC at a Glance (Standards, Education, Advocacy, Solutions and Industry Intelligence)
- Exhibitor New Product Presentations
- Technical Conference Sessions
- Closing Remarks

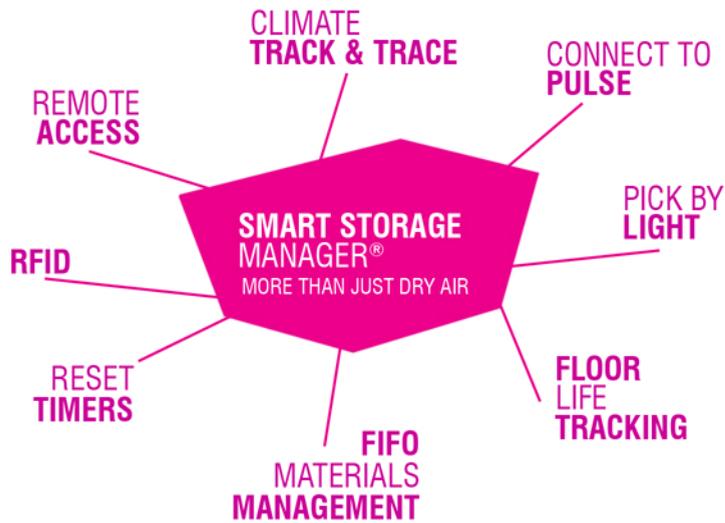


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# Rising Star Award Winner: Radu Diaconescu

## IPC APEX EXPO 2021: A New Hope

Last year's IPC APEX EXPO, which took place in sunny San Diego, seems to have taken place in a different world. This was a world where talks were held in front of a large crowd, not a monitor, and travelling to the other side of the world wasn't considered a reckless risk.

By February 2020, however, we were starting to grasp the seriousness of the situation. Back then, there were a lot of things that we didn't know, and more importantly, there were a lot of things that we had no clue that we didn't know. The concept of "knowing what you don't know" or figuring out the areas where one lacks knowledge is probably as important as acquiring the knowledge itself.

Coming "back to the future" and attending the IPC APEX EXPO 2021 virtually, it seems that we as an industry start to finally understand and discover the things that we don't know. From the integrity and resilience of our supply chain to the failed digital transformations of the past, it seems that the electronics manufacturing industry starts to realize that change is difficult, but also inevitable.

## Changes, Revolutions, Evolutions

Ever since the term "Industry 4.0" was coined back in 2015-16, there were several technologies that seemed to lead the way to the "promised land" of transformation. We believed that big data, IoT, IIoT, AI, ML, autonomous vehi-



Radu Diaconescu

cles and so many other technological advances would radically change our operations and deliver the holy grail of billions of dollars of savings. While being a firm believer in the benefits of all these technologies, the reality, as we were brutally reminded in the past 12 months, is much more complex. At the end of the day, to paraphrase Travis Hessman's keynote speech, digital transformation was never supposed to be a revolution, but rather an evolution.

There's no silver bullet that will magically solve all of our problems and I think the 56% of manufacturing companies that are still waiting for the right use case for digital transformation or the 60% of digitization projects stuck in the "proof of concept" stage are a testament

to that. Revolutions are tough, but evolution is a continuous process. Instead of focusing on Industry 4.0, 5.0, or whatever might come next, we should adapt our mindset to one of a continuous evolution and treat digital transformation the same way we treat quality, that is in a state of continuous improvement.

## Breaking the Silos

One of the recurring themes that I've seen in the past years both at Swie.io and in the IPC-1782 (critical component traceability) and the IPC-2551 (the Digital Twin) standard development committees is an increasing need to break the silos. Throughout the Industry 4.0 cycle, we've created data silos inside our organizations, but in order to continuously evolve on our digital journey, we need to start to break them.

Two of the most cited challenges of our industry at this year's show were the semiconductor shortage and the counterfeit component issue. Unfortunately, those two challenges come hand-in-hand and there is no easy or permanent solution to either of them. Many technical solutions out there claim that they will

solve the issue and will eliminate counterfeits from the supply chain, but in reality we need to move from a reactive to a proactive approach. Much like with the digital transformation or the Industry 4.0 revolution it won't be one single technology or solution—be it blockchain, AI or cryptography—that will magically remove the counterfeit risk from our supply chain. Ignoring or pretending the problem doesn't exist won't help either. It will take time and it will involve improving the purchasing process and using better tools for component purchasing, improving the cybersecurity of our factories, building trusted digital twins, and so on.

In a way, IPC APEX EXPO 2021 marked a new beginning or “a new hope” for our industry. It's a new hope that all of these overhyped technologies will provide tangible and timely benefits for an industry that is faced with so many extraordinary challenges, and a new hope that we've learned from our own past failures. Now we know much more, even if we just know what we don't know. **SET**

**Radu Diaconescu** is an electrical engineer at Swie.io in Lausanne, Switzerland.

## Radu Diaconescu, Swie.io, Receives the IPC Rising Star Award from IPC APEX EXPO 2021





## IPC Managers Forum: Vertical Integration

by Pete Starkey, I-CONNECT007

Denied by circumstances the opportunity to travel transatlantic to attend the IPC APEX EXPO 2021 in person, I sat up until late in the evening here in the UK, eager to catch the Vertical Integration session of the IPC Managers Forum. And my presence was well-rewarded—a most meaningful experience.

