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REALTIME with... **APEX EXPO[®] IPC 2022**

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It's Great to Be Back

By Nolan Johnson

I-CONNECT007

Welcome back... on so many levels! First, welcome back to *Real Time with... IPC APEX EXPO 2022 Show & Tell Magazine*. This special publication is a supplement to our other monthly magazines and brings you exclusive, in-depth coverage of the 22nd year of IPC APEX EXPO. Which leads me to the next welcome: Welcome back to IPC APEX EXPO as a live event. It was good to see all the attendees, to reconnect, and talk about business (and our friendships) once again.

It was at the awards luncheon on Monday that I had the first feeling of truly being back.

In this moment, as I surveyed the main ballroom full of round tables populated by conference attendees all sitting together over lunch, reconnecting, using their presence to show their appreciation for the research and achievements over the last 24 months, I was struck by how *good* it felt to be amongst these people in the industry. While we are talking to you every day, seeing you in person felt so good.

We are back in the sense that we are stronger. As I walked the show floor, it was clear that the last two years have been good to our industry. Demand for electronics has grown,

only partly because of pandemic-related urgencies.

We are back in the sense that we're in a super cycle. At the Monday EMS Leadership Summit, information was presented that suggests electronics manufacturing is in the beginning years of a 20-year super cycle. They compare this to the 20-year microprocessor super cycle in the 1970s and 1980s, predicting that the electronics manufacturing industry will see growth and prosperity similar to the go-go microprocessor days.

Factory of the Future was more of a showcase at this conference. Sensors and data acquisition to enable smarter processes were everywhere—in the new machinery, as retrofits to older machinery, in software systems to collect and manage all this data. Factory of the Future now also includes supply chain intelligence. The pandemic taught us about the importance of a ready set of alternates (components, suppliers, shipping methods).



Finding sufficient staffing, of course, relates directly to how this industry must respond to meet the super cycle opportunity. Now is the time to scale up with efficiencies and capacity. Where we once could throw people at the growing demand, now we must use pragmatic factory automation to make more product with the staff we have. In my [interview with Matt Kelly](#), he made the point that automation is no longer just an option, and that Europe and Asia are both 5–10 years ahead of the U.S. in implementing smart



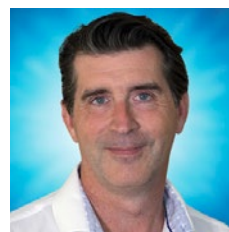


nical tracks had plenty of paper submissions, that there were many more papers submitted than could be published, and that the quality of the submissions overall was very high. From what I've read post-show, and in the coverage from both Happy Holden and Patty Goldman, the reports are true: the research presented was top-notch.

We're back in the sense that it's time to invest. Especially in board fab. Concurrent with IPC APEX EXPO, three key news items caught my attention. The monthly PCB fab and EMS sales reports were released, and the industry continues to show ongoing strength and growth (consistent with the idea of a super cycle),

but the third report spread caution. I'm referring to Joe O'Neil's detailed report on U.S. PCB fabrication capabilities. For the U.S., at least, the domestic manufacturing chain has been broken in numerous places. The U.S. may still be an innovation leader, but in many cases, we cannot even manufacture in quantities in which we can design. This message was echoed in Dr. John Mitchell's keynote, and in Matt Kelly's interview, both of which are reviewed in this issue.

So, yes, we're back. Back and ready to move forward. In a global sense, IPC APEX EXPO reflected the health and vibrancy of being in this industry. That is worth celebrating. There is, however, much need to invest, modernize, and become more sophisticated. Now is the time; that message was delivered loud, proud, and repeatedly at IPC APEX EXPO 2022. I, for one, can't wait to see how much progress we make between now and 2023. **\$E7**



Nolan Johnson is managing editor of *SMT007* and *PCB007* Magazines. Nolan brings 30 years of career experience focused almost entirely on electronics design and manufacturing. To contact Johnson, [click here](#).

factories. The implications are clear: Build out your automation now, so you can maximize your participation in the super cycle.

We are back, working on challenging problems to keep our manufacturing infrastructure supplied. Companies like Siemens, CalcuQuote, and many others shared their expertise in optimizing the purchasing and procurement functions considering all the supply chain challenges facing the industry. It's clear that supply chain management has reached the point where innovation will inevitably happen; necessity is the mother of invention, as the saying goes. With all the component part availability issues, the experts forecasting that the shortages will continue into 2023, the long lag time to ramp up new production facilities, and the rampant demand for components, this is a set of challenges that requires new approaches, new solutions, and some creative R&D. If ever there were a time and a niche in our industry begging for a "killer app" it would be now, in supply chain optimization.

We are back as a community. The electronics manufacturing industry finally was back together; as a community we can and must move forward. The good news is I see that happening. IPC reported that this year's tech-



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IPC APEX EXPO 2022: Better Than Expected!

By Barry Matties

I-CONNECT007

It's good to be back. Though not everyone who normally would be here was in attendance, the spirit of the people who are here is strong. There are in-person reunions in every corner of the convention center. Heartfelt greetings that they have missed for the last two years are shared. The team of people working Registration, the security team, organizers, teamsters, exhibitors and the rest who make up our community are truly glad to be here, all while embracing the new rules and order of things. If a mask and other precautions are what we must do to be together, then so be it. It won't be like that forever; we are just on the path to the future.

As you walk the show floor, you see the familiar. It's what you expect: signs overhead, carpet on the aisles, equipment in booths. Yes, I was pleasantly surprised to see the amount of equipment that made it here. With all the challenges of supply chain, materials, labor and shipping, it is wonderful to see the commitment and determination of so many com-

panies to have equipment on the show floor.

As far as attendance goes, most expected it to be very low, myself included. I think the best way to describe it is that it clearly exceeded expectations. This is the comment I heard frequently throughout the event. Comparing attendance to years past just did not seem like the metric that made sense for the return of an in-person event.

Our team covered the event in many ways—videos, interviews, meetings, booth tours, and photos. The photos that you will see throughout our special *Real Time with... IPC* event coverage are the result of a collaborative effort between our team and Josh Sears, the official IPC show photographer. From the opening ceremony, conferences, keynotes, show floor receptions, STEM event, and much more, our team was there to capture the moments.

We also invite you to visit our [Real Time with... IPC](#) site to view the full gallery of photos, interviews and more. **S&T**







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Industry Reconnects—IPC APEX EXPO 2022 Reconvenes as **Live, In-person Event**

By John Mitchell

IPC

Every IPC APEX EXPO is unique, and 2022 was no exception. Let's address the reality of this year's event: attendance was down. The pandemic-imposed travel restrictions upon companies and a global spike in infections caused by the fast-moving Omicron coronavirus variant kept many at home. Yet, in the middle of a pandemic, with a show that typically sees a healthy international audience and an equally healthy exhibitor presence, APEX

EXPO 2022 experienced a vibrant and very engaged show floor, lively standards development committee meetings, a robust technical conference, and professional development course offerings.

When I first walked onto the show floor, I was thrilled to see equipment. I must admit, I was nervous—would equipment actually arrive to the show floor on time given transportation delays? But there it was, a multitude of high-

tech machinery showcasing the latest in flying probe testing, conformal coating application, fume extraction systems, photoimaging, and much more. IPC's trade-show committee shared that buyers did not come to this year's APEX EXPO to just "kick tires" and that sellers were back, ready to do business. John Lee with Insulectro told me, "Our team feels this was one of the best IPC APEX EXPOs we have participated in. Sure, it seemed attendance was a little light, but we had top-quality opportunities to meet with customers, prospects, and suppliers. We were all blown away with the effectiveness of the week for us."

IPC APEX EXPO continues to be a forum for new ideas, and new ways for generations to connect, something that is so important as we look to the future of our industry. Just seeing all the faces of our new Emerging Engineers, along with the high school students who attended our STEM event, was something I thoroughly enjoyed. I was able to learn from Emerging Engineers about their career plans, as well as to learn what their mentors planned to teach them. To see engineers from every age group building a stronger industry right in front of me was exciting and encouraging. Attending our Newcomers Reception, I was able to watch our subject matter experts and long-time volunteers share their knowledge with a new crop of eager engineers who will succeed them as subject matter experts with time.



The IPC Education Foundation (IPCEF) hosted its annual STEM event, welcoming 80 local high school students for a hands-on experience allowing them to see, feel, and touch what the electronics industry has to offer. Students participated in educational tracks with a focus on soldering, PCB design, and building circuits. Students learned hand soldering from IPC trainers, talked to exhibitors on the show floor about the varied opportunities a career in electronics would provide them, and participated in a career panel discussion. The STEM event was supported by IPC members and partners such as TTM Technologies, CAES, DigiKey, Google, Mycronic, Nano Dimension, Novagard, Omron, Zestron, KYZEN, Chemcut and I-Connect007, all instrumental in pulling it together either through donations of equipment, participation of trainers and exhibitors, and generous sponsorships. It's a rewarding outreach event for all of us and we eagerly anticipate the reaction the students



have to the event, and we enjoy answering their insightful questions.

We had a wonderful opportunity to ask questions of our own when David Pogue, disruptive tech expert and CBS Sunday Morning and NOVA reporter, delivered his keynote speech about how technology impacts our work, business, and connections with each other—proving that science and technology blend brilliantly with storytelling, humor, and even with music and song.

From attendees, I was pleased to hear accolades on technical program offerings, many stating that it was the best conference in years. The Technical Program Committee outdid themselves, and built a strong program with four tracks, 38 sessions, and 104 papers, with peer-reviewed content from 18 countries focused on all aspects of factory of the future implementation, PCB fabrication and materials with specific attention paid to micro-via reliability and PCB design, quality, reliability, inspection and test, covering failure analysis for automotive electronics, and assembly materials and environment, covering the move toward “green” electronics. It was so exciting to learn from international subject matter experts who eagerly shared their knowledge and expertise, providing attendees with critical informa-



Michael Milostan, IPC's marketing director.

tion that they cannot find anywhere else. We are very proud of the technical conference and eagerly look forward to next year's event.

This year we launched the first Factory of the Future Pavilion and worked to bridge the raw technical content in the conference with the companies and the suppliers that work in this space. The difference is when you're in a conference session, all is very technically focused, with limited ability to promote company services and products. The Pavilion is a place on the exhibition show floor where companies can talk tech and promote their commercial product and service offerings at the same time. Given the success of this inaugural year, we expect this pavilion to grow in future years.

As I walked the show floor or attended various committee meetings and other events, I received positive feedback from attendees who were enthusiastic about not only returning to an in-person event, but the ever-expanding innovation in this industry. The convergence of influences such as AI, additive manufacturing, and robotics are all coming together and IPC is at the heart of it, and that is enthralling.

I was so happy to be back in person at IPC APEX EXPO. I've always enjoyed the show, but this year was special, and it showed in the interactions I had with



attendees and IPC staff. This event is a gathering place for the present and future of electronics, enabling us to connect in remarkable ways. I learn so much from committee members, exhibitors, speakers, and every attendee I meet. I never tire of hearing about all the new equipment, new ideas, and new ways of looking at this ever-changing industry. We at IPC are profoundly grateful to an industry that has encouraged and supported us in producing IPC APEX EXPO. We never lose sight of the fact that we could not host this event without the dedicated volunteers who share their time, their expertise, and their enthusiasm with all of us.

Though we wrapped up IPC APEX EXPO just a few weeks ago, our team is already preparing for next year's show which will take place January 21-26, 2023. I'm already looking forward to seeing everyone in San Diego. For more information on next year's event, visit www.ipcapexexpo.org. S&T

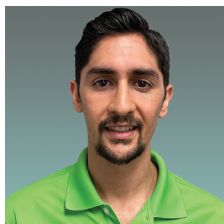


John Mitchell is president and CEO of IPC.

IPC APEX EXPO: Conference Speakers Speak Out

Leveraging CFX-QPL to Integrate Equipment and Create a Smart Factory

Presenter: Ivan Aduna,
Global MES Leader,
Koh Young



As an electronics manufacturer, how can one easily create a smart factory that includes both new and legacy SMT equipment?

The IPC-2591 Connected Factory Exchange (CFX) is an industry-developed open standard for assembly manufacturing that uses a secure, omni-directional, AMQP protocol and JSON data encoding to enable plug-and-play solutions to simplify and standardize both machine-to-business and machine-to-machine communication. Koh Young implements IPC-CFX natively on its inspection systems through its KSMART Business Rules Management and the open-source IPC-CFX Software Development Kit. Koh Young was the first inspection equipment supplier to officially certify using the IPC-CFX Validation and Certification Program and obtain a qualified product listing (QPL) for SPI and AOI, which guarantees CFX support. Nevertheless, this is only the first of a series of steps to create a true smart factory. There are multiple factors that create a smart factory, yet there will be key differentiators that will make

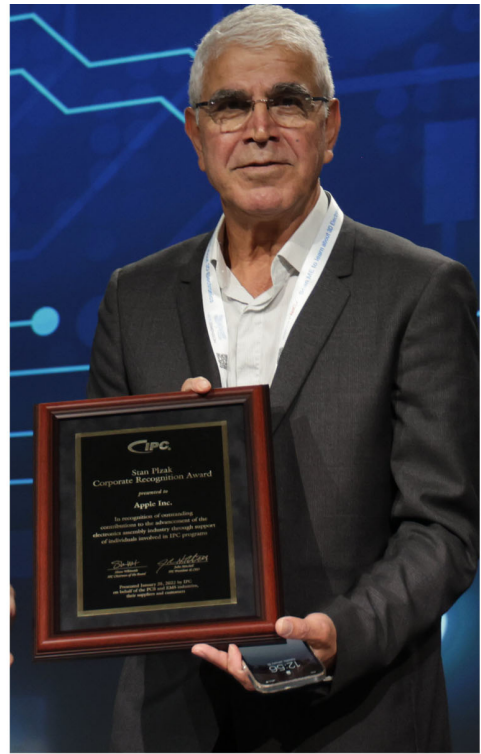
a company thrive in the Industry 4.0 transformation. Security, reliability, and interoperability are concepts that will resonate strongly among companies looking to stay competitive in the digital transformation race. Inspection systems using AI-based learning will focus on generating and converting data into process knowledge and actionable insights, and IPC-CFX will facilitate a secure and reliable environment to share the data throughout a smart factory.

There are many ways to create a smart factory via IPC-CFX, but the key is to understand how far you can go with the available data and create the necessary tools and applications that will help companies succeed in the next industrial revolution and digital transformation. Using the protocol and its messages, plus the QPL certification is critical for inspection systems in the IPC CFX Validation and Certification Program. Hence, the best advice is to invest the time to review the information contained in these messages, and then ask yourself: How do I want the smart factory landscape to look in the next five to 10 years?

Related Content

I-007e Micro Webinar: [“Converting Process Data Into Intelligence.”](#)







Blackfox Training Institute, Vince Price

IPC Training Updates

Vince Price of Blackfox Training Institute discusses the latest updates to IPC certification programs and their online training with Pete Starkey.



Aegis Software, Jason Spera

Connecting the Digital Thread

We hear from Jason Spera on the subject of IIoT, including the increasing need for managing and optimizing interconnected sensors, instruments, and other networked devices.



all4-PCB, Torsten Reckert

Latest Trends in PCB Manufacturing Equipment

Torsten Reckert, president of all4-PCB, discusses their product lines with Andy Shaughnessy. In this conversation, they look at the latest trends and requirements from the industry.



Burkle North America, Kurt Palmer

PCB Manufacturing Today

Dick Crowe (right) interviews Kurt Palmer, president of Burkle North America, on the trends he sees in PCB manufacturing today. From LDI to laser drills, they cover a wide range of concerns and opportunities.



ASTER Technologies, Willam Webb

Test Coverage Puts Results at Your Fingertips

William Webb shares with Andy Shaughnessy the latest in design for test (DFT), including the company's new test coverage analysis.



Nordson ASYMTEK, Camille Sybert

Time to Conform

Joe Fjelstad of I-Connect007 talks with Camille Sybert of Nordson ASYMTEK about conformal coating equipment and process options, as well as material and market demands.



CalcuQuote, Kaitlyn Dotson

Current EMS Trends

Kaitlyn Dotson talks about current EMS market trends with Nolan Johnson and what EMS customers should be focusing on.



CyberOptics, Subodh Kulkarni, PhD

Advanced Metrology and Inspection

In this interview, Steve Williams talks with Subodh Kulkarni about the company's new SQ3000+ system for advanced metrology and inspection applications, while also looking at the challenges companies are facing with inspection.



DownStream Technologies, Joe Clark

Disruptive Technologies Growing Business

Joe Clark, founder of DownStream Technologies, gives editor Andy Shaughnessy his report of what's been causing a 10% growth in his business during the past two years. Rigid-flex as a disruptive technology has been a focus of the latest phases to his software tools.