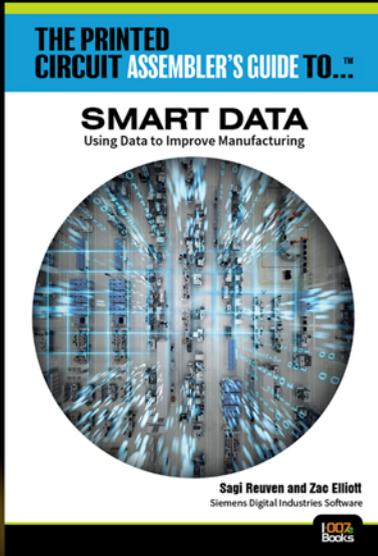
In my own early days, vertical integration appeared a fairly typical characteristic of the electronics industry and most of the big companies had their own PCB shops. They all worked to their own internal designs and standards and often developed their own techniques and processes. But as the specialist independent

shops were established, they could offer economies of scale and progressively dominated the business. They worked to national and international standards and bought their materials and process chemistries on the open market, resulting in a relative consistency of manufacturing technology. I can recall upwards of 400 board shops, from mom-and-pop to large corporations, in the UK alone, as recently as the late 1970s and early 1980s. Then there was a progressive drift of business to Asia and a steady decline in the number of manufacturers to today's figure of less than 40. And the industry very much relies on its suppliers for technical innovation, rather than do its own process development.



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So, it was refreshing to hear Alex Stepinski, Diane Maceri, Jessi Hall and Jeff Leblanc talking about a new generation of vertical integration in the programme entitled “Managing Challenges in Periods of Transition,” smoothly moderated by IPC Hall of Famer Gene Weiner.



Gene Weiner

Alex Stepinski, vice president of GreenSource Fabrication and managing director of AWP Group, is well-known as the pioneering developer of green and automated smart factories for the U.S. market that out-compete low-cost and ecologically unsustainable Asian plants. Latterly, he has led the integration of a PCB fabricator and a PCB equipment supplier into one integrated company that builds and develops smart factory solutions and industrialises new process concepts. His case study, “From inventor to contractor in several steps of vertical integration,” looked back over the previous eight years and forward into the future.

It had been a bold move to start-up a new PCB fabrication plant in the U.S., particularly in addressing the challenge of a “missing generation” of skilled labour resulting from downsizing of the industry, further exacerbated by the disadvantages of a high-cost region, onerous regulations and a reliance on an Asian supply chain.

Speaking from a hotel in Poland, with somewhat hit-and-miss sound quality, Stepinski reviewed the chronology of GreenSource from 2013, when design and build started for the Whelen factory, through its initial installation, some remarkable process innovations, and the acquisition of its equipment



Alex Stepinski

suppliers, to 2020 and a new integrated business plan with PCBs, wastewater recycling, and the supply of turnkey factories.

The original Whelen factory represented a \$12 million investment and produced around 50 panels per hour of mainly double-sided work, with HASL and ENIG finishes, by a staff of 19. By 2017-18, the capability had evolved to include multiple-build-up HDI, with 15 micron line-and-space and microvia diameters down to 30 microns, industrialising processes such as SAP and selective resistors.

Because it had been planned to avoid dependence on Chinese suppliers, the equipment for the upgrade was sourced in Germany but when the suppliers ran into financial difficulties it was decided to acquire them and to re-engineer their designs to support the GreenSource vision of smart workcells and recycling technology. The resulting equipment division became suppliers of the turnkey projects to Schweitzer Engineering Laboratories and Vicor Corporation, for whom the value proposition included factory design and equipment selection, technical details for permit applications, employee training at the GreenSource factory, equipment manufacture and installation, and commissioning and qualification of the processes. Stepinski listed the many benefits of his “Blue Ocean” strategy, which focused on integration of processes for Industry 4.0 in the PCB sector, substantially reduced the environmental footprint of PCB fabrication, and reduced the dependence on skilled labour for simple issues. A wide range of equipment was currently manufactured at the AWP factory in Poland, then tested and qualified in Charlestown, New Hampshire.

He described his patented Zero Liquid Discharge (ZLD) recycling technology; in his words “GreenSource uses more water in the bathrooms than in the board shop,” the first commercial installations of which would be at Schweitzer Engineering Laboratories and Vicor Corporation in 2021-22.

He listed current roadmap projects: a smart

warehouse system, on-line metrology systems, full digital twin for managing the plant, artificial intelligence and machine-learning-based scheduling, deep bind-microvia upgrades up to 10:1 aspect ratio, and automatic recipe generation by artificial intelligence and machine learning.

## Schweitzer Engineering

Now that Stepinski had set the scene, it was the turn of his turnkey clients to reveal the reasoning behind their strategies. Diane Maceri, supply chain director, and Jessi Hall, senior director vertical integration at Schweitzer Engineering Laboratories (SEL), explained why and how they had decided to build a new printed circuit factory in Idaho.

Headquartered in Pullman, Washington, with one of its manufacturing plants in Lewiston, Idaho, SEL had introduced the world's first digital relay in 1984, and currently employed more than 5,000 people. They provided complete power system protection, control, monitoring, automation, and integration for utilities and industries worldwide, with the objective of making electric power safer, more reliable and more economical. The company had nine SMT assembly lines and specialised in quick-turnaround custom-configured devices. Most components were sourced close to the assembly facilities, and SEL worked closely with its suppliers, who shared its continuous-improvement philosophy. Diane Maceri made it clear that SEL had excellent relationships with its existing PCB partners. During the 1990s and mid-2000s, North American companies with high-volume PCB requirements were increasingly buying from China and the number of domestic board shops had declined from 2,000 to 200, the same pattern as I had observed in the UK. Those who



Diane Maceri

remained were focused on more complex PCB technologies, and there were few who could sustain SEL's requirements, either in volume or at an economic price.

SEL's PCB demand was growing, and a long-term strategy was needed to maintain supply while keeping up with technical developments and avoiding the need to purchase from China. After discussions with several American PCB fabricators who aligned with their strategy, and considering either buying a manufacturing company or building their own, they decided on the latter, with the help of GreenSource.