ICAPE Group, Paulo Franca

ICAPE Continues to Expand

ICAPE's Paulo Franco discusses the company's recent acquisitions around the globe, including a PCB fabrication facility in South Africa.



Electra Polymers, Ashley Steers

Supplying the U.S. Market for 30 Years

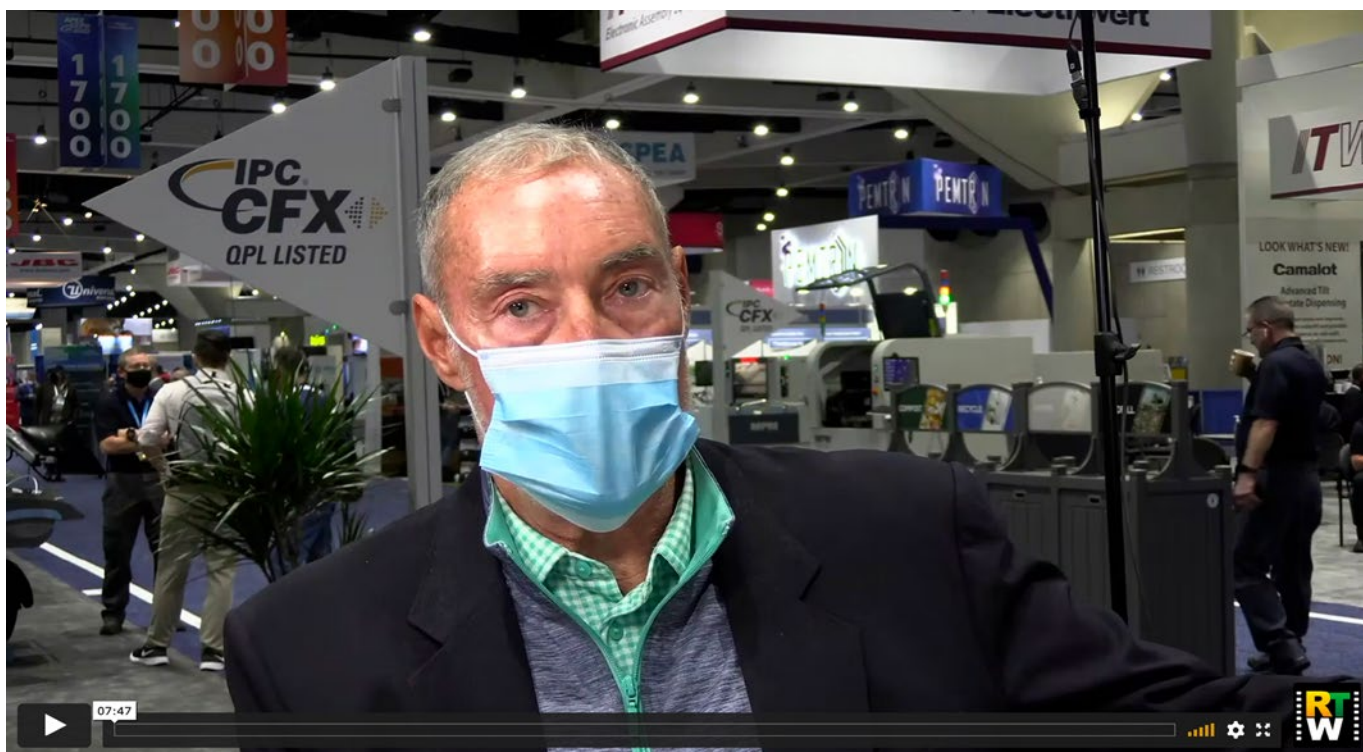
Ashley Steers of Electra Polymers shares his perspective with Pete Starkey on supplying the U.S. market for 30 years. They also discuss the latest trends in inkjet solder mask.



Hitachi High-Tech Analytical Science, Dean Schmidt

Electronics Coating Quality Control

Dean Schmidt of Hitachi High-Tech Analytical Science talks with Nolan Johnson about the increasing need for more in-line automation and the role that coatings analysis plays in this.



Super Dry, Richard Heimsch

Digitized Component Storage

Richard Heimsch shares his thoughts with Nolan Johnson on the need and application of digitized component storage to maintain component reliability.



International Electronic Components (IEC), Shawn Stone

Continuous Supply Chain

Nolan Johnson talks with North American distributor Shawn Stone of International Electronic Components (IEC) about their strategies for maintaining a continuous supply chain in the PCB industry.



Koh Young America, Inc., Joel Scutchfield

Smart Factories Demand Total Inspection

Joel Scutchfield of Koh Young America, Inc. shares with Nolan Johnson the need for a total inspection solution for a smart factory that includes SPI, AOI, DPI, API, KSMART along with multi-point Inspection (SPI, PRE, POST) to improve yields.



Taiyo America, Don Monn

Fire Up the InkJets

Don Monn discusses the benefits of inkjet solder mask and how it helps streamline the manufacturing process. He and Pete Starkey also discuss the recent acquisition of Circuit Automation.



MIRTEC, Brian D'Amico

Full Spectrum of Inspection

Pete Starkey asks Brian D'Amico how MIRTEC is addressing the full spectrum of inspection requirements associated with the electronics manufacturing industry.



LPKF Laser & Electronics, Stephan Schmidt

With Laser Focus

Stephan Schmidt of LPKF Laser & Electronics looks at why, with new technologies, more applications are migrating to laser depaneling and away from traditional singulation methods as cost drops and performance increases.



IPC, Dr. John Mitchell

John Mitchell Shares His Thoughts

President and CEO of IPC, John Mitchell, shares his thoughts with Barry Matties on the return of the in-person IPC APEX EXPO.



KYZEN, Tom Forsythe

The PCBA Cleaning Trends

We talk with Tom Forsythe about the launch of KYZEN's newest addition to the AQUANOX line. Also discussed: trends in cleaning of PCBAs and what EMS companies can expect in the future.



Mycronic, Jesse Dowd

The Testing Demands on PCBA

Mycronic's Jesse Dowd shares how the company's new 3D AOI is well adapted to high-mix production. They also look at the demands on testing and what companies should be aware of.



IPC, Matt Kelly

Advanced Packaging Report

Matt Kelly, chief technologist at IPC, provides a quick assessment of APEX, reviews the technical programs, and talks about the importance of the Factory of the Future.



Omron, Brad Ward

Omron on Their New AOI

Omron's Brad Ward speaks with guest editor Steve Williams about their new VT-S1080 3D AOI, along with the high-speed updates to VT-X750 3D CT AXI.



PulseForge, Stan Farnsworth

Dynamics in Soldering

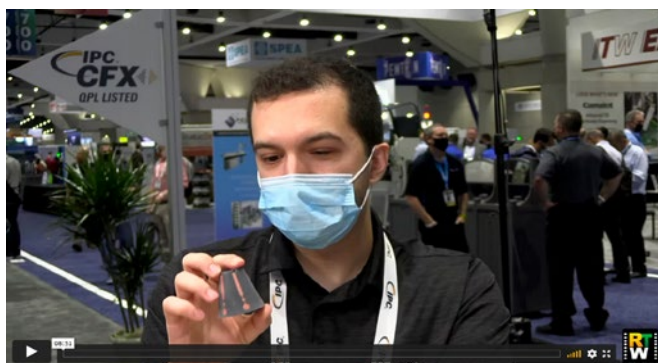
Joe Fjelstad of I-Connect007 speaks with Stan Farnsworth of PulseForge on the changing dynamics in soldering and the new PulseForge Soldering In-line.



IPC, Shawn DuBravac

Speaking of the Economy

Shawn DuBravac, IPC's chief economist, talks with Nolan Johnson about the latest economic trends that we all need to be aware of, and how they will impact our businesses.



Rogers Corporation, Trevor Polidore

New Materials and Additive Manufacturing

Trevor Polidore of Rogers Corporation discusses with I-Connect007 guest editor Tara Dunn the introduction of their new materials for 3D printing. They also look at the trends in materials for additive manufacturing.



Siemens Digital Industries Software, Mark Laing

Quoting, Supply Chain and BOMs

During this conversation, Mark Laing of Siemens shares the latest in EMS quoting and challenges in the supply chain. He and editor Nolan Johnson also discuss the quality and accuracy of BOM data supplied to EMS companies.

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Aismalibar, Jeff Brandman

The Growing Demand for Automation

all4-PCB, Torsten Reckert

Latest Trends in PCB Manufacturing Equipment

AltiumLive, Kelly Dack

AltiumLive Goes Virtual

Altix, Sylvain Dromaint

A New Direct Imaging System

American Standard Circuits, Anaya Vardya

The PCB Fabricator Voice

Arlon, Deanna Bustamante

High Speed Material

ASTER Technologies, Willam Webb

Test Coverage Puts Results at Your Fingertips

Averatek, Mike Vinson

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BTU International's New Aqua Scrub

Burkle North America, Dick Crowe

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Disruptive Technologies Growing Business

Electra Polymers, Ashley Steers

Supplying the U.S. Market for 30 Years

Electrolube, Beth Turner

Good for the Environment

Electrolube, Phil Kinner

The Winds of Change

Elmatica, Jan Pedersen

Ultra HDI/Substrate-like PCBs

Essemtec USA, Pierre Marechal

An All-in-One Unique Solution

Flexible Circuit Technologies, Chris Clark

Flexible Circuit Specialists

**Floor Interview, Kris Moyer, Kevin Kusiak,
Russ Steiner, Steve Roy**

IPC Design Competition: Meet the Judges

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Thoughts on Mega Trends

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Dean Schmidt**

Electronics Coating Quality Control

Horizon Sales, David Trail

Standards in Process Test

ICAPE Group, Paulo Franca

ICAPE Continues to Expand

Indium Corporation, Chris Nash

Automotive Electrification

**International Electronic Components (IEC),
Shawn Stone**

Continuous Supply Chain

INVAP, Adrian Oscar Danta

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IPC, Shawn DuBravac

Speaking of the Economy

IPC, Randy Cherry

Update on IPC's Validation Services

IPC, Charlene Gunter du Plessis

We Can All Learn Something

IPC, Chris Mitchell

Advocacy in Washington

IPC, Dr. John Mitchell

John Mitchell Shares His Thoughts

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Keynote from IPC APEX EXPO 2022

IPC, Matt Kelly

Advanced Packaging Report

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A Global Collaboration

IPC, Patrick Crawford

IPC Design Competition Update

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Selecting the Right Base Material

Koh Young America, Inc., Joel Scutchfield

The Need for Total Inspection

KYZEN, Tom Forsythe

The PCBA Cleaning Trends

LiloTree, Kunal Shah, PhD.

Eco-Friendly Surface Finishes

LPKF Laser & Electronics, Stephan Schmidt

With Laser Focus

**MacDermid Alpha Electronics Solutions,
Joe D'Ambrisi**

The Health of the Electronics Business

**MacDermid Alpha Electronics Solutions,
Scott Lewin**

Low Temperature Soldering

Manncorp, Ed Stone

The Challenges With Lead Times

MIRTEC, Brian D'Amico

Full Spectrum of Inspection

Mycronic, Jesse Dowd

The Testing Demands on PCBA

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What Do We Have in Common?

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Digitized Component Storage

Taiyo America, Don Monn

Fire Up the (Ink) Jets

The Test Connection, Bert Horner

Time to Design for Test

Ventec International Group, Mark Goodwin

The Supply Chain and Markets

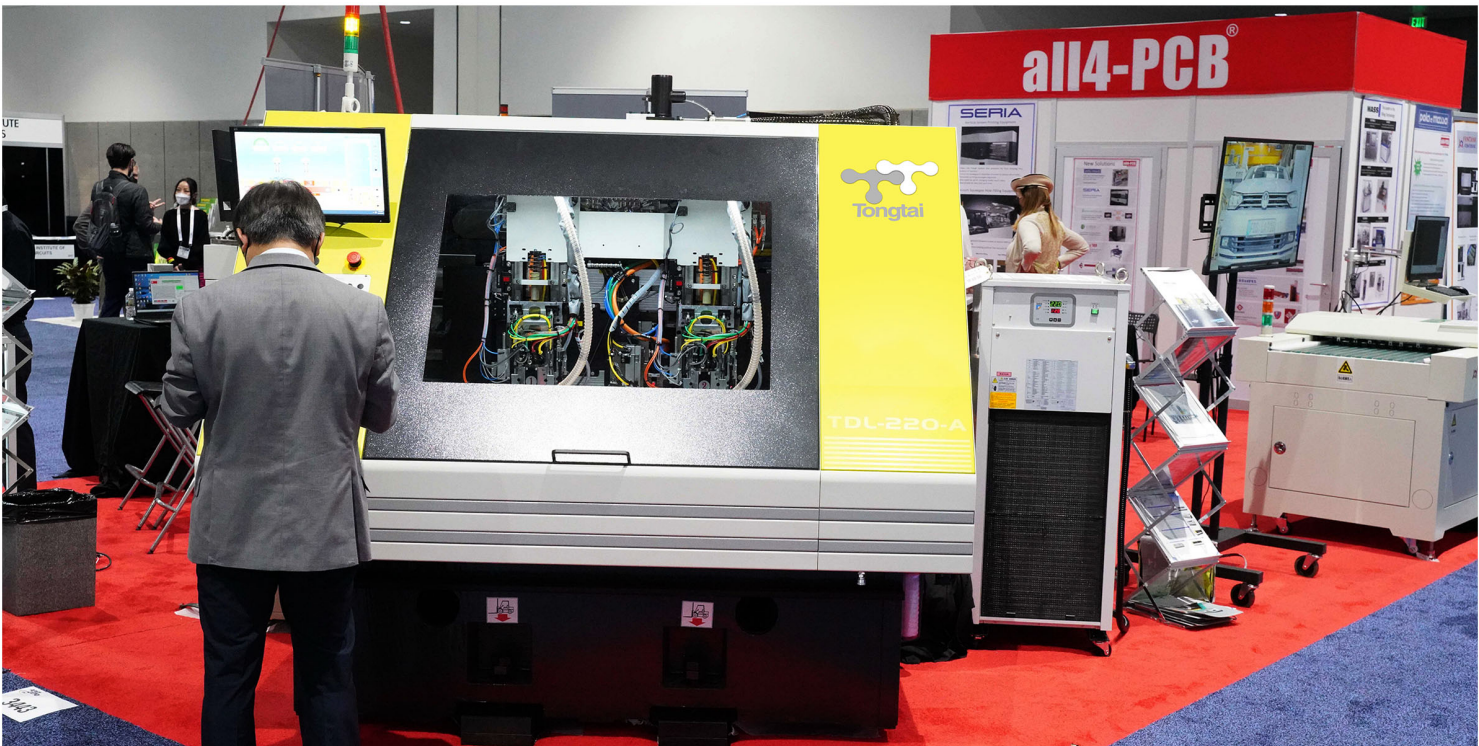
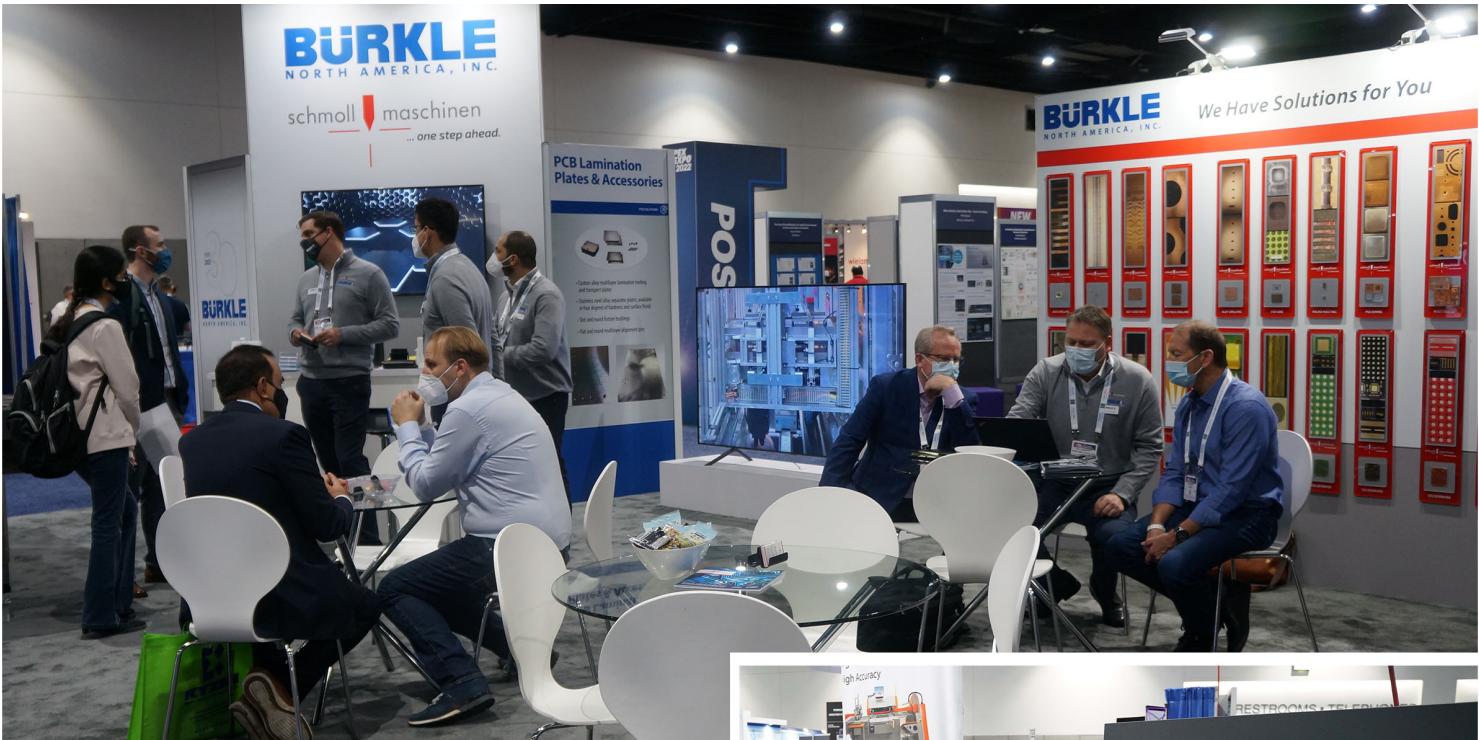
Z-zero, Bill Hargin

New Book on PCB Stackup

Zentech Dallas, Charlie Capers

EMS Management Committee Update With
Charlie Capers





Thank You to the I-Connect007 Team



Andy Shaughnessy



Dick Crowe



Happy Holden



Joe Fjelstad



Michelle Te



Kelly Dack



Tara Dunn

During IPC APEX EXPO, the I-Connect007 team works very hard to bring you dozens of great interviews that will keep you up to date on the latest industry activity. This year, we had Nolan Johnson, Andy Shaughnessy, Pete Starkey, and Happy Holden of I-Connect007 in front of the cameras.

We also extend a very special thank you to our guest interviewers, who conducted a variety of interviews in the I-Connect007 studio on the show floor. The list includes Tara Dunn, Dick Crowe, Joe Fjelstad, Steve Williams, and Kelly Dack. Their contributions are greatly appreciated.

Our show floor production crew included Bryson Matties, Bryan Bernas, and Mike Radogna. I-Connect007 Associate Editor Michelle Te was on hand to greet guests and usher them into our studio for their interviews. And with the remote support of Shelly Stein, each video was published within minutes of being produced. Thanks go out to the entire team!

Once again, we greatly appreciate their combined efforts to help make this the best IPC APEX EXPO coverage in the industry.

To see the interviews, visit our *Real Time with... IPC APEX EXPO* website. **S&T**



Nolan Johnson

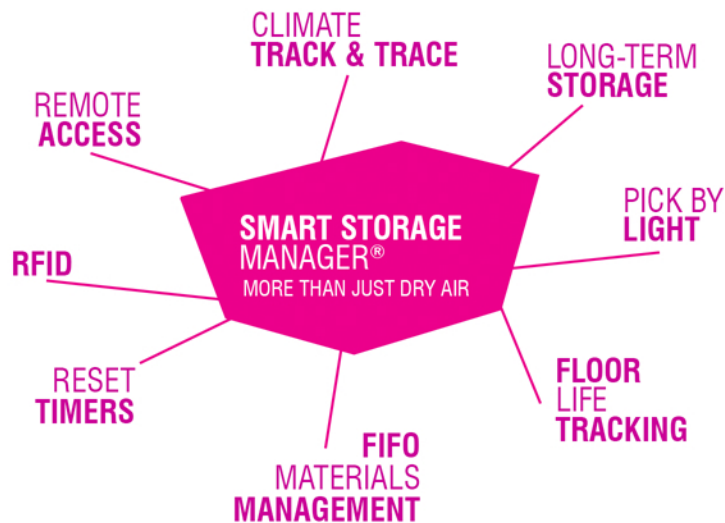


Pete Starkey



Steve Williams

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Joe O'Neil Joins **Illustrious** **Group** of IPC Hall of Famers

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 word being long term).

Joe O'Neil has nearly 30 years of experience in the electronic manufacturing services (EMS) sector. Joe is currently advising clients through his firm, OAA Ventures, which he founded in 2015 following the acquisition of Hunter Technology Corp by Sparton Corporation. OAA Ventures provides consulting and advisory services to electronic manufacturing service providers, printed circuit board fabricators, and technology start-ups. In addition to his consulting engagements, Joe serves as chairman of the IPC Education Foundation, has served on the IPC Board for more than 12 years, and has served as IPC Board chair.

Joe is a very involved IPC volunteer and is either currently serving or has served on the V9-20 PCB/IMS President's Management Council Steering Committee, the G-10 Government Relations Steering Committee, G-11, IPC Department of Defense Task Force, G-11A, Defense Road Map Task Group, and G-12, the Government Relations Grassroots Participants committee. Joe's company was an active participant in the 2019 IPC Cares program as well as IPC's Workforce Champions initiative. Joe was part of a four-member IPC team that presented the initiative to the U.S. White House administration.

Patty Goldman: Joe, where should we start? First, congratulations!

Joe O'Neil: Thank you.

Goldman: You got a call from John Mitchell. What did he have to say to you?

O'Neil: He said, "How familiar are you with the Hall of Fame award?" And I thought, "I am familiar with it." I figured it was a call where we were going to brainstorm for a few names of people who might be on the list of nominees. When he mentioned, "No, we'd like to

make you the recipient," I thought it was kind of funny, because off the top of my head I can name a dozen people who I think are more deserving of the award. But he talked me through the rationale, and I thought, all right, it's an opportunity to take presumptive acceptance of the award and then spend the rest of my career trying to live up to the lofty aspirations.

Goldman: It's certainly one of IPC's highest honors. Tell me about your involvement here at IPC. When did it start? I know once it starts it never ends.

O'Neil: It is an honor to join an illustrious group of which you are included. I'll never forget the first

IPC meeting I attended. I was in my 20s, didn't know much about anything, and went to the management meetings. In those days it was almost all board shops, PCB fabricators. It was like drinking through a firehose during the day of the meetings, learning a lot and taking a lot of notes. I didn't know anybody there and was definitely the youngest guy in the room. We went to dinner, I sat down at a table, and I





didn't know I was sitting down with the whales of the industry: Peter Sarmanian, Larry Velie, Andy Lietz.

Over the course of dinner, I felt like I earned an MBA. Over a lot of wine, I was shocked at the level of candor, the sense of community, the collaboration, and the openness. In my mind, these were all fierce competitors. They were competing with each other every day and were mortal enemies. In reality, there was a sense of comradery, and willingness to help. They all took the time to get to know me and take me under their wing a bit and offer some mentoring. I was hooked at that point and haven't looked back since.

Goldman: You were in a board shop, right?

O'Neil: Yes, Hunter Technology. We had the board fab, we also had what was referred to as "board stuffing" back in the day, and then we'd buy components for customers if they needed us to. We had a couple of designers as well.

Goldman: And the rest is history, so to speak. What is your more recent involvement? I

take it you've always been on a management council and board of directors and that kind of thing?

O'Neil: I think it was close to a dozen years that I served on the board. Now my involvement is largely with the IPC Education Foundation. I'm the black sheep of the family. My parents are both teachers. My sisters are both teachers. I'm the "failure" who went into industry. But it's nice to have a tie into the world of education now, bringing up people, making sure that we've got onramps into the industry,

making sure that we're getting today's youth to understand that there are careers that aren't at Facebook or Google and that both of those companies actually have hardware as well. We are creating onramps from high schools and universities and working through curricula and providing scholarships—a very rewarding offshoot of the IPC and one that's relatively new and growing, although a big part of that is kind of the same as my first meeting, that networking and community establishment. It's hard to do in an environment with a global pandemic, but it's progressing, nonetheless.

Goldman: When you're attending a meeting, I know you meet a lot of new people, maybe not necessarily committee members or other regulars, but certainly new people in management. What's your advice to them?

O'Neil: I've had the honor of sitting through a lot of standards committee work, and I think my message is to say thank you, for the most part, and offer words of encouragement and support. I think back to that first meeting. It was only a few years prior to that, I remember

my dad telling me the words “semiconductor,” “Silicon Valley,” and “start in the mailroom.” I knew none of what any of those three things meant, but my vision of semiconductor was something to do with a choo-choo train and going into some lush green valley. So. I’ve learned a little bit along the way, but I think that the message is that if I can know so little from then to now, others can do it, too. There’s no doubt.

The number of people who helped a lot along the way, who went to hand, who spent an inordinate amount of time openly telling me about lessons learned, best practices, words of encouragement, and advice are too many to list. One that really sticks in my mind is Dieter Bergman. He’s a recipient of this award and I feel I don’t belong in the same conversation.

Goldman: I understand.

O’Neil: But the vast amount of knowledge, the openness, the willingness to sit down and spend as much time as you’ve got talking about whatever, whether fishing or solder joints, that level of commitment and openness is what makes the industry what it is today. I think the work going on in standards is the foundational core of the organization. I think it’s more important today than ever. If you go back to when the industry started, the airplanes, the Class 3 hardware that was produced 50 years ago is still working today in many cases.

Now you’ve got autonomous vehicles, transportation as a service, medical devices, IoT. Everyone’s using the “get to market tomor-

row” type of mentality, the understanding of risk and the differentiation between Class 1, 2, and 3, the importance of having solid standards that address today’s technology, and the education so that industry understands that there are differences, and how to take the necessary precautions and best practices to make sure that we don’t have to relearn difficult lessons by applying commercial practices to mission-critical applications. Even if those mission-critical applications are now commercial air taxis and self-driving cars, and all those things, our lives depend on those.



Goldman: It seems that all the sectors—I believe it was seven different industries or markets—have all blended together. Automotive and consumer and computer, it’s all blending into just a couple of industries. They’re all starting to have the same requirements, too, which are tough.

O’Neil: Yes.

Goldman: Tell me more about the Education Foundation and your role in it.

O’Neil: We got started about three or four years ago. We’ve rolled out student chapters at dozens, probably getting close to 100 colleges and universities. Those are our student-led chapters, and they’re incredible. We did a few face-to-face events, but since then, it’s been mostly virtual, and it’s been good to really get to know some of the student leaders through the scholarship program where they submit video essays, if



you will. The amount of talent out there is tremendous. Sometimes you get a bit worried about tomorrow. I have three kids and sometimes I worry about what the world holds if they're in charge. But then I calm down and get to see that the world is in good hands, that this generation coming up is incredibly intelligent.

They are immersed in technology and understand the interconnection between all aspects of life, and devices and software. In some respects, it's very scary, but in others, it gives you great hope for the future that they're interested in the industry. The amount of understanding they have at all levels of the industry is incredible. I think if we can get those minds that understand artificial intelligence and automation at a level that's inherently part of who they are and have them bring those tools to our industry, there are so many opportunities to rise quickly within the ranks for them to be the leaders of the printed circuit board fabrication world or the electronic manufacturing services realm. I think there are many more opportunities in this industry. There are steeper ladders to climb there than being one of 5,000 artificial intelligence engineers at a big conglomerate.

erate. It seems like it's much more rewarding to deal with a medical project one minute, a networking project the next, and a defense and aerospace project to end your day. There's just so much variety in this industry that it's not that hard to present that picture to them, and they get that.

Goldman: That's good to hear. We always talk about how you kind of get sucked into the industry and it's because it's always changing. You're never bored. There's always the next level, the next level, the next level. It's never the same old thing.

O'Neil: Yeah, you don't look at the clock and go, "When's it going to be 5:00?" You look at the clock and you say, "Oops, I can't believe it's 8:00." Yeah, time flies.

Goldman: This has been great. Do you have any final thoughts?

O'Neil: I am definitely humbled by this and aspire to someday be worthy of the award. But until then, I'll just keep doing my best. It's quite an honor to be counted among the many illustrious names, including yourself, so thank you for this.

Goldman: Well, I also look back at those illustrious names early on like Dieter, Larry Velie, Peter Sarmanian, Bernie Kessler, and others, right? They were truly the giants and have mentored me as well.

O'Neil: Yeah. Lofty heights.

Goldman: Good, Joe. Thank you so much for your time and congratulations again. S&T

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Happy's Thoughts

By Happy Holden

I-CONNECT007

The attendance at this year's IPC APEX EXPO seemed higher than I expected, so thank you all for making the necessary arrangements to attend. However, we sorely missed many of our foreign contributors and friends.

I repeatedly heard this well-worn phrase, "It's good to see everyone again!" I agree. It was good to see so many friends—both renewing former acquaintances and making new friends. I enjoyed several conversations, many of them technical, about the current state of the industry, how we feel about masks and COVID, and what we can expect to see in the coming year.

One of my cherished reunions was with Pete Starkey, who fought through the red tape of government restrictions to make his way from England for the show. Both of us were able to help conduct interviews with many of the industry's business and technical leaders. For that, I am grateful.

I also want to thank I-Connect007 for inviting me to participate with them, and for taking extra safety precautions so that I would be able to return home and not bring back any virus to my wife. Thankfully, I made it through seven days without an incident.

I also want to mention our "data angel" Amanda Gustafson, a contractor from Convention Data Services, who oversaw the registration for IPC. She was fast, efficient, and took loving care of us.



As for the show, what can I say but it was beyond expectations. I thoroughly enjoyed the keynotes from John Mitchell and David Pogue, the latter of whom chose the appropriate topic of "disruptive tech" and how it will affect your business. Be sure to read the reports and interviews regarding Pogue's presentation here in this magazine.

I thought John's talk was inspiring and truly covered the needs and challenges our industry faces. I hope those who listened will take action. However, it had a heavy focus on electronics assembly and was weak on substrate fabrication, where I feel there is a dire need for some support.

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But the real highlight for me this time around was an opportunity to meet some young engineers who are just starting their careers. As many of you know, I have been in this business for the better part of 50 years, and I so enjoy seeing young people who are developing a love for the industry and want to make their own mark—just as I have done.

Two of these young engineers were Paige Fiet and Hannah Nelson. Paige is leaving her position as a student director on the IPC Board of Directors now that she has graduated, while Hannah is still in college and is taking on the role left open by Paige.

We have great confidence in Paige as she gains comfort in her new role at TTM. The IPC STEM program did its job well in helping pre-

pare Paige, and others, for their new careers. I also know Hannah will do exceptionally well. She is eager to listen and learn and has already recognized where her voice can be heard.

On Monday of the show, I attended my committee meeting, V-TSL-MVIA, the Weak Microvia Interface Subcommittee. It was well attended and there were many fresh faces. The main topic was “Round robin microvia D-coupon fabrication and test for North American fabricators,” sponsored by IPC. This testing of stacked and

staggered microvias will be looking for dependent variables of materials, metallization processes, and design parameters. All contributors will be anonymous and known only to IPC in all reporting, but contributors will receive a report of their performance and their code ID used in the report. This is an opportunity for smaller firms to have their process and materials tested without the cost to themselves.

I also attended the technical session, “S02-BF1: Microvia Design and Test 1.” This was also well attended and with social distancing, it was standing room only. The three papers presented were excellent.

My other focus during this event was on the Factory of the Future program. I have authored



another report on this special section, which will include summaries from those companies that were presenting in this part of the show floor.

Hopefully, you have noted that this edition of I-Connect007 *Real Time with... IPC APEX EXPO Show & Tell Magazine* is bigger, better, and more detailed than ever. Not only can you find reports on activities from the show, but we feature well over 60 interviews that you will not find anywhere else. Much thanks to our IT genius, Bryson Matties, for his tireless efforts in getting these videos ready for publication.

We sorely missed two of our lifelong friends and contributors, Gene Weiner and Dan Feinberg, who were not able to attend this year. We hope to see them next year as well as any of you who stayed away for assorted reasons. All the safety considerations really worked, but, hopefully, next year the situation will be back to normal all around the world.

I attend IPC APEX EXPO because the technical papers are always excellent and talking to the authors is insightful. But for me, the best part of the show is meeting old friends, new students, and new engineers who are just start-

ing out. That is a real treat and one that I would hate to miss. And because I live in Michigan, warm San Diego is a pleasant vacation from the cold.