Jessi Hall took up the vertical integration story. She explained the benefits of World Class Manufacturing as shorter feedback loops and lead-times, reduced inventory, and improved quality control. SEL planned to



Jessi Hall

construct a 100,000 square foot purpose-built manufacturing plant in Moscow, Idaho, within easy reach of their factories that used PCBs and was close to the University of Idaho. Their decision was supported by their existing suppliers, and the full transition from buying-in to making their own was expected to take several years. Construction would begin in the spring of 2021 and opening was scheduled for December 2022. They were already hiring technical team members who would undergo training at GreenSource. The project was still at an early stage, and there would be many more lessons to share. But so far it was clear that there was a lot of information to consider regarding location, federal regulations, learning about suppliers, new technologies, and understanding staffing needs. Much of the expertise was already in the company, and where it wasn't, strong partnerships existed. A strong cross-functional team had been crucial to the progress of the project. Also critical was good communication with

partners and the local community. As well as their training at GreenSource, new team members would be encouraged to work within SEL to understand the needs and constraints of upstream and downstream customers.

## Vicor Corporation

GreenSource's second turnkey client was Vicor Corporation, (with head-quarters in Andover, Massachusetts), designers and manufacturers of modular power components. The presentation was given by Vicor's senior strategic sourcing manager Jeff LeBlanc.



Jeff LeBlanc

He explained that Vicor was an engineering-driven operation with a history of vertical integration and a fully automated manufacturing environment. There was a goal to develop competences aligned with the company strategy and a willingness to develop and invest in resources, with a focus on continued automation and improvement, along with a need for flexibility. Extensive use of business intelligence throughout the manufacturing process enabled a significant reduction in cycle time. Vicor built a large mix of product, more than 9,000 active models with many common platforms and components, and all new designs were built on the production line.

“So why is a power-solution manufacturer talking at an IPC summit about plating integration?” LeBlanc asked. “Why do you or anyone want to get into plating? Why not continue to partner/outsourcing these operations?”

Looking at the product going forward, Vicor's next generation and future architecture was built on the foundation of plating, imaging, and etching defined features. Processes became part of the product portfolio offering. So, it was not considered a

return-on-investment discussion but more a risk of not investing in capability and what that would mean to Vicor's future portfolio, together with the risks to revenue if there were any gaps in the supply chain. Another consideration was that Vicor's products were not traditional and did not necessarily fit into a conventional PCB operation. There had already been a strategic alignment with GreenSource and a lot of development from which Vicor could leverage. One of the benefits of working with GreenSource and AWP was the knowledge that the significant amount of engineering involved would not fit well into a high-volume PCB operation and would be better carried out internally. And lastly, the process development going forward would enable new-technology product to be brought to market faster, in line with Vicor's strategy to accelerate NPI, to be a pioneer, to be first-to-market and to be fully automated. Looking at Vicor's surface-mount chip technology, the growth rate had been exponential with main markets being in computing, automotive, and advanced industrial applications. Other areas of market development included defence, aerospace, and artificial intelligence, all focused on high-end power with high efficiency and low thermal output.

LeBlanc described the 90,000 square foot expansion plan for manufacturing at the Andover facility, which now incorporated a large area committed to the plating cell, with a combination of mechanical and laser drilling, thickness capability from 0.05 mm to 8 mm, weight up to 10kg, and a capacity of up 8.8 panel square feet per week.

Construction was in progress...oh, the joy of building in New England in the winter-time!

As Gene Weiner brought the session to a close, he agreed that yes, there is definitely an exciting future for this new generation of vertical integration, led by visionaries like Alex Stepinski. **S&T**

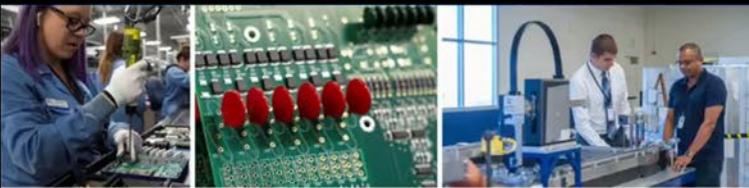
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# SEL Lewiston

Lewiston, Idaho, U.S.A.



Supply chain risk reduction

## Vertical integration at SEL



## Developing our PCB strategy



## Innovation





# Hans-Peter Tranitz: Dieter Bergman IPC Fellowship Award Recipient

Interview by Patty Goldman, I-CONNECT007

From the IPC website: The Dieter Bergman IPC Fellowship Award is given to individuals who have fostered a collaborative spirit, made significant contributions to standards development, and have consistently demonstrated a commitment to global standardization efforts and the electronics industry. Each recipient will be eligible to bestow the Dieter Bergman Memorial Scholarship upon the university or college of his/her choice.

Patty Goldman speaks with Continental Automotive's Hans-Peter Tranitz about his IPC involvement with press-fit and other automotive standards which have earned him the coveted Dieter Bergman IPC Fellowship Award.

**Patty Goldman:** Peter, congratulations on this award. It's quite an honor as you're aware, and it means you have done a lot of work with IPC and standards development. Perhaps you can tell us a little bit about yourself and your involvement with IPC and the different committees.