Attending the show reminds me that our industry is remarkably diverse. For electronics assembly, the new IPC standards and IPC-CFX are leading us in the right direction. The work on IPC-2581 Design Data Standard hopefully will do that as well. I would like to see the IPC give more attention to other standards groups, such as SEMI (currently run by a former IPC director) that has the standards for wafer fabrication, photovoltaics, and LCDs. Their SECS/GEM is the preferred standard for PCB and substrate fabrication, and for electronic box build assembly, the General Motors MAPS standard. It is going to take a community to get the job done.

My conversations at IPC APEX EXPO just reinforced that everyone realizes there is a need, but they feel hampered by not knowing how to get started, a problem I am tackling with the help of the ICT and EIPC this summer, where we will have an eight-hour online seminar on this topic. **SET**

IPC APEX EXPO: Conference Speakers Speak Out

IPC-HERMES-9852 Lays the Foundation for Automated Flexible Production

Presenter: Dr. Thomas Marktscheffel, Director of Product Management, ASM (Assembly Systems) GmbH



What is the most interesting question that your IPC APEX EXPO presentation answers? What is needed to support data-driven workflows in an automated flexible production?

What is your answer to that question, and why?

In an SMT line, a lot of data is available, and this data needs to be linked consistently to individual PCBs to make it actionable for data-driven workflows.

What is the most important piece of advice that you have for your audience? Implement IPC-HERMES-9852 on all machines of your SMT lines to ensure consistency of each PCB and its individual data while traveling down an SMT line. This will provide a sound basis for implementation of advanced data-driven workflows in your SMT factory.

David Pogue Keynote Opens IPC APEX EXPO 2022

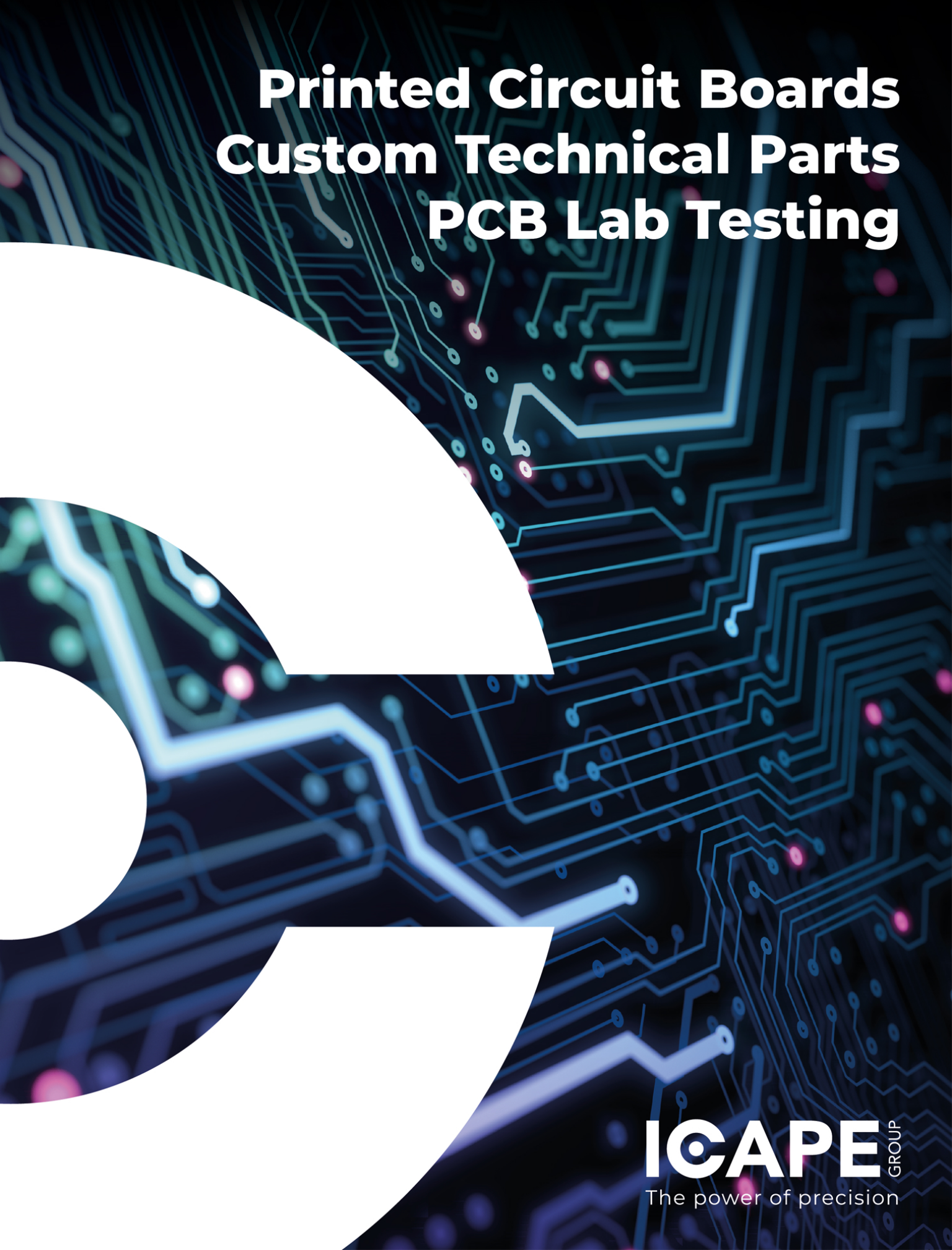


By Pete Starkey

I-CONNECT007

There were just a few empty seats in the huge, main lecture hall of the San Diego Convention Center on January 25 as IPC APEX EXPO welcomed the opening keynote speaker, science

and tech writer David Pogue. Despite the early time of 8:30 a.m., the crowd enjoyed his topic, “Disruptive technology and how it will affect your business: What’s coming by 2026?” Pogue



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took us on a short journey through some of the technological innovations that continue to accelerate the transformation of our lifestyles and gave us a preview of how we might succeed in a world we've never seen before.

Entertaining, informative, thought-provoking, and equal parts inspirational, amusing, and even frightening, Pogue delivered at high speed but in the laid-back style of a professional storyteller a message that captured the attention of an appreciative audience. "Please leave your questions in the chat box and Bob, you're muted," Pogue said, reminding us what a privilege it was to be at a live show with real people, after having for so long communicated through Zoom and its analogues.

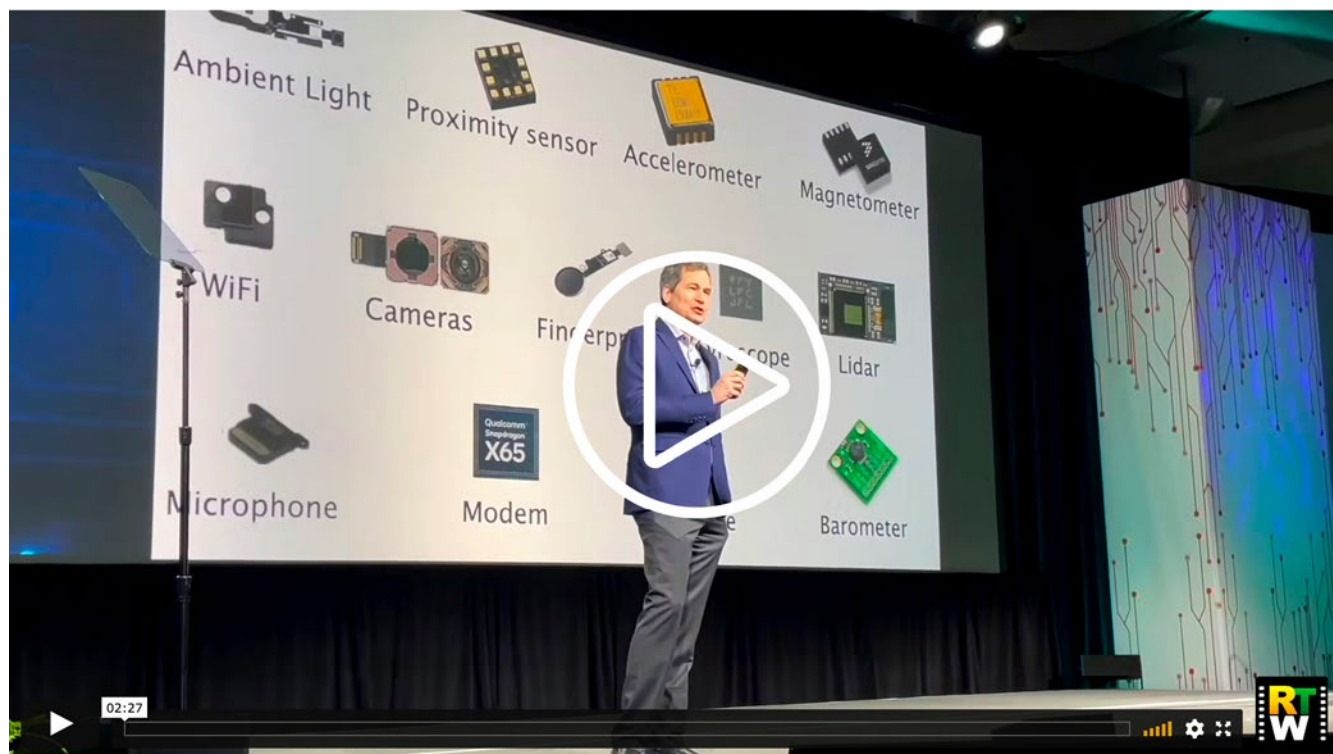
With reference to his own family, he reflected upon the expanding generation gap catalysed by the introduction of the iPhone 15 years ago. Its most significant feature, other than the lack of buttons, was that it actually contained 35 sensors, and the numbers and functionalities of sensors in successive iterations of the device were increasing exponentially.

Pogue was not a great fan of the term "Internet of Things," although he admitted that the

concept of putting sensors inside ordinary devices could result in some meaningful applications. His example was domestic heating, where it had been estimated that 50% of people with programmable thermostat controls never programmed them. With appropriate sensors and a little artificial intelligence, an iPhone could detect when you were on the way home and learn to program the heating so that the house was nice and warm when you got there.

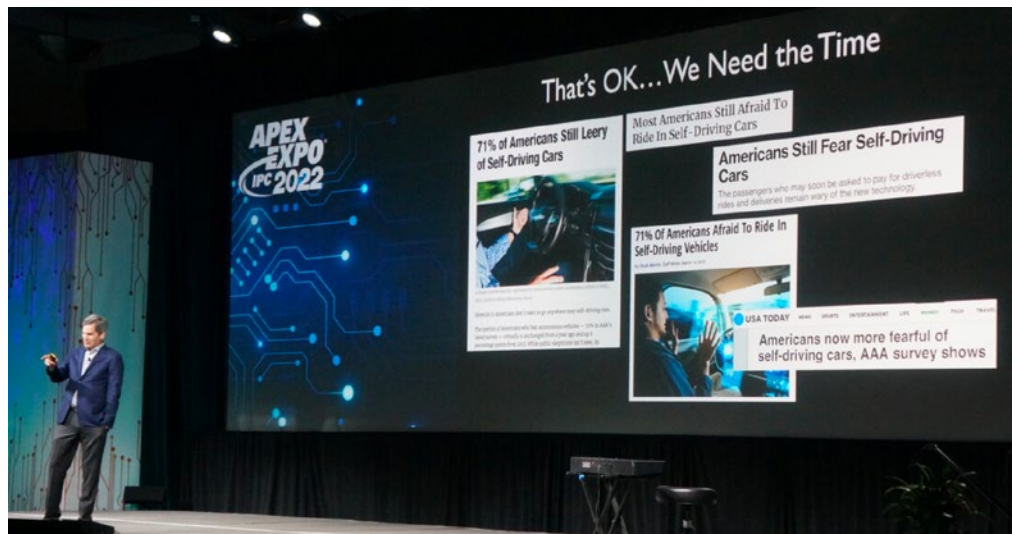
Unfortunately, the Internet of Things opportunity had resulted in the development of hundreds of smartphone apps for domestic devices of dubious utility, although the introduction of the smart speaker had enabled a new generation of useful and practical functions employing voice commands.

The internet of things had now evolved to include the "Internet of Buildings" and was progressing towards the "Internet of Cities," with the interaction between the digital world and the physical world. But at the other end of the scale of physical size, developments in the capability of the smart watch were verging on the incredible. Current models were crammed with so many sensors and measured so many



bodily functions and activities by a non-invasive method known as “wrist actigraphy” that they were not far from literally “knowing what the brain was doing.” Combining all these data streams and applying some artificial intelligence could potentially predict events such as attacks of atrial fibrillation, or even the onset of specific diseases, some time before any symptoms were outwardly apparent. A hundred thousand people had already agreed to allow Fitbit to use their personal measurement data in a study to investigate these possibilities.

Another huge range of opportunities for sensor applications was to be found in robotics technology. Pogue’s video illustrations showed many examples: some quite amusing, some very serious, of the abilities of humanoid and animal-inspired robots to rapidly recover their balance and poise after suffering physical disturbance or assault.



“Self-driving cars: Why do we need them?” was a rhetorical question that gave Pogue an opportunity to list a whole lot of positives. Why own a car anyway? It had been calculated that for 94% of its life the average car stands idle. So why not rent it out for the rest of the time? He discussed Tesla’s development of robotaxis, which would detect your approach and personalise all their settings automatically by proximity to your smartphone. The technology was almost ready, but were people ready to accept the



change? He would return to explore that question later.

Delivery by drone was the next topic in Pogue's catalogue of sensor applications. A concept that many people believed would never be practical had just received approval from the Federal Aviation Administration. Pogue demonstrated the principle of operation of the Amazon delivery drone, an autonomous aircraft capable of vertical and horizontal flight, bristling with sensors to enable safety-critical operation. Apparently, the service was only "months away" from commercial launch, although the actual number of months had not been quoted. And the drone itself was physically huge compared with its effective payload.

So, what new consumer technologies could we look forward to seeing in the next five years; things that were going to change every aspect of business and home life? Pogue listed drones and robotics, artificial intelligence, self-driving cars, employee-less stores, flying taxis, wearable medical sensors, and more. But there would be obstacles, principally our

instinctive distrust of anything new. Historical examples of revolutionary innovations whose initial adoption had been strongly resisted by irrational fears and scary stories included steam trains, air travel, microwaves and, more recently, even COVID vaccination. But he stressed that people didn't fear all science, just new science. People were comfortable with things they had grown up with because their familiarity made them feel natural.

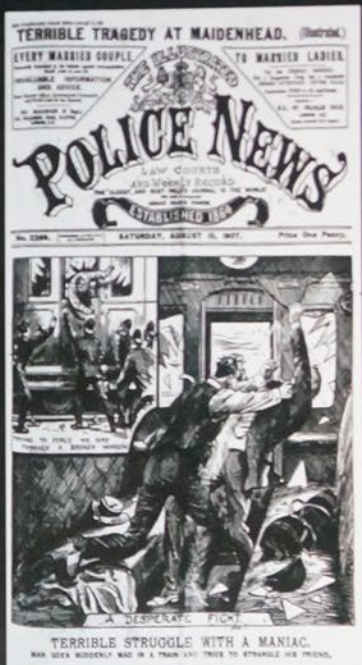
Pogue could not tell us exactly what the new status quo would be, or when it would actually happen, but he promised us a wild ride along the way.

A natural entertainer, he crossed the platform to a conveniently placed keyboard and closed his presentation with a song—to the tune of "I did it my way"—in celebration of the 15th anniversary of the introduction of a new generation of mobile phone with a touchscreen interface that performed functions of a computer, with internet access, and the capability to run downloaded applications: "I took a stand, paid half a grand, and got an iPhone." **S&T**





"Railway Madness"



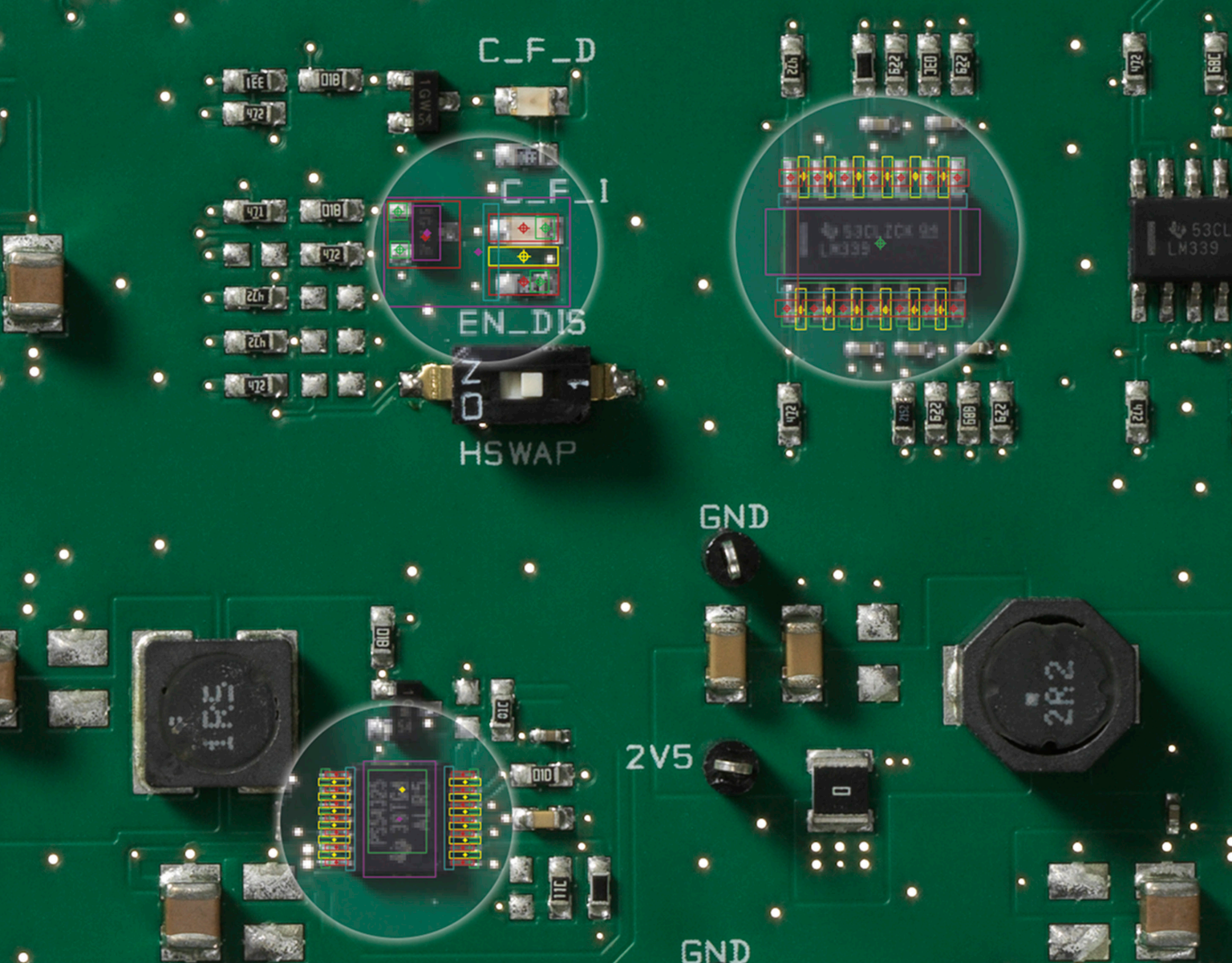
David Pogue:

Is the Fear of Change Holding Us Back?



Interview by the I-Connect007 Editorial Team

David Pogue, an American technology and science writer and TV presenter, sat down with the I-Connect007 Editorial Team after his keynote presentation at IPC APEX EXPO to talk about today's technology, the breakthroughs that have shaped our current landscape, and whether fear of change and innovation is what's keeping us from the next technological revolution.



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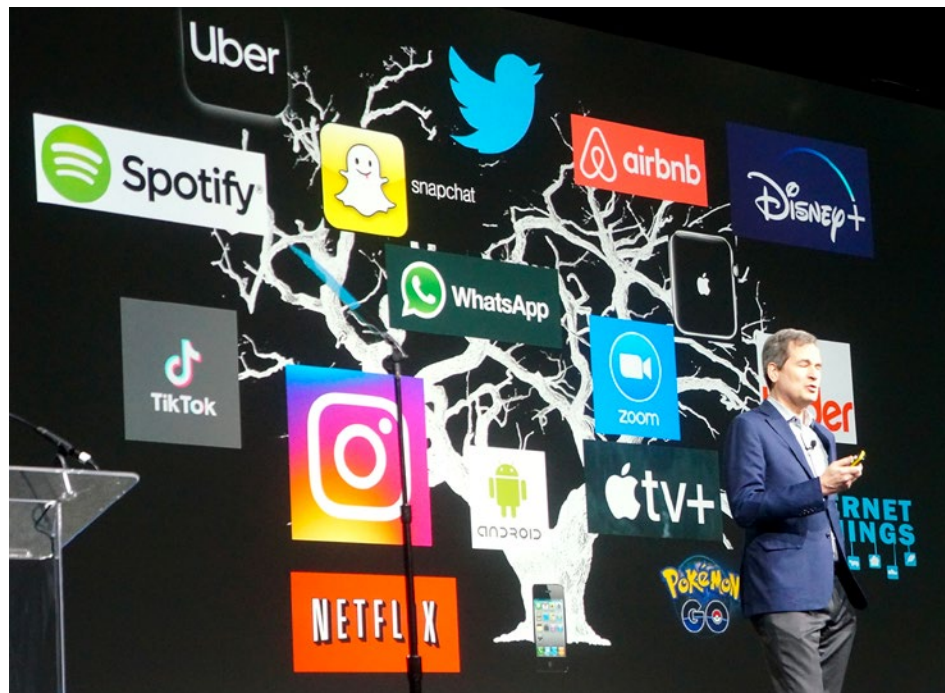
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Nolan Johnson: You started off your presentation talking about sensors and how that changed everything. Not so long ago, we watched the whole MEMS market and application-specific design just basically crater and go away based on sensors and smartphones. Could you talk a bit more about that?

David Pogue: I feel like, from the consumer standpoint, just about everything that people love today, and that they think is cool, is coming from the sensors, starting with the first iPhone where Steve Jobs, behind the scenes, would talk about the 35 sensors he crammed in there, from the accelerometer and compass to the gyroscope. To me, that was the success story of the iPhone. It lets it do all these human things like understanding speech, visuals, text to speech, speech to text, and so on. That led to enormous industries all based on sensors—the Internet of Things; self-driving cars, trucks, ships, and planes; drones and drone delivery; and robotics. It all came from this notion of better, cheaper, smaller sensors.

Johnson: You basically have a control panel in your smartphone that is loaded with sensors.



You can use that innately, or you can connect external sensors through all these smart devices to really expand and open your reach. That is a complete game changer for applications.

Pogue: It really is. Fifteen years ago this month [January], Steve Jobs unveiled the iPhone by saying, “Today, we’re going to unveil three radical products, an internet terminal, a telephone, and a music player.” And then he joked, “Of course, it’s not three different products. It’s all this, the iPhone.” He was almost right; it is indeed an internet terminal. That’s what most people use it for most of the time, not so much to make calls. But the third one is, as you say, as a front end for the rest of the universe, for everything that your readers put together.

Every device now has an app, light bulbs have an app, refrigerators have an app, your watch has an app, and the front end is all this little three-and-a-half-inch screen. It’s kind of amazing because, again, there are no physical keys. Typing on glass still isn’t as good as pressing physical keys, but it’s this massive trade-off that, I’ve got to tell you, in 2007, people didn’t think would pay off. People thought

that it was stupid. We can’t go from a BlackBerry, which has keys, to a device that doesn’t have keys. But it was a trade-off people were willing to make.

Johnson: Some of the financial people in this industry—the bankers, the people watching M&A, the investment people—are commenting that we seem to be entering into a second super cycle. The first super cycle for the electronics industry was commercializing the micro-



processing, and that was just gangbusters for 20 years or so. It seems like we're heading into a second one, and these financial people are claiming it's sensors, internet of things, and making everything smart; that is the super cycle for this industry. Would you agree?

Pogue: I think we tend to extrapolate, to oversimplify, and to overhype in this industry. I've seen it year after year. I've been going to the Consumer Electronics Show since I was born, and they've been promising the internet-connected complete home every single year I've been there, since the '80s. The average person still doesn't have a connected home. There is a tendency to overproject, but I think that the AI advances are making a huge leap in the effectiveness of everything we're doing on these devices.

There are tens of thousands of examples, but I just had 1,200 old family slides scanned by a scanning service, and every single one of them is blurry in its own way. Some, because

the photograph wasn't good; some, because there was motion blur; and some, because the scanner wasn't great. There's an AI app that compares each photo against tens of millions of other photos that it's looked at. It knows, "That's a face, someone's glasses, the Arc de Triomphe, or that's the Eiffel Tower," and sharpens it based on all the photos that have ever come before. It creates sharper pictures out of material that you wouldn't think could be usable. That's just one example of many where AI is tripling the usefulness of all of this. I would call that, if not part of the next super wave, the super wave.

Johnson: Got it. Thank you. I just want you to know that I've been reading your books since the '80s.

Pogue: You have good taste.

Barry Matties: In your keynote, you were talking about the autonomous car, and giving some examples of how the car is going to work and make decisions. It couldn't quite merge into the lane to turn left, unfortunately cut off another driver, and that other driver wasn't very happy. But that driver didn't know it was not the driver decision to cut them off. This brings up a values decision. In a crash situation, when that self-driving car must choose between a tree, a dog, and a person, do you want a programmer making that decision for you?

Pogue: That's the age-old question.

Matties: Right. Because that's what we're handing over, isn't it?

Pogue: I have a Tesla, a Model 3, and I'm a huge fan of the autopilot as it exists today. On the highway, the thing is unequivocally safer than I am. It does not make a mistake. It will not hit a car ahead, no matter how suddenly they stop. On sites we've seen in other situations, when



there's a UPS truck pulling out of a driveway or a huge pothole, those are things not yet in its database. Any Tesla owner will tell you, there are times when you have to grab the wheel and take over, and Tesla says as much, like this is not for you to go to sleep. This is a driver assistance thing, but you must still be alert.

I often wonder, if I hadn't grabbed the wheel and taken over, let's say I grabbed two seconds before impact, would it have taken over one second before impact? I'll never know. That's in a parallel universe. It's really tough that we allow software to make all kinds of decisions for us all day long.

Matties: But these are fatal choices.

Pogue: But these are fatal. Right. These are fatal ones.

Matties: I love dogs...

Pogue: That's right. Yes. The old trolley problem brought to life. I mean, would you want to have to make that decision as a human anyway, though?

the risk/reward that's associated with it. But maybe the risk of handing over your values is what's the greatest roadblock for this to happen.

Pogue: I wonder what Elon Musk would say to that question. I would guess that he would say, that's not how to frame the question. The question is, how do we prevent the car from ever hitting anything alive? And that seems like an easier programming job. Such as, it's always better to hit something inanimate than something animated, something like that. But I have to say, they have tens of millions of cars on the road, driving billions of miles a year. And to my knowledge, they've only ever hit one person.

Matties: By choice?

Pogue: It was that strange situation a couple years ago, at night. It doesn't seem like a huge problem compared with the problem of human beings hitting other human beings.

Matties: Right. I get that. But I think these are some of the hurdles that people are going to

Matties: You're forced to make it. And you're going to base that on your values. But when you step into an autonomous car, you've surrendered all your values to somebody else's values.

Pogue: Right.

Matties: And as your keynote further talked about, change is scary. The unknown is scary. But maybe, obviously, it's incremental to the degree of change and

have to process and deal with. But I agree with your Elon Musk interpretation answer, that the goal is to avoid all collision. And if we can do that, change happens.

Pogue: That's right.

Matties: Personally, I can't wait.

Pogue: I know. Me too. It's interesting how Tesla is rolling out the full self-driving beta software. It's not available to everyone. Their AI software actually looks at how carefully you drive. They're only issuing it as an over-the-air update to their safer drivers, which is wild. They're smartly using AI to see who should be eligible for this not-quite-finished software, and then giving them this AI-based software, based on merit. I think it's kind of ingenious.

Matties: Let's go back to our discussion about sensors, and what has happened with Industry 4.0 smart factories. It's exploded. But the reality is, it creeps in. No one will transform their factory overnight. First, there's not a roadmap for it. Second, finding the skill sets to transform a factory is limited right now. What we say is, we're going to see smart processes before we see smart factories. That's going to come in one at a time. What makes it smart are the sensors. So, you were talking a lot about sensors in our routine lives, but what do you see on the industrial side for sensors?

Pogue: I think you're exactly right. And I think I was just hearing about, is it CFX, the new standard?

Matties: Yes.

Pogue: I was just hearing from the IPC guys that CFX takes off much, much faster in Europe and Asia than in North America, which is sort of weird, because we're supposed to be

the inventors, the light bulb, the computer, etc. This is America. It seems weird that we are the ones dragging our feet. They told me it's fear of change, of investment, and of relearning. In my realm, which is consumer electronics, it's the same thing on a smaller scale. This tells me that if it's both your industry and mine, that fear of change, that it's got to be something human. It's got to be something deep-seated.

This is America. It seems weird that we are the ones dragging our feet.

It must go back to the Neanderthal who learned not to go into a darkened cave because he might get eaten. This is inherent fear of change. And it makes no difference how, even if we can turn on a flashlight and see in the cave, in other words, even if our COVID vaccine has been shown to be safe, some people still won't take it. It has nothing to do with whether it's scientifically unknown, it's just whether these changes are unknown to us personally. I think it's a fascinating realm of study that we're supposed to be the rational animal, and yet when it comes to something that could benefit us, whether it's CFX or smart factory or multi-factories, we're a little scared.

Matties: It's interesting that the iPhone anniversary is this month. The electronics industry is the business you are seeing represented at this show. We're the global leading publication for this industry. Back in 1987, I called home and I said, "I'm at this Mac store, and there's this computer, a Mac Plus. And I'm going to take a loan out for it, no hard drive, 512K with the printer and some software." She's like, "What the hell are you going to do with a computer?"

"I don't know. I'll find a way for it to pay for itself," was my response. Because it was \$5,000 for that package, I literally had to finance it, at that point in my life.

I started my computing skills with a stick figure flight simulator, because I knew nothing about computers. It turned out that the company I was working for went Chapter 11, and it was in this industry, so I started looking around. I thought, "Well, this does more than flight simulators, I can actually lay out magazine pages." And so we pioneered desktop publishing. Now, I never set out to be a publisher, a computer expert, or a business owner. But the thing that happened with that technology was it empowered me to do these things. Today, I see 3D printers as an equivalent to that empowerment that I found 36-plus years ago. How do you see the 3D printers changing the landscape?

Pogue: Well, you'll be disappointed because I don't think 3D printers are an everyday household object for most people. This has been predicted over and over, and my son owns one. But the examples people give, such as, "If you need a new part for a door handle, you can just run up and print one." I just don't think the expense and the learning curve is worth it for the average family. But there are, of course, niches, demographics, and people whose lives will be changed. I guess you could say the same for desktop publishing. It did change everything, but you don't have one like you have a refrigerator.

Matties: It's a tool that empowers people and sparks innovation. Because you're right, I agree that you're not going to see a widespread application; not everybody became a desktop publisher. But I'm watching some of these kids that are creating products, ones that never existed before. This entrepreneurship that this tool empowers them is creating something. There's something going on there.

Pogue: Yeah. One great thing that's happened in the 3D printing world is moving beyond the terrarium-sized plastic printer. They are now 3D printing houses, and materials other than plastic. There are 3D printers that work with multiple materials simultaneously. They can layer metal with plastic, for example. So, I think that's where the mind really blows. That's where the sky becomes a limit.

Matties: Well, it's an exciting time to be alive and to be watching technology. What has surprised you the most in your coverage of electronics?

I think my favorite thing that happens is when a surprise by some visionary, that everybody says is wrong, turns out to be right and changes the world.

Pogue: I think my favorite thing that happens is when a surprise by some visionary, that everybody says is wrong, turns out to be right and changes the world. That's happened a few times. I was among the people who said Apple was insane to put out a phone without keys and without a battery that you can change out. That was not the design of phones in 2007, and I thought it was very foolish. I was wrong and, of course, it changed everything. Elon Musk is another guy who's done it several times. There has not been a successful new American car company since 1920, since Chevrolet.

This guy comes along and says that not only is he going to do it, but he's going to build his cars in America and they're going to be all elec-

tric. And everyone's commenting that there aren't charging stations and no range; it's not going to work. Yet, he made it work. He said he would start a commercial, not government, rocket company. The common wisdom was he couldn't do it, the finances wouldn't work, and his rocket would blow up and kill everyone. He pulled it off.

Matties: He sure did.

Pogue: These guys are tyrants and megalomaniacs. But when they have a vision and they keep pushing after it, when the entire world says they're wrong and they succeed, I mean, my jaw falls on the floor. That's what I love more than anything, is when one of these megalomaniacs with an idea wins despite all doubters.

Matties: We talked about the greatest surprise. What's been the greatest disappointment for you?

Pogue: My greatest disappointment is people's resistance to change even when it benefits them. There are many examples: 5G, climate change solutions, regular vaccines, COVID vaccines, self-driving cars. There's a lot of resistance to change even when, as with the COVID vaccine, it's been scientifically demonstrated not to be harmful, and in fact, helpful both personally and to society. So, there's a larger, anti-science sort of backlash unique to the United States. I don't understand what it is about being American that makes us suspicious of new science.