**Hans-Peter Tranitz:** Hello Patty. I'm working for Continental Automotive GmbH. My home location is Regensburg, and my profession is being an expert for mechanical joining technologies for metals and plastics in automotive final assembly, such as press fit and all kinds of technologies dealing with laser and



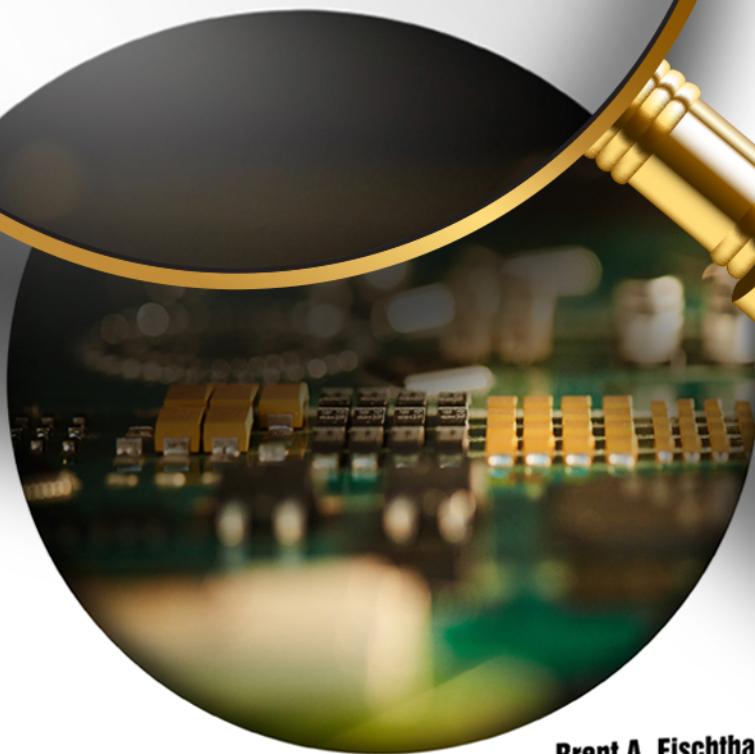
Hans-Peter Tranitz

material interaction. Welding, riveting, and screwdriving are also within my and my team's responsibility.

My first contact with IPC was in 2010 when I joined for the first time a tin whisker conference in Schaumburg, Illinois, near Chicago, and there I made a presentation about my current risk issues and how I deal with that. At that time, I felt that the people who joined the meeting were all "dinosaurs" that knew everything about whiskers and then here comes a freshman—even if I was already quite long in the industry at that time.

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But, for them, I was a freshman, and I saw this very little smile in their faces when I was presenting. And I felt like, “Oh, they all know what I’m talking about. I don’t tell them anything new.” But when I arrived at the APEX EXPO one year later all of them recognized me and all of them talked to me. And there was a very, very open-minded communication and I felt really accepted right away. That is something which is quite unique and that is what I would consider the special environment that IPC has. I was impressed by its open-minded and warm welcome of new members and new arrivals.

**Goldman:** Yes, IPC and volunteers love new volunteers. Worker bees, as we call them.

**Tranitz:** Agreed. After that time, a few years later, I proposed to IPC to start a press-fit standard for the automotive industry and high reliability applications because the current standards that existed were basically coming from the former telecommunications industry. So simply, cold-joining technology is where a compliant zone of a connector or housing pin is pressed-in to a specific plated through-hole of a printed board. This joint can withstand very tough environmental conditions beyond those usually known for solder joints as long as the overall design is matching. And particularly from the reliability perspective, this is what we needed more in the automotive industry, and that’s why we made this proposal.

A year later my other co-chair, Udo Welzel, and myself got the request from IPC to write

a PIN (project initiation request). From this moment onward, we were a very productive working team. After three years we were already in the ballot phase, and in May 2020 finally the standard has been published. I think we have been quite fast considering we started the standard absolutely from scratch.

**Goldman:** That’s great to hear. When you volunteer for something at IPC, they never turn you down, wouldn’t you say?

**Tranitz:** Yes. We needed the international standard for high reliability applications and IPC is a well-approved homeland for all kinds of electronic manufacturing standards, and therefore it was a win-win situation in my opinion.

**Goldman:** Have you been at most of the IPC meetings since then?

**Tranitz:** I have been at all APEX EXPOs at least, and at the one or other intermediate meetings in Chicago and Munich in the high phase of the standard. I also presented one time at an automotive reliability forum in Nuremberg, Germany back in 2017, I believe it was.

**Goldman:** That’s great. So, the committee that you chair is press fit; are you involved with any other committees?

**Tranitz:** There is the 5-21M Cold Joining Press-fit Task Group—the standard is IPC-9797—and the 5-21N Cold Joining Press-Fit Handbook Task Group. I am also from time to time working on the J-STD-001 committee and the A-610 automotive addendum depending on the topic. On top of this, I’m becoming active a little more in the IPC European Standards Steering Committee.

**Goldman:** Sounds good. Now, part of this fellowship award is a scholarship to the university or other school of your choice. Tell us about your choice.

**Tranitz:** I chose the University of Regensburg. First of all, I studied there and finished my diploma—what we would call a master's today—in physics, and then started my PhD study there, but I had to change my university since my supervising professor at that time got a new position at the Technical University of Chemnitz. Therefore, I made my PhD at the Technical University of Chemnitz beginning of 2002. And a month later I took over a post-doctoral position at the University of Cincinnati because my professor, who moved from Regensburg to Chemnitz, got a permanent professor position there. He presented to me a work contract, which in Germany usually comprises quite a few pages. The work contract from the American university, however, was one page with one sentence that was basically my salary.

**Goldman:** So, you spent some time in the U.S., then. How long?

**Tranitz:** I was there six months. That was in the year 2002. I built up the laboratory there at the University of Cincinnati. Then I went back for another one and a half to two years as a post-doctoral fellow to the Regensburg University and from there I entered industry.

**Goldman:** Have you been with companies other than Continental?

**Tranitz:** Basically, I have been first with Siemens, which automotive part was then sold to Continental. Since that time, I have been working as technology project manager in Plant Regensburg and later as an expert in central function departments.