Matties: Is it suspicious or is it confused? There are so many "experts" that are squawking at us these days. How do you know what to believe?

Pogue: Well, that's true. The solution is clearing the confusion through education, repetition, explanation, and patience. I re-published

a book last year called *How to Prepare for Climate Change*. One of the chapters is about how to talk to a climate change denier. Expert after expert, these are people who've done white papers and research papers. They say that you cannot change somebody's mind with facts of an opinion that wasn't formed by fact in the first place. So, if somebody has an emotional reaction to something, you cannot change their mind with facts, you must meet them with more emotion. You say, my kid can't sleep at night, because he's worried the world is ending. You say my uncle in Nebraska's entire crop was wiped out by flooding, I'm so distressed. That's the only way to begin that conversation.

**People don't care what
you know until they
know that you care.**

People don't care what you know until they know that you care. It's another way of putting it. And it's true in every one of these cases, with vaccines, climate change, or AI software that people are afraid of. It requires empathy, compassion, and patience, not bombardment with studies.

Matties: David, I certainly appreciate your time today. I enjoyed your keynote immensely. And I look forward to going out and buying some of your books and learning more about your messaging and the stories you're sharing. It's really wonderful.

Pogue: Well, thank you so much. And I admire what you do too.

Matties: Thank you. **SET**

Best Technical Papers at IPC APEX EXPO 2022 Selected

The best technical conference papers of IPC APEX EXPO 2022 have been selected. Voted on by members of the IPC APEX EXPO 2022 Technical Program Committee (TPC), the paper authors were recognized during show opening remarks on Tuesday, January 25.

“The TPC is absolutely focused on providing highest quality content to the technical conference,” said Matt Kelly, IPC chief technologist. “This commitment to quality is reflected in this year’s selection of Best of Conference, NextGen, and Best Student Research papers. We extend our congratulations to all the award winners.”

Taking top honors in the Best of Conference category, the winning papers are:

- “Analysis of a Dynamic Flexed Flat Cable Harness” by Bhanu Sood, Ph.D., NASA Goddard Space Flight Center. His co-authors are Mary E. Wusk, Eric Burke, Dave Dawicke, George Slenski, NASA Langley Research Center; and Stephen Lebair, NASA Goddard Space Flight Center.



Bhanu Sood

- “Microvia Reliability Testing Utilizing D-Coupons to Understand Best Design Practice” by Kevin Kusiak, Lockheed Martin.
- “A Critical Analysis of CAF Testing—Temperature, Humidity, and the Reality of Field Performance” by Kevin Knadle, TTM Technologies, Inc.

The NextGen best paper is awarded to:

- “Bio-based Encapsulation Resins: Good for the Environment, Good for Your Environment” by Beth Turner, Electrolube.

Selected for the Student Research award, the best paper is:

- “Reliability and IMC Layer Evolution of Homogenous Lead-Free Solder Joints During Thermal Cycling” by Mohamed El Amine Belhadi, Ph.D. Candidate, Auburn University. His co-authors are Xin Wei, Palash Vyas, Rong Zhao, Sa’d Hamasha, Haneen Ali, Jeff Suhling, Pradeep Lall, Barton C. Prorok, all with Auburn University.



Kevin Kusiak

In addition to the “best of” categories, eight papers were selected in the honorable mention category. Honorable mentions go to:

- “Towards Artificial Intelligence in SMT Inspection Processes” by Mario Peutler, Continental Automotive GmbH; co-authors Michael Boesl, Johannes Brunner and Thomas Kleinert, Ph.D., Continental Automotive GmbH.
- “A Multiphase Model of Intermittent Contact in Lubricated Electrical Contacts” by Robert Jackson, Auburn University; co-author Santosh Angadi, Nitte Meenakshi Institute of Technology.
- “Electro-thermal-mechanical Modeling of One-Dimensional Conductors, Whiskers, and Wires Including Convection, and Considering Tin, Bismuth, Zinc and Indium” by Robert Jackson, Auburn University; co-author Erika R. Crandall, TE Connectivity.
- “Design and Testing of Three Levels of Microvias for High-Reliability PCBs” by Maarten Cauwe, Ph.D., imec-CMST; co-authors Jason Furlong, PWB Interconnect Solutions; Stan Heltzel, ESA-ESTEC; Marnix Van De Slyeke, ACB; Bob Neves, Microtek Changzhou Laboratories; Kevin Knadle, TTM Technologies.
- “Recrystallisation and the Resulting Crystal Structures in Plated Microvias” by Roger Massey, Atotech GmbH; co-authors T. Bernhard, K. Klaeden, S. Zarwell, S. Kempa, E. Steinhäuser, S. Dieter, F. Brüning, all with Atotech GmbH.
- “Defluxing of Copper Pillar Bumped Flip Chips” by Ravi Parthasarathy, ZESTRON Corporation; co-author Umut Tosun, ZESTRON Corporation.
- “Reliability SoH Degradation and Life Prediction of Thin Flexible Batteries Under Flex-to-Install Dynamic Folding, Dynamic Twisting and Battery Lamination” by Pradeep Lall, Ph.D., Auburn University; co-authors Ved Soni, Jinesh Narangaparambil, Hyesoo Jang, Auburn University; Scott Miller, NextFlex Manufacturing Institute.
- “Electromechanical Testing of Flexible Hybrid Electronics” by Mark Poliks, Ph.D., Binghamton University; co-authors Mohamed Alhendi, Behnam Garakani, Udara S. Somarathna, Gurvinder Singh Khinda, all with State University of New York at Binghamton.

All technical conference 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. **\$6T**



Kevin Knadle



Beth Turner

A Conversation with Two Student Leaders



Paige Fiet and Hannah Nelson

Interview by Barry Matties

I-CONNECT007

While at IPC APEX EXPO, Barry Matties visited with Paige Fiet and Hannah Nelson, student liaisons to the IPC Board of Directors. Paige recently graduated from Michigan Technological University and is leaving her position on the board. Hannah is a junior at Valparaiso University and will be taking Paige's spot on the board. Both of these young engineers expressed their concerns about the disconnect between their education and the real-world setting but feel encouraged about the opportunities ahead of them.

Barry Matties: Paige, you are the outgoing student liaison board member for the IPC?

Paige Fiet: Yes, that's correct.

Matties: And Hannah, you are the incoming?

Hannah Nelson: Yes.

Matties: Congratulations to both of you.

Fiet: Thank you.

Nelson: Thank you.

Matties: Paige, would you tell us your experience of being on the board for the last two years?

Fiet: I joined the board right after IPC APEX EXPO in 2020, and we all know what happened to the world soon after. Our board meetings then turned to Zoom, and I had never met the board in person until this past October. That was a little difficult, but I attended all the board meetings. I met with them for sometimes hours at a time to discuss the industry, how students feel about the industry, and ways to engage students more.

Matties: What is your responsibility as the liaison? You're going to these meetings, so what do you do with that information?

Fiet: I act as a go-between for the student chapters from the IPC Education Foundation to the Board of Directors, just to say, "This is what we want, this is what we need. Can you help us get there?"

Matties: Do you feel you've effected change?



Fiet: I think the biggest change I've helped with is asking for more money for the Education Foundation so we can expand that. We're up to 50 scholarships a year. They're valued at \$1,000 each for student chapter members.

Matties: Hannah, what is your expectation as you come into this?

Nelson: I'm really hoping that what I'm doing now will help future individuals in the electronics industry, building those industry connections between college students and future employers. We have such a disconnect right now between schooling and the electronics industry, where many individuals are not getting the education needed to first start out on their training in the electronics industry. These companies must go through extensive training for months. Why can't we just have people in college have these standards already exhibited to them? I want to help get those connections started.

Matties: That's probably going to be a strong mission for you in this one-year term?

Nelson: Honestly, one of the main goals I'm planning on pursuing is the industry connections.

Matties: You're currently a junior in college, and you're doing an internship or recently had done an internship at Caterpillar? Tell me about that experience.

Nelson: I interned with Caterpillar Inc., last summer and will do the same this summer as well. I am also in the parallel co-op program where I worked 10 hours a week while going to school; it was honestly amazing, such a great experience. I met so many incredible people, conducted so many informational interviews to learn about the diverse paths we can take in electronics, and then I was given my own project where I worked on an electrical connector publication that is now published on the Caterpillar website. It was incredible to have an experience like that as a junior. I never thought that was possible, and now I'm doing quality analysis during the school year, finding the cause and effect of different problems, and then this next summer I'll be working on field testing on construction equipment.

Matties: Do you think the education you got at this school was a foundation, or was it just misaligned to what the real-world needs are?

Nelson: I honestly feel like it missed the mark because a lot of my classes did not really line up to what my job was, and I understand I was an intern and doing entry level work, but I watched my managers work and it was nothing like I've ever seen before.

Matties: How did that leave you feeling about your path in the school system?

Nelson: It was discouraging, thinking about the education we have going on right now in our engineering classes. It made me like engineering a lot more, but it also disheartened me because they're almost using education as a weed-out system, discouraging people away from engineering because these classes are

just so difficult; they're so rigorous and people don't really want to take classes that they're stressed out in. I believe we need to figure out what the disconnect is and how to overcome that.

Matties: Right. Paige, you've graduated, I believe?

Fiet: Yes, I graduated in December from Michigan Tech.

Matties: Great, and what are you doing currently?

Fiet: I just started a job at TTM Technologies in Logan, Utah. I am a process engineer in the solder mask department.

Matties: As a process engineer, what's your function there?

Fiet: My job is to do some R&D in my department. It's to keep our yields up above our 99.25% limit.

Matties: That's a tall order, right?

Fiet: Yes. I engage with the operators daily. I'm always on the floor. I couldn't love it more.

Matties: That's great. Why did you choose circuit board manufacturing?

Fiet: I just think circuit boards are so unique. Each one is different and has different processes to make them. It's just crazy to me how we can streamline that process, and I really enjoy the variety each day and how much I interact with people. You're always busy. You're always up and moving. I've really enjoyed it.

Matties: You were coming in at an interesting time. We just listened to John Mitchell's keynote about the factory of the future, and you

are the future. I'm curious what your takeaway was from the keynote.

Fiet: Technology is improving, you can see that. In my department, we got rid of film. We're into LDI machines. I think we're going to continue to see more of that, but now they're doing inkjet of solder mask. That's crazy to me.

Matties: Right. I think inkjet is something that we're going to see evolve and really get much more traction in the industry. It makes a lot of sense.

Fiet: Yes, I agree.

Matties: You know, when we look at process

Voices of the Show:

Allison Budvarson, Out of the Box Manufacturing

Interview by Nolan Johnson

Nolan Johnson visits with Allison Budvarson about her reasons for visiting IPC APEX EXPO this year.

Nolan Johnson: Allison, right now we're taking during a break at the EMS summit. Are you glad to be back at APEX EXPO?

Allison Budvarson: Absolutely. This is my second APEX EXPO. I attended several years ago for the first time, and I'm really excited to be back because there's been such a long break in between.

Johnson: What are you looking to take home with you back to Out of the Box after this week?

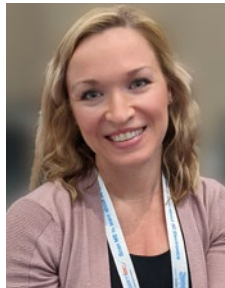
Budvarson: I'm really excited to be attending the leadership summit today. It's nice to be able to connect with other owners and industry leaders to talk about solutions and changes to our industry, but I'm also really excited to check out the trade show floor, see equipment, and get to know what is new and exciting.

Johnson: Do you have a shopping list?

Budvarson: Yes, I do.

Johnson: Out of curiosity, then, what are you looking for?

Budvarson: You know, really the gamut from pick-and-place to inspection equipment, software, etc., kind of all over the board.



Johnson: How many employees do you have?

Budvarson: We have just over 60 employees.

Johnson: 60 employees? So, you fit more of a boutique profile?

Budvarson: Absolutely.

Johnson: Okay. Is it fair to say that Industry 4.0 and Factory of the Future are high on your priority list?

Budvarson: Absolutely.

Johnson: How do you see that adding to your business?

Budvarson: Well, I think that electronics manufacturing by nature is a low margin business. So, the more we can continually improve our processes and our products and be able to further automate and increase quality, all of us in this industry are able to increase our profit margins. That allows us to grow, we'll hire more people, and so forth.

Johnson: Right, make the whole business spiral upward?

Budvarson: The flywheel effect.

Johnson: Awesome. Thank you.

Budvarson: You're welcome. Thank you for coming by to talk to me.

engineering from our publication's point of view, we're constantly talking about how to reduce waste, increase efficiency, increase yields, lower costs, increase employee happiness, reduce their frustration, and eliminate stress, because these are the things that make a great company, I think.

Hannah, what do you think makes a great company?

Nelson: I think it's the people who make a company great. John Mitchell says all the time that you need to surround yourself with good people to get far in life. You don't want to be surrounded by people who stress you out or

bring your mood down. Otherwise, you will feel you're just stuck in the same place and you might feel like you are unable to grow. You want to have valuable work, feeling like you have a passion for your work. You want to get up every day and have a purpose in your work.

Matties: That's a great answer. How did you become the student liaison board member? What's that process?

Nelson: Well, I got voted in. I initially went through an interview with Charlene Gunter du Plessis, president of the IPC Education Foundation, then went through the entire process

IPC APEX EXPO: Conference Speakers Speak Out

Surface Treatment for Soldering Aluminum PCBs to Conventional Copper PCBs

Presenter: Divyakant Kadiwala,
VP of Manufacturing, Averatek

Co-Author: Nazarali Merchant, Ph.D.,
Senior Materials Scientist, Averatek

Can aluminum be soldered at low temperatures without ENIG or ENEPIG finish and is the solder joint reliable? The answer to that question is: Yes.

Our presentation shows that the surface treatment that we have developed makes soldering to aluminum as easy as it is to copper, without ENIG or ENEPIG finish. It enables the production of aluminum PC boards (Al-PCBs) and integrating them with traditional copper PCBs to make complete systems. The surface treatment has passed both SIR test

(surface insulation resistance) and air to air thermal cycling (AATC) from -40°C to 105°C for 1,000 cycles, without a single failure of any resistors assembled in a daisy chain test pattern. Besides this, Al-PCBs can be built using aluminum on PET (Al-PET) substrates as replacement for copper on polyimide (Cu-PI) substrates. This makes a lot of economic sense as Al-PET is over 40 times less expensive than Cu-PI.

Advanced surface treatment exists that simplifies the manufacturing of Al-PCBs. It also helps with integrating them with Cu-PCBs, wiring and connectors for building complete electronic systems. The overall process is simpler, cost effective, and the resultant product is reliable. Do not be afraid of embracing change and new technologies. Fortune favors the brave.

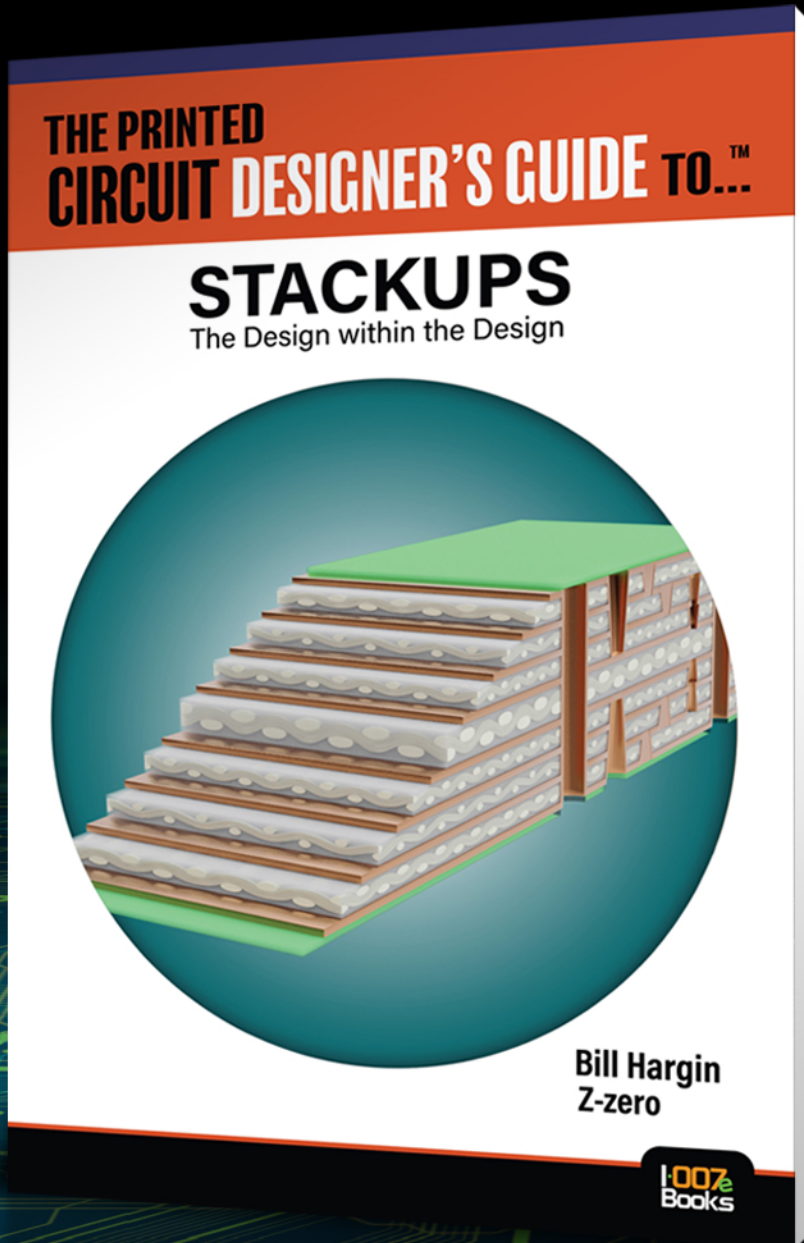


Divyakant Kadiwala

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and was asked to be a nominee for this position. I then uploaded a video onto the Education Foundation page and was voted in.

Matties: Fantastic. Congratulations.

Nelson: Thank you.

Matties: This is your first IPC APEX EXPO?

Nelson: Yes.

Matties: I'm curious what your impression, your initial reaction, and your takeaways are from this show?

Nelson: I think it's such an incredible honor. It is a lot different than I thought it was going to be. It is amazing how you can network with such a diverse range of individuals, talking to all these prestigious individuals, and realizing that they're people too.

Matties: Paige, you're part of the Emerging Engineer Program from the IPC. I think you're a couple of years into that.

Fiet: This is my second year in the Emerging Engineer Program. Mike Carano is my mentor.

Matties: Tell me about the program and how that's impacted and helped you.

Fiet: I joined the Emerging Engineer Program in 2021. Unfortunately, APEX EXPO was virtual that year, but I still attended. We have a passport that we fill out while at APEX EXPO. It has a list of activities and meetings as well as ways to grow both professionally and technically. Our mentors help advise that. They help us meet people. I've really enjoyed the program so far.

Matties: And Hannah, I think you're in a similar three-year program? Tell me a little bit about that.

Nelson: My mentor is Jason Keeping. I also have to go through the same passport where we get technical and professional advice.

Matties: Is it very helpful?

Nelson: It is. I definitely believe I've changed as an individual being here so far.

Matties: Fantastic. Those are big words.

Nelson: Yes. My confidence has gone up exponentially.

Matties: Good for you. What advice would you give a young student today?

Nelson: Don't be afraid to put yourself out there. Make as many connections as you can, and work hard to get to where you want to be. My advice for what I was doing at school is to take every opportunity you can. If you're given a position, go after it and if you fail, failure is so good for growth.

Matties: It's where we build success.

Nelson: Yes.

Matties: All right. Paige, what sort of advice would you give?

Fiet: I think Hannah said it perfectly. Networking is so important, not just to network in your industry, but outside and meet people who do different jobs and especially find people who do the type of job you want so they can help you grow.

Matties: Well, I certainly appreciate you both being in this industry. It's fantastic. Welcome to APEX EXPO and welcome back. We've been at APEX EXPO ever since it started. We've been working in this industry for nearly 40 years, so it was sad to miss during that two-

year gap, or last year's show, but it's so wonderful to see so much equipment on the show floor. I was surprised, actually, that there was so much equipment.

Fiet: Yeah.

Matties: When you walked the show floor, was there any one thing that really stood out to you?

Nelson: Honestly, it was how many companies there are and big-name companies too. It's kind

of crazy out here, but it's such a good networking opportunity and a great opportunity as I'm so new to the industry that I didn't even know what PCB manufacturing was and I'm learning about it as I go.

Matties: Wow. Well again, congratulations and thank you so much.

Fiet: Thank you.

Nelson: Thank you. [s&t](#)

Voices of the Show: Yan Manissadjian, Mycronic

Interview by Nolan Johnson

Nolan Johnson visits with Yan Manissadjian, product marketing manager with Mycronic, about the company's reasons for setting up a booth at APEX EXPO.

Nolan Johnson: Yan, how does it feel to be back at the show?

Yan Manissadjian: It's very interesting and exciting. This is a second big show we've done in three months, the first one being productronica in Europe. What we see is that the customers who did come are very happy to meet with us again. We are very happy to meet with them again, to exchange ideas, and to exchange points of view and challenges. This is really motivating because of all the work that we've done in-house during this pandemic. Because we had a pandemic, we had some big issues like everyone, but R&D didn't stop, product development didn't stop. We really wanted to keep that going on, and we were very proud, excited, and a little bit anxious about showing that. Finally, we had in Munich, and we are doing here again in San Diego, our new product, an AOI, new tower, new things. The response is very positive, so we are very, very happy.



The second point is about the quality of the attendance. It's slower than it used to be. We all know that. But the people who came are here for a reason. Those who bother coming in spite of all of COVID restrictions and all that, had a purpose, they had a project. Business-wise, it's positive. We're really positively surprised.

Johnson: What are your objectives for the show?

Manissadjian: From the product marketing perspective, I think it's making sure that what we have proposed and what we are showing and launching, the new products, are well positioned. It was important for us to be reassured. I mean, we did our job, we did our homework, we did all our study before, of course. But you know, there is always this little anxiety, when I'm launching something, making sure that people will follow you and will buy the idea.

Johnson: Some verification that your assumptions and decisions were the right ones?

Manissadjian: Exactly. This is one point that's very important for us to validate. The second one is filling up the orders. I mean, the books for the coming months. So, that's for the sales team here in the U.S.

Johnson: Yan, thank you.

Manissadjian: You're welcome.

Bob Neves: IPC Continues Its Global Reach

Interview by Nolan Johnson

I-CONNECT007

During IPC APEX EXPO, Nolan Johnson visited with Bob Neves of Microtek Laboratories China and the new chair of the IPC Board of Directors. Nolan asks Bob about IPC's views on the disruption in supply chain, about restoring PCB fabrication in the United States, and how the IPC is looking to resolve supply chain issues from a global perspective.

Nolan Johnson: Looking through the rest of 2022 from your seat on the board, at the end of the year, what will be the big story or stories for our industry? Where are we going to be?

Bob Neves: That's a good question. As the pandemic ends and things start going back to normal, we are unsure of what the industry will look like. Our members have spent a lot of time fighting fires trying to solve supply chain issues and I am unsure how quickly they're going to go away. I believe one thing we have definitely learned is that hiring qualified people is a challenge now and that's not necessarily going to go away quickly. IPC is addressing the need for industry education. The IPC board has really stressed the need to create an educational model that will make it easier for our members to hire skilled people who have knowledge that our members need, so that they're not starting from zero going into the workforce.



Bob Neves

Workforce education and skills challenges are something we're really trying to solve. There are obviously additional regional issues that our government relations (GR) committees are trying to address given the supply chain has changed dramatically for a variety of economic and political reasons. There is a big push to move the supply chain more locally. As that develops and needs change, our goal is to help our members adapt to the changes that are going to happen post-pandemic. Other than the very clear educational needs, I don't know if the industry has a clear understanding of what the supply chain will look like as we move forward. We're watching that carefully, and we continue to fund the initiatives that we believe benefit our membership. The issues created by the recent pandemic have given the organization some time to react and push these things forward and to focus on them.

On the Standards front, the recent implementation of our IPCWorks digital platform is helping us better manage document development and has allowed us to improve the process of creating standards. We're working hard

on the IPC bookstore, our web presence, and just getting the word out about our mission and who we are as an organization.

Johnson: IPC has been involved in advocacy and lobbying, if you will, for the industry, to the U.S. government, zeroing in on the legislation and the discussion there about how to help bring technology back into the U.S. supply chain to create some resilience and local independence. And that's certainly happening. How do you think that message is getting across at this point?

Neves: Well, let me re-characterize what you said. I think IPC as an organization is looking to help the industry worldwide resolve the issues that it faces. In the U.S., one of the issues our members face is dealing with the supply chain, and I think we have put together a strong effort to help our members with that issue, but that's not the only issue or the only effort that we're putting for-



ward. We're doing similar things in Europe and Asia with our regional GR committees. We are looking closely at regional issues, trying to help our members deal with the challenges they are facing, whether it's government relations, supply chain, or anything else. This is not just a one-off response. As our mission clearly states, we are a global trade organization that acts regionally to

IPC APEX EXPO: Conference Speakers Speak Out

Microvia Reliability Testing Utilizing D-Coupons to Understand Best Design Practice

Presenter: Kevin M. Kusiak, Associate Fellow, Lockheed Martin

What is the most interesting question that your IPC APEX EXPO presentation answers? How does my design influence reliability of my microvias?

What is your answer to that question, and why?

There are many factors that influence the reliability of the end-product. Two main factors include the processing of the bare boards and the design. There are many steps when it comes to microvia formation and each fabricator may have a slightly different approach and different processing equipment, such as horizontal microetch, vertical microetch, different electroless chemistries, different laser formation processes, etc. Much of this is out of

the designer's control, but the designer should conduct due diligence to ensure their fabricators have a robust process for microvia formation. The processing is so complex that I think the most important thing that a designer can do is follow good design practices that give the fabricator a larger process window.

What is the most important piece of advice that you have for your audience? Know the end use of your design and take risks accordingly. Don't push the design limits if loss of life is a risk due to the failure of your product. Even in non-life-threatening applications the reputation of your company may be at stake if you put out a product with reliability issues. This needs to be weighed against the benefits of pushing certain design limits.

help our further the competitive excellence and financial success of our members.

Johnson: Correct.

Neves: We're looking at government relations, environmental issues, all the issues that are affecting our members worldwide and putting efforts where we feel they need to be in order to assist our members worldwide.

Johnson: From that perspective then, are the needs and the trends in the different geographic areas similar or vastly different? Can you compare and contrast?

Neves: Supply chain issues are global right now. We have concentrations of members in high volume regions that have fewer issues than lower volume regions. These lower volume regions have lost local supply chains and face issues that differ from regions that have mega volumes like some parts of Asia do. Regarding government relations, each region is markedly different. North America tends to

act consistently. Europe tends to act reasonably consistent within the EU. Asia is a group of individual countries with different cultures, governments, and company structures. Rather than a regional approach in Asia, we're looking at taking more of a country-by-country approach. The needs of our members in each of these countries are different due to differing government regulations, culture, and company structure.

The GR need of our U.S. members is focused on Washington D.C., and we have a single point of focus there for our U.S. members. We're addressing differing regional issues based on the needs our membership has in the country or the region that they are located in. We have committees and working groups working on identifying and addressing issues in all the different countries and regions around the world where our members exist.

Johnson: Great. Thank you for sitting down and talking with me.

Neves: No problem. S&T

IPC APEX EXPO: Conference Speakers Speak Out

Sn-Cu Intermetallic Growth Study with XRF-CS Method

Presenter: Jose Servin, Ph.D.,
Automotive Technologist, Vitesco

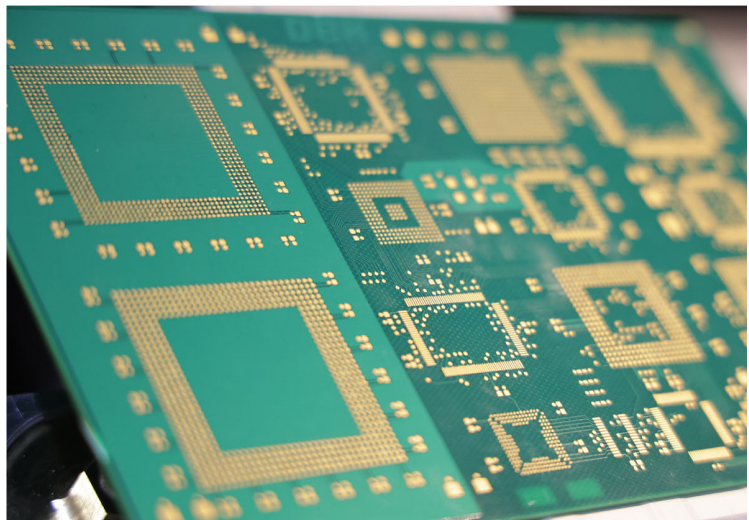
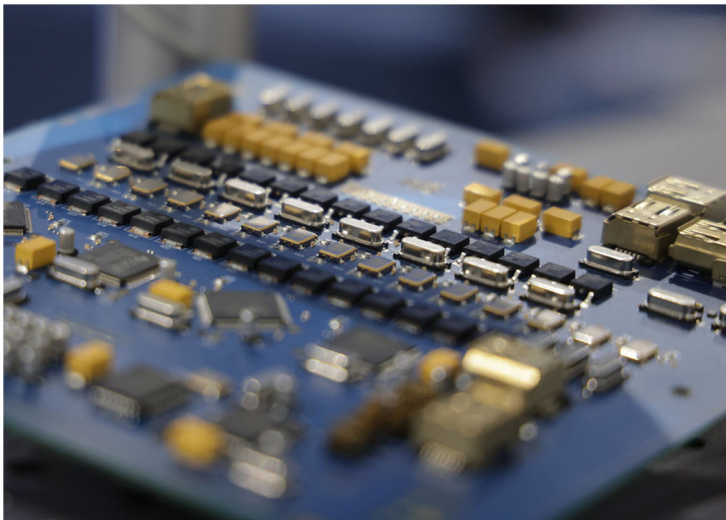
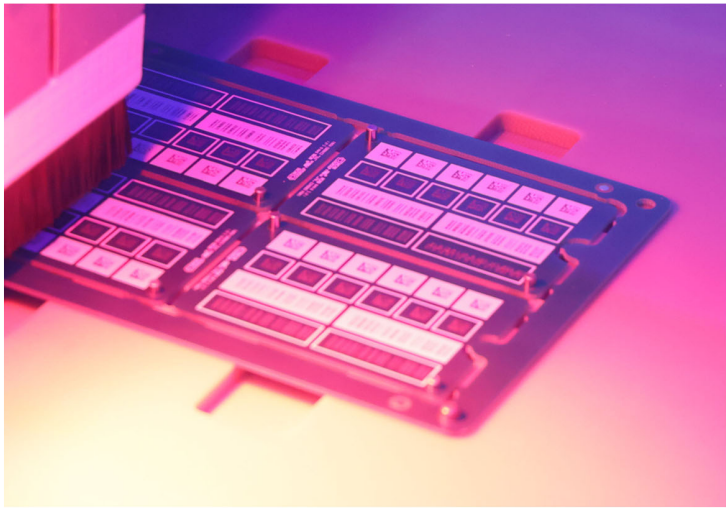
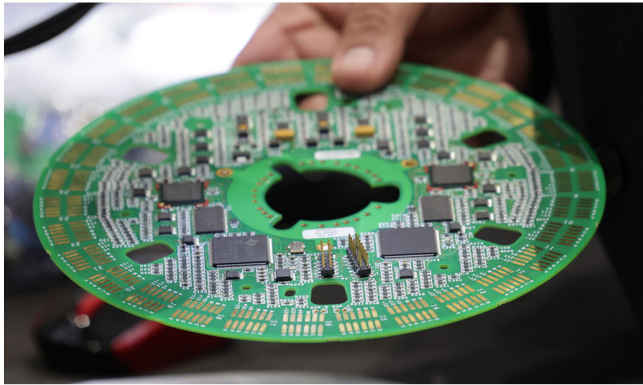
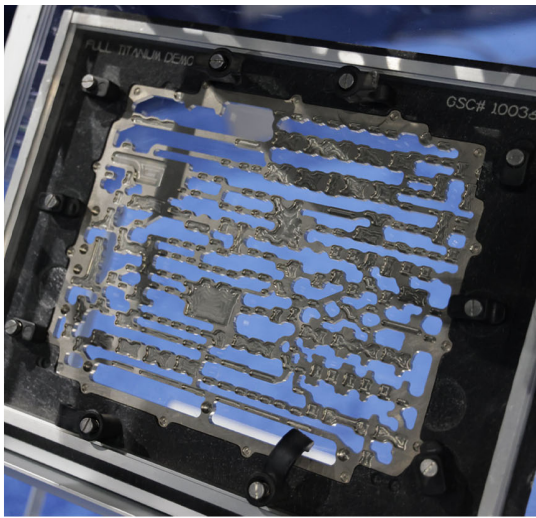
What is the most interesting question that your IPC APEX EXPO presentation answers? Are there other methods to analyze intermetallic compounds and their growth further than only using cross-sections or using expensive equipment?