**Goldman:** Well, this has been enjoyable. Thank you so much for your time, and congratulations again on your award. I'm sure you're pleased. Too bad it can't all be in person, but we have to live with that this year. I hope to see you at next year's IPC APEX EXPO. **S&T**

## Hans-Peter Tranitz, Continental Automotive, Dieter Bergman IPC Fellowship Award Video





# APEX Thursday Keynote by **Shawn DuBravac:** A Data-driven Tech World

by Barry Matties, I-CONNECT007

Shawn DuBravac, IPC chief economist, provided Thursday's IPC APEX EXPO keynote address, "The Tech Industry in a Post-pandemic World." The presentation began with a timeline of statements and events, highlighting key moments from as far back as 1843, and including a statement from Herbert Simon in 1956 who predicted, "Machines will be capable, within 20 years, of doing

any work a man can do." Now, we all know that by 1976, that prediction did not come to fruition.

Shawn then discussed how data and will impact our lives and that AI will be a large part of that. Shawn gave some great examples of how surfers will use data, as well as demonstrating the effects of AI on his Twitter profile. He explained that even though he didn't complete the gender question in his profile information, the AI did it for him. He said that it

The Tech Industry in a  
Post-pandemic World

Shawn DuBravac, PhD, CFA  
@ShawnDuBravac

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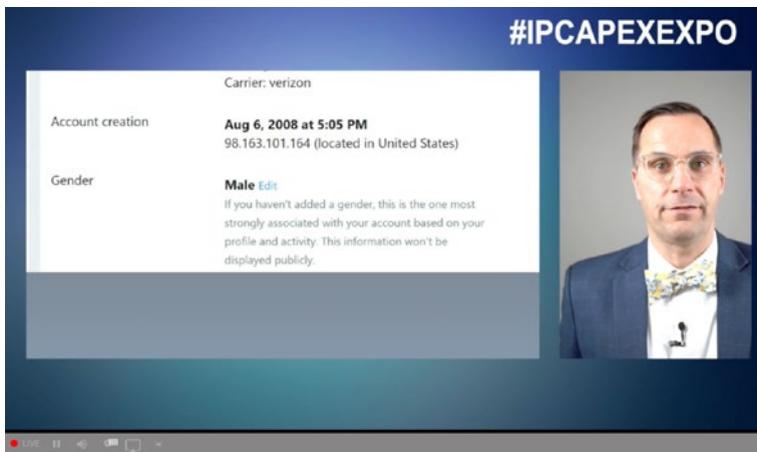
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Figures 1-2: A screenshot of Shawn DuBravac and his explanation of how even surfers will use AI to hone their craft. Another screenshot that details his Twitter “profiling.”



Figures 3: In the future, buying shoes will be a fast and simple process.

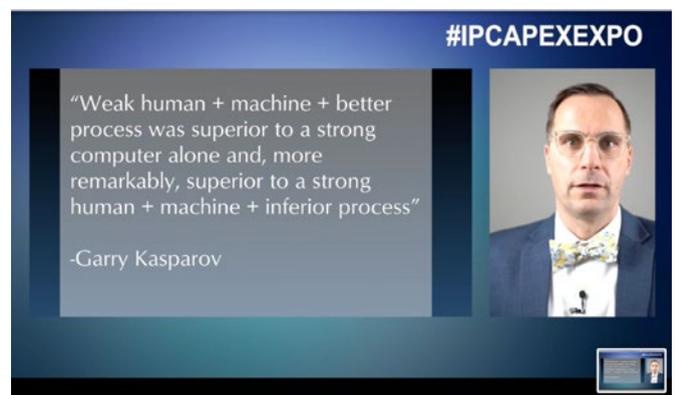


Figure 4: DuBravac closed with a quote from chess champion Garry Kasparov, who won his first match against IBM’s Big Blue but lost his second, after the computer’s AI was able to learn his playing style.

looked at his writing style, activities and other information to make that determination and complete the form automatically.

Shawn compared well known predictions of the past that completely missed the mark and warned us to think carefully about such predictions. Our lives will change with the use of data in ways that we can’t really imagine right now. When Shawn talked about data, he reminded us that it has always been there; what’s different today is our ability to harvest and organize the data in real time. He shared a video from OMRON of a man playing ping pong with a robot. Think about all of the data the AI must interpret to respond in a second to a ball, calculate the angle, return the ball over the net, and continue the rally. Amazing.

He also shared some simple ways that data will help us purchase our shoes in the future. There’s not a more essential piece of gear when covering a non-virtual trade show (see you in San Diego in January 2022) than a pair of great fitting shoes. Shawn shared an example of how our feet will be instantly analyzed and the perfect shoe size, based on the shoe of your choice, will be provided to you (Figure 3).

In the end, Shawn reminded us that it’s the explosion of data that will drive our thinking and change our processes. But it will not be data and AI alone that makes us better, it’s the combination of human creativity, data and AI that will transform our business (Figure 4).

If you missed Shawn’s keynote, it is now available [on demand](#) until June 13, 2021. **\$67**

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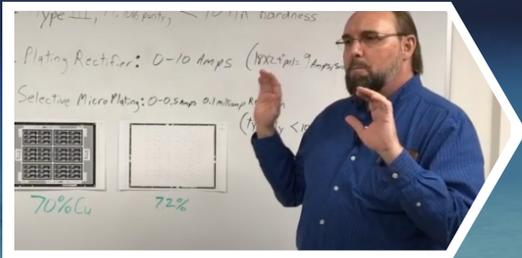
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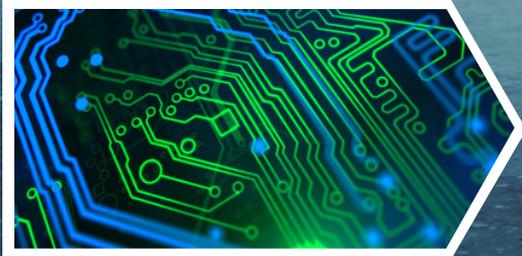
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# APEX EXPO EMS Panel: Lessons Learned in Times of Crisis

by Happy Holden, I-CONNECT007

During a crisis, communication among employees, customers and suppliers is key to keeping business operations running as smoothly as possible.