What is your answer to that question, and why? Yes, there are other methods that can be easier to use and give more information about intermetallics growth under several thermal conditions. These methods include X-ray fluorescence and coulometric strip-



ping being used together. This helps to understand how intermetallics grow for better modeling and simulations and to compare the results with other more sophisticated methods such as Auger profiling. Good information can be obtained with these methods.

What is the most important piece of advice that you have for your audience? That we have more information about how Sn-Cu intermetallics grow and their different stages, especially when the intermetallic is less than 1 μm in the article. This presentation will help attendees to understand intermetallics better.





IPC's Dieter Bergman Fellowship Awards

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.

Interviews by Patty Goldman

I-CONNECT007

Bev Christian, HDPUG

Bev Christian is a facilitator for the High Density Packaging User Group (HDPUG) and an adjunct associate professor in the Department of Mechanical and Mechatronics Engineering of the University of Waterloo, Waterloo, Ontario, Canada. In the past 31 years he has held positions at Nortel, BlackBerry, and CALCE; all in the areas of materials and failure analysis. Bev has never missed an IPC APEX EXPO since its inception. He is a member of

27 IPC committees and attends as time and the lack of clones allow. He has been the chair of the 5-32E Conductive Anodic Filament and 5-32D Electrochemical Migration task groups and is now the chair of 3-11G Corrosion of Metal Finishes and 5-24B Solder Paste task groups. Bev has helped author more than 50 published papers and has presented 23 of them at IPC events. Bev met his wife at the 1999 IPC Printed Circuits Expo.

Patty Goldman: Bev, congratulations on this most prestigious award from IPC. Tell me about how you got started with IPC.

Bev Christian: Thank you. At the time, I was working for Nortel here in Canada, and I went to an IPC Printed Circuits Expo in, I think 1996 or '97. I walked into either a component or PCB solderability task group meeting that Dave Hillman was chairing and I was hooked.

Goldman: And are you still on that committee?

Christian: I am actually, yes, all these years later.

Goldman: Yes. All those years later. Tell me about it, though. What were your impressions with your first meeting and subsequent ones? And I'm sure you became chairman shortly thereafter.

Christian: The first thing that hit me was I was in a room with people that spoke my language, that were interested in the things that I was interested in and were dedicated to moving the industry forward by building standards and test methods. And so, I branched out. I did a count and I think, over the years I've been on 30+ committees, certainly not all at the same time. I don't have clones. But it has been and still is a great ride.

Goldman: Great. Now I know you didn't stay with Nortel. But have your companies always supported your IPC efforts?

Christian: Yes, absolutely. In fact, I'm sad to report that this one this year will be the first APEX EXPO that I've ever missed, mainly for reasons of health. Certainly, my present part-time employer at High Density Packaging User Group would help supplement my expenses, but no, I personally chose not to go.



In terms of committees, I'm also the co-chair of the Technical Program Committee for APEX EXPO this year.

Goldman: It's a shame to miss it all, though, I do understand. Well, now, suppose you were at the meeting, and you met a first timer; what's your advice to those first timers?

Christian: I would say to try out several different committees. Just come into the back of the room, sit there, take it in, maybe for the first two times that you come just get the lay of the land. See how it works and where you think that you could provide some input and be useful to the industry.

Then I would dive in and become an active member. Perhaps volunteer to be the secretary, the notetaker for a committee on occasion. Once you get your feet under you, then think about stepping up to being a chair or a vice-chair. Do it gradually.

Goldman: But basically, get involved. Right?

Christian: Absolutely.

Goldman: I've done that, where you sit in the back of the room and don't get involved. But

you really miss out on an awful lot. You miss not just contributing but interacting with other people and meeting people. We've always talked about the networking that's so important at IPC, just getting to know other people that you can call up anytime you want.

You miss not just contributing but interacting with other people and meeting people.

Christian: That's true. And you can't really say this to bosses, but I would say probably for me, the number one reason for me going to APEX and attending task groups and committee meetings is to meet my friends.

Goldman: Which happen to be your colleagues in business and in the industry. And of course, those are the people you want to talk to. Because you're right, they talk the same language.

Christian: Exactly.

Goldman: Now, part of this honor of the fellowship award is a scholarship to the university or college of your choice. Have you picked one yet?

Christian: Yes. But it wasn't an easy choice. I had four different institutions in mind—two where I attended and two that I worked at before I went into industry. And so, it was somewhat of a difficult choice, but I decided to give it to the chemistry department of the University of New Brunswick. That's the province of

New Brunswick, Canada, not the city of New Brunswick, New Jersey.

Goldman: Of course! Over the years though, do you have any special memories, thoughts, or notable times in your committee work?

Christian: Yes, several. I did a little homework before our meeting today and came up with a list of about a dozen; I don't think you want to hear them all.

Goldman: Well, how about a couple?

Christian: I guess the first, most significant one was working with the Electrochemical Migration Task Group and syncing the IPC method with the Bellcore method for doing that testing. That is probably my first highlight of my times on the committees.

And as we've already mentioned, I've been deeply involved in the solderability task groups, both for components and boards. I was on the committee for A-610. I did that for probably over a decade until I couldn't stand it anymore. It just got to be too much, and I had to leave that one. I've also been on committees for fluxes and solder paste.

Another highlight was as an active member of TechNet. And with my TechNet pals, I started and we crafted a test method for underfills that made it into the underfill document. I'm quite proud of that. I was also an original member of the 1601, 1602 PCB Handling and Storage task group where I've been active ever since.

I rewrote two chapters of the Assembly and Joining Handbook. And then the last one I'll mention, I was the chair of the Conductivity Anodic Filament Task Group where Karl Sauder did most of the major lifting by writing the handbook for that technique. I and others sort of helped him sharpen it though, editorially speaking. Like I said, he did most of the work. Those are some of my highlights.

Doug Pauls, Collins Aerospace



Doug Pauls holds a B.A. in chemistry and physics from Carthage College, Kenosha, Wisconsin, and a B.S. in electrical engineering from the University of Wisconsin, Madison. He worked nine years for the Navy, eight years as technical director of Contamination Studies Labs, and 19 years at Rockwell Collins (now Collins Aerospace), in the Advanced Operations Engineering group, where he is a principal materials and process engineer. Doug was awarded the Rockwell Collins Arthur A. Collins Engineer of the Year Award in 2004.

Doug is a long time IPC chairman and was awarded the IPC's Hall of Fame Award in 2017. Most notably, he is known for his expertise in surface insulation resistance testing, cleaning and cleanliness assessment, conformal coatings, and how to investigate and qualify manufacturing processes. He has been a U.S. representative to ISO and IEC working groups on SIR, electromigration, and cleanliness reliabil-

Goldman: Wow. And more to come, I'm sure. Hopefully next year is better than this year and last year. And I suppose, though, between meetings you and your fellow committee members are meeting on Zoom or something like that every now and then?

Christian: Yes. We've been meeting quite regularly for the Assembly and Joining Handbook 820. Joe Kane of BAE Systems is the team leader. And I'm hoping to have regular meetings of the same sort for the solder paste task group to do an update of J-005.

Goldman: You are busy! Do you have any final thoughts here?

Christian: Thanks for taking the time to talk to me, Patty. It's always good to see you; we spent quite a bit of time together on the technical program committee for previous APEX EXPOs. And of course, that's just another committee getting together with friends and colleagues to move the industry forward. I think it goes without saying we need definite test methods. We need specific standards so that we are all on the same page to avoid confusion.

Goldman: Yes. And you know those standards always need to be updated because things in our industry are just moving at lightning speed. Things can't stay the same.

Christian: That's right.

Goldman: Thanks so much for your time and congratulations. It's a big honor. Are they going to beam you in to boldly receive your medal?

Christian: No.

Goldman: Oh, well, but I understand.

ity standards. He has participated in numerous national and international consortia on electronics manufacturing materials and processes. He recently led a team of SMEs to redefine the cleanliness provisions of J-STD-001, culminating in what is presently J-STD-001H.

Patty Goldman: Doug, we're here to congratulate you on the Dieter Bergman Fellowship Award, which is quite an honor.

Doug Pauls: It is. I was quite surprised when John Mitchell called and told me I had been elected to receive it. I was shocked that I had gotten this. I know my friend and colleague, Dave Hillman, was one of the original recipients of that award. But I hadn't really much thought about it. I didn't really think that what I have done was really in line with what his award stands for. I think back on my interactions with Dieter. When I was a young engineer and mammoths roamed the earth, he was one of the giants of the industry.

A lot of people I met were dedicated to a technology, or they might be dedicated to their company. He was the first person that I had ever known who was truly dedicated to the industry itself, not really caring about where a technology came from; he was not an advocate of the "not invented here" syndrome.

While he and I did not always agree on things, I always had a great deal of respect for him for what he did to make sure that the technology paths we pursued were right for the industry, and not just as an organization. To be even mentioned in the same breath as Dieter for that same thing was both very gratifying and very humbling to me.

Goldman: That's a good way to describe Dieter. He was really like a freight train. He wanted it all and he did it all. But you're quite active in various parts of IPC and committee work. What committees are you involved with right now?

Pauls: Since turning over the cleaning and coating work to Jason Keeping, I've been trying to work my way out of a lot of the active leadership stuff. I'm doing what I can to promote a lot of the new and up-and-coming members of IPC and shifting more into a mentoring role. I'm still very active with J-STD-1 and IPC-A-610. I'm still very active in all the cleaning and coating aspects of IPC, and the associated specifications. As a Technical Fellow for Collins Aerospace, I am our technical lead in both electronics cleaning and electronics coating. It is part of my job responsibilities to stay as a leader in those areas and that's where most of my focus is these days.

Goldman: Are you still representing the U.S. in ISO and IEC working groups, or has that been passed along, shall we say?

Pauls: I'm not really sure. A lot of the IEC/ISO work I have done was with my friend and colleague, Graham Naisbitt. Graham is very active in the IEC and leads several of their technical committees, when there are industry consortiums that deal with the testing of materials, the characterization of manufacturing processes, and so on.

Things that Graham is leading are predominantly from an IEC, or European standpoint, and we have several RTX locations in Europe. So, I like to stay involved with those as well. I know that I have put in several comments on IEC draft specifications for consideration. So, overall, I'm still involved.

Goldman: Good. You said you were mentoring. Are you mentoring some of the Emerging Engineers?

Pauls: Again, it's one of those "I think so." The reason I'm a little hesitant on that is that the pandemic has really thrown everything into a cocktail. There is a young engineer who I have as part of the Emerging Engineers pro-

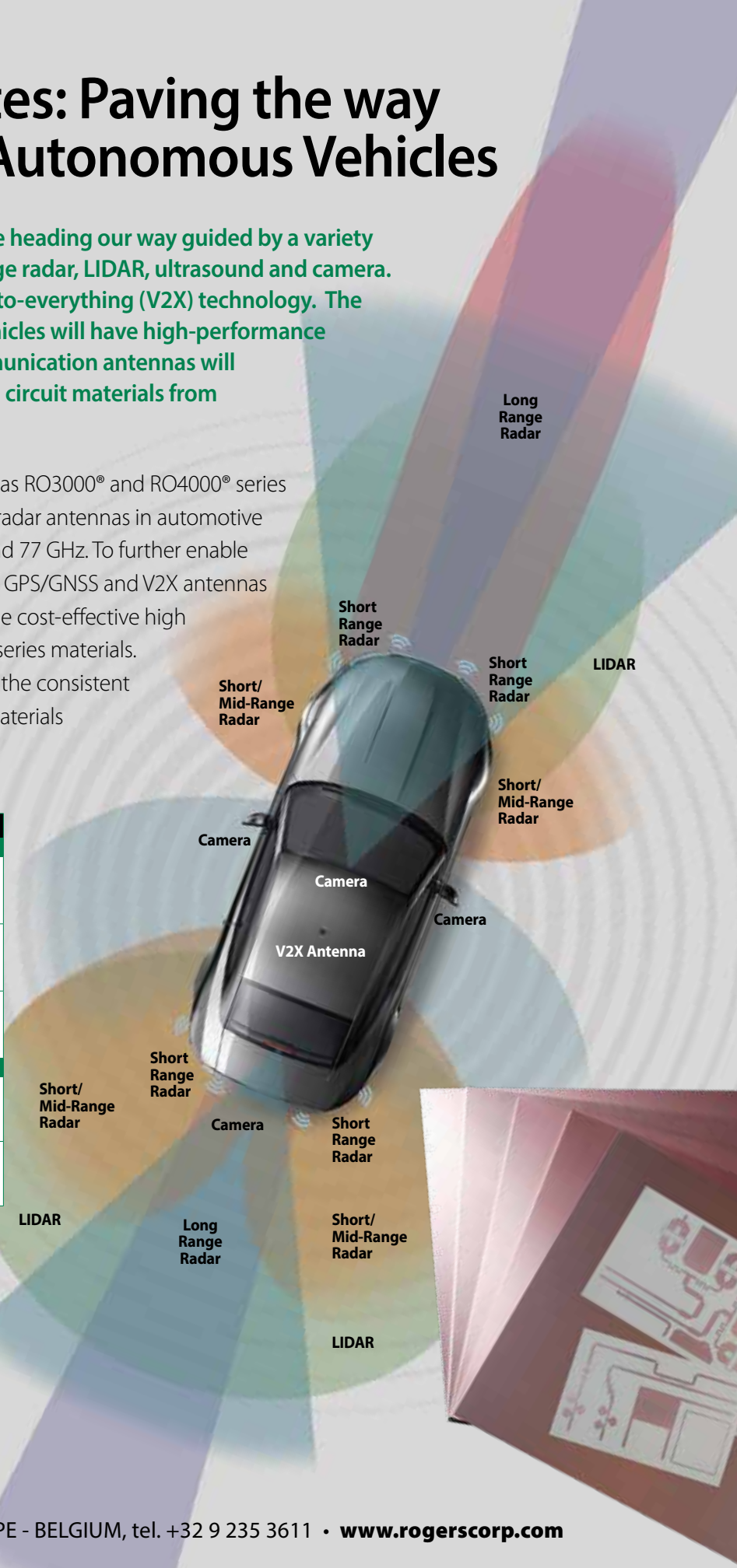
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gram, and we attended his first IPC meeting together. I think that was in 2019. The pandemic hit shortly thereafter, and I haven't really had the opportunity to meet with him at IPC any time since then. I sent an email earlier on to say, "Hey, are you going to be at IPC this go-around in San Diego." But I don't know yet if he will be coming. We might have to kind of reboot that relationship and start over.

But there are a lot of younger engineers. Many of the cleaning and coating committees have been turned over to the next generation. I know Dave Hillman, as he is approaching retirement in a couple months, has been working the last couple of years to bring his replacement, Tim Pearson, up to speed. Another young man, Dan White, has been my colleague, my protégé, and so on. I've been working to bring him along in the cleaning and coating area. It is an expectation of a Collins Fellow to mentor the next generation of professionals. For many of our younger engineers in cleaning and coating, I still serve as a mentor and try to always listen to their ideas before putting forth my own. I don't want to be too much of a force of nature.

That's one of my passions, Patty, is helping to mentor and bring along the next generation of engineers. I think back to when I was a young engineer, and I first started attending in 1985 long, long ago. Many of the leaders then were so generous with their time, and their expertise. They were all very much of the "pay it forward" mentality. It so impressed me. It helped me so much that I had said, "That's the kind of person I want to be as well." So, in these latter years of my career, I want to focus on taking a lot of what I've learned through the years and pass that on.

Goldman: I often wonder if other industries are like ours and have the kind of mindset and way of thinking where we all work together. We are competitors, but we all work together for the industry. I know there are always contentions here and there, but for the most part, we all are

focused on moving forward. Do other industries actually get along like our industry does?

Pauls: Well, I think most industries have a common thread in that working to standards, working to specifications where everyone in the industry says, "Yeah, this is the right way to do something." It's in everyone's best interest, that we can all participate in developing standards, but without necessarily doing away with the fun. I think all of us are working from that standpoint to better the industry. Almost every industry, at least that I've ever seen, has some form of professional society, professional organization, that represents that industry segment. Most of them have areas in which people are working on agreed activities that will advance their industry.

In this cleaning of electronics and so on, I've looked into the medical and automotive industries. One of our groups at Collins is called Knowledge Management (KM). Basically, almost every company in the U.S., regardless of what they're doing, is struggling with what has been called the gray tsunami. As all of us with silver in our hair tend to retire and leave the workforce, how do we replace them and how do we capture that knowledge and experience?

Everyone