This consensus came from a panel moderated by Mark Wolfe in the Managers Forum on Monday, March 6, during the virtual IPC APEX EXPO. Panelists were asked to speak about lessons learned during the pandemic and how it affected their business and employees.

The panel consisted of: Dave Patterson of Cirtronics, Katherine Ducharme of General Dynamics, Barb Jorgensen of AsperCore, Jonathan Rowntree of Rogers Corp, and Brad Bourne of FTG Group. Each panelist provided their perspective during the pandemic before beginning a general discussion and answering questions.

Patterson, for example, stated that frequent communication during a crisis is critical. He said it's important to identify one trusted source for guidance, have an in-depth, specific contingency plan, and don't go it alone; reach out to trusted peer groups.



Figure 1: Moderator Mark Wolfe (top left), was joined (clockwise from top center) by panelists Dave Patterson, Katherine Ducharme, Brad Bourne, Jonathan Rowntree, and Barb Jorgensen.

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Jonathan Rowntree, Sr. Vice President & General Manager  
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**Agile Organization**

Top-down hierarchy → Bureaucracy → Silos → Quick changes, flexible resources → Leadership shows direction and enables action → Teams built around end-to-end accountability

"Boxes and lines" less important, focus on action

Source: "The five trademarks of agile organizations" McKinsey & Company

Ducharme emphasized really knowing your supply base and having strong relationships with customers. The biggest adversity, she said, was addressing industry changes that were occurring at the same time as the pandemic.

Jorgensen provided a perspective from two companies, one global and one regional, and how the pandemic affected their business both positively and negatively. Having thousands of suppliers, for example, was beneficial, but when many of those suppliers are in China, which was the first to be impacted by the pandemic, it created new challenges.

In his presentation, Rowntree said it's important to have organizational agility. This concept

allowed Rogers to respond better to conflicting demands while protecting the health and safety of their employees. They built teams to address specific concerns.

Finally, Bourne spoke about the drop in demand during the early months of the pandemic, and how his company responded to suppliers and customers. They pivoted to new markets, but remained within the defense sector.

In a separate question about future trends, Bourne believes there will still be uncertainty in the electronics industry, citing a cyberattack against his company in 2019 as a very real and continuing threat.

Jorgensen emphasized greater visibility in the supply chain, not with just your suppliers, but with their suppliers as well. Ducharme agreed that supply chain risk management must continue to be a focus.

Finally, others concluded that while the work-at-home model is feasible, there's something lost when teams are unable to meet together in person.

"I'm tired of Zoom meetings," Bourne said, "but there is no choice." **S&T**

**#IPCAPEXEXPO**

**APEX EXPO IPC 2021**

## Lessons Learned in Times of Crisis

Brad Bourne  
President and CEO  
FTG Corporation  
March 2021

**TECHNICALLY SPEAKING:**  
IT'S THE PLACE TO **connect**



### Transitioning to Factory 4.0

- 1. Create Talent**  
- up-skilling is the key for 54% of your labor
- 2. Collaborate**  
- don't invent the wheel again
- 3. Visualize Content**  
- no one reads manuals anymore
- 4. Look for LXP Homebase**  
- be smart and start

**Reduce 101 days to LXP!**

Built a Foundation for "Smart" Over the Last Decade

**SIEMENS**  
*Ingenuity for Life*

- Connectivity
- Optimize
- Simulate
- Analyze

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## Jon Vermillion President's Award Acceptance Speech

IPC  
President's Award  
Presented to  
Jonathon Vermillion

0:57 / 1:04



# Keynote: John Mitchell on the State of the Industry



John Mitchell

by Nolan Johnson, I-CONNECT007

IPC President and CEO Dr John Mitchell was the Monday keynote for the 2021 edition of IPC APEX EXPO. Delivered via video conference as a part of this year's virtual format, Mitchell made good use of a panel approach. After opening remarks, Dr. Mitchell anchored an around-the-horn series of reports from IPC experts.

Sean DuBravac, IPC's chief economist, delivered a high-level review of the economic influences in 2020 and leading into 2021. DuBravac pointed out, for example, that while the service industries were hit hard by the pandemic, electronics manufacturing was surprisingly resilient and adaptable. DuBravac said that this drop in services and increase in manufacturing made this into a unique recession with respect to its impact on the economy. DuBravac also said that, in the past, a supply chain disruption would be regional; in this case the disruption was global, causing a completely different set of consequences. DuBravac further shared that the remote work and social distancing restrictions accelerated the digitalization of our factories and processes, and a broader adoption of digitalization downstream in the supply chain also.

IPC Chief Technologist Matt Kelly picked up the digitalization message and added more insight. For example, Kelly outlined how IPC is working to proactively implement the trans-

fer of digital instruction to the physical world. Kelly summarized by using his Chief Technologist Council as an example: to identify real business problems and to determine the means to resolve them.

As Kelly wrapped up, John Mitchell stated, "As individuals, we need to know how to use the technologies of the future."

Other reports were filed by David Hernandez, IPC vice president of education; European senior director, Alison James; Kelly Scanlon, director of EHS policy and research; Chris Mitchell, IPC vice president of global government relations; and Sydney Xiao, president of Asia operations.

Dr Mitchell closed with a video from IPC Hall of Fame member Dan Feinberg, who shared his infectious excitement not only for how far we've come in the 50-year history of our industry, but how far we'll go in the next 50 years.

Mitchell's presentation aimed to share enthusiasm in the state of the industry, backing that excitement with data and announcing new programs, by slicing through the pandemic-related chaos and highlighting how we're emerging stronger. Even still, Mitchell and his team remind us that we have a lot more work to do.

A video of the entire keynote is available on the IPC APEX EXPO content library as a part of the on-demand content IPC will host until June 13, 2021 at [ipcapexexpo.org](http://ipcapexexpo.org). S&T

# Distinctly different.

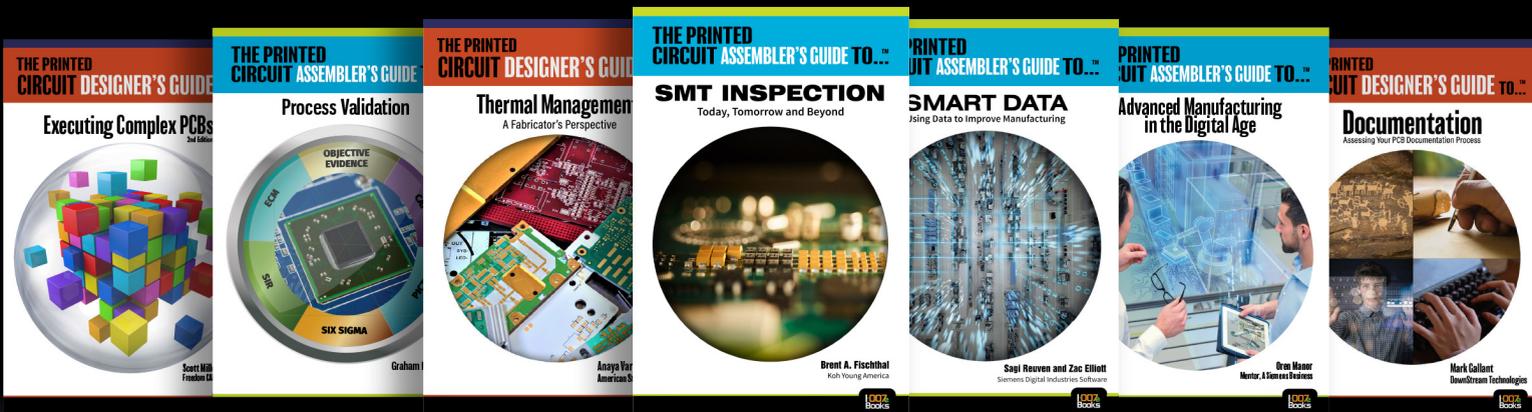
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PCEA Chairman, MIT, CID+



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# Achieve Digital Transcendence

## 2022 Call for Participation

Submit an abstract for one of the industry's premier technical conferences or provide a course proposal for one of its largest educational events. Presenting at **IPC APEX EXPO 2022** in **San Diego** will provide significant visibility for you and your company. Thousands of individuals will receive the technical proceedings of the conference, ensuring that your published paper will be seen by key engineers, managers and executives from all segments of the worldwide electronic interconnection industry. Presenting a technical conference paper or teaching a professional development course is a unique and cost-effective channel to promote your expertise and your organization to your customers, prospects and the industry.

### TOPICS FOR TECHNICAL CONFERENCE PAPERS AND PROFESSIONAL DEVELOPMENT COURSES

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3D Printing/Additive Manufacturing in Electronics  
 4D Smart Material Printing  
 AI-Enabled Inspection  
 Artificial Intelligence (AI)/ Machine Learning  
 Augmented Reality/Virtual Reality  
 Automation  
 Blockchain  
 Connected Factory Exchange (CFX)  
 Cybersecurity  
 Data Analytics/Big Data/ Business Intelligence (BI)  
 Digital Transformation of Operations and Supply Chain  
 Digital Twin/Digital Thread  
 Industrial Internet of Things (IIoT)  
 Industrial Networks (IT/OT Convergence)  
 Industry 4.0  
 Robotics/Cobots  
 Simulation and Modeling  
 Smart Factory  
 Smart Sensor/Actuator Technologies  
 Systems Integration

#### Circuit Design and Component Technologies

Design for Excellence (DFX)  
 Design for Manufacturability (DFM)  
 Design for Test (DFT)  
 Embedded Passive and Active Devices  
 CAD Design Tools  
 Printed Electronics  
 Flexible Circuits  
 RFID Circuitry  
 2.5-D/3-D Component

Packaging  
 Package on Package  
 Flip Chip/O201 Metric  
 Re-balling Components  
 Connectors  
 Die attach  
 Semiconductor  
 Wire Bonding  
 Ultra-thin die assembly  
 BGA Packaging

#### Quality, Reliability, Test and Inspection

Accelerated Life Testing  
 Automated Inspection (SPI, AOI, AXI)  
 Solder Paste Inspection (SPI)  
 Automated Optical Inspection (AOI)  
 Automated X-ray Inspection (AXI)  
 Failure Analysis  
 In-circuit Testing (ICT)  
 Inspection Methods  
 Microvia Interface Failures  
 Process Control  
 Reliability after Repair or Rework  
 Surface Reliability  
 Corrosion  
 Electromigration  
 Objective Evidence  
 Surface Insulation Resistance Testing (SIR)  
 Test Method Developments  
 Tin Whiskers

#### Enabling Future Technologies

Microminiaturization  
 Nanotechnology  
 E-textiles and Smart Textiles  
 Energy Harvesting  
 Flexible Hybrid Electronics  
 Graphene in Electronics  
 Manufacturing  
 LED Manufacturing

Optoelectronics  
 Photovoltaics  
 Sensors and Haptics  
 Wearables

#### Meeting Extreme Requirements

Automotive  
 Biotech  
 Class 3+  
 Harsh Environments  
 Power Electronics  
 Battery technologies  
 Ruggedization  
 Space/Avionics

#### Electronics Materials

Adhesives  
 Conformal Coatings  
 High Temperature Alloys  
 Material Evaluation Methods  
 Pb-free Alloys  
 Low temperature soldering  
 Sintering Materials  
 Thermal Interface Materials (TIMs)  
 Underfills

#### Conscientious Engineering

Electronic Documentation  
 Environmental Protection and Compliance  
 ESD Protection  
 Industry Roadmaps  
 Leadership Strategies  
 Lean Manufacturing (Six Sigma)  
 Onshoring/Reshoring  
 PCB and Component Storage and Handling  
 Preventative Maintenance  
 Problem Solving/Design of Experiments/Root Cause Analysis  
 Sustainability  
 Supply Chain Management

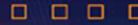
Traceability/Counterfeit Electronics

#### Assembly Processes

BTC/LGA/QFN Assembly Challenges  
 Cleaning  
 Coating Processes  
 Electronics Manufacturing Services  
 Novel Solder Deposition Methods  
 Process Best Practices  
 Reflow Ovens and Profiling Rework Process  
 Robotic, Laser and Selective Soldering Processes  
 Stencil Printing  
 Surface Preparation Methods  
 Surface Mount Technology (SMT) Process  
 Vapor Phase  
 Warpage-induced Defect Mitigation

#### PCB Fabrication and Materials

5G  
 Additive and Semi-Additive Processes  
 Black Pad and Other Board Related Defects  
 CAF  
 HDI Technology  
 High Frequency  
 High Speed  
 High Voltage (for Automotive Applications)  
 Microvia Design and Testing  
 PCB/Pad Repair  
 RF Materials  
 Signal Integrity  
 Solderability  
 Surface Finishes  
 Via Plugging and Other Protection



# Achieve Digital Transcendence

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## 2022 Call for Participation

### Submit Technical Paper Abstract

#### REQUIREMENTS FOR SUBMISSION

Provide an abstract of **approximately 300 words** that summarizes technical work, covering case histories, research and discoveries. Authors of papers selected for the conference will each receive a detailed speaker manual to assist them with numerous items, including the formatting of their papers and presentation slides.

The selection process is competitive and sufficient detail needs to be included to allow the Technical Program Committee to properly assess content of the proposed paper. The paper should be noncommercial and describe significant results from experiments, emphasize new techniques, discuss trends of interest and contain technical and/or appropriate test results. Presentations will be limited to **30 minutes**, which includes approximately **5 minutes** for questions and answers.

#### CONFERENCE BENEFITS

Conference speakers are entitled to a free one-day conference pass for the day of their presentations, discounted registration fees for the full conference and complimentary admission to the exhibit hall.

All speakers selected for papers who provide both their paper and presentation to IPC by **October 15, 2021** will be eligible for a free full-conference pass. IPC leaves it to the primary discretion on how the honorarium should be distributed.

#### CONFERENCE AWARDS

To recognize exceptional achievement, awards will be presented for "Best Paper." Each award consists of a recognition plaque for each author and a **\$1,000 prize**.

#### Please Note

Previously published papers and/or commercially focused papers are not appropriate and will not be accepted.

#### CONFERENCE PAPER TIMELINE

- **Abstracts due June 18, 2021**
- **Acceptance/status of your submittal by July 23, 2021**
- **Papers are due September 17, 2021**
- **Presentations are due November 19, 2021**

For more information about conference participation, please contact **Toya Richardson** at [ToyaRichardson@ipc.org](mailto:ToyaRichardson@ipc.org) or **+1 847-597-2825**.

#### PROFESSIONAL DEVELOPMENT COURSES

### Submit Professional Development Course Proposal

Course proposals are solicited from individuals interested in teaching half-day (three-hour) professional development courses on design, manufacturing processes and materials. Travel expenses and honorariums are offered to professional development instructors.

#### PROFESSIONAL DEVELOPMENT TIMELINE

- **Proposals due July 16, 2021**
- **Acceptance by August 20, 2021**
- **Final presentation revisions due December 17, 2021**

For more information about professional development, please contact **Andrea Keefe** at [AndreaKeefe@ipc.org](mailto:AndreaKeefe@ipc.org) or **+1 847-597-2879**.

#### ABSTRACT AND PROPOSAL INSTRUCTIONS

Submit your [Technical Paper Abstract](#) or [Professional Development Course Proposal](#) online.

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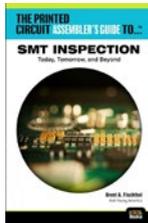
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## The Printed Circuit Assembler’s Guide to...



### SMT Inspection: Today, Tomorrow, and Beyond

*by Brent Fischthal, Koh Young America*

This book offers an accurate look at the aspects and challenges the electronics manufacturing industry faces with regards to SMT inspection and its surrounding technology. In-depth insight on new and exciting true 3D inspection technology is provided, with a look into the future of leveraging big data management and autonomous manufacturing for a smarter factory.



### Smart Data: Using Data to Improve Manufacturing

*by Sagi Reuven and Zac Elliott, Siemens Digital Industries Software*

Manufacturers need to ensure their factory operations work properly, but analyzing data is simply not enough. Companies must take efficiency and waste-reduction efforts to the next phase using big data and advanced analytics to diagnose and correct process flaws.



### Process Validation

*by Graham K. Naisbitt, Chairman and CEO, Gen3*

This book explores how establishing acceptable electrochemical reliability can be achieved by using both CAF and SIR testing. This is a must-read for those in the industry who are concerned about ECM and want to adopt a better and more rigorous approach to ensuring electrochemical reliability.



### Advanced Manufacturing in the Digital Age

*by Oren Manor, Director of Business Development, Valor Division for Mentor a Siemens Business*

A must-read for anyone looking for a holistic, systematic approach to leverage new and emerging technologies. The benefits are clear: fewer machine failures, reduced scrap and downtime issues, and improved throughput and productivity.

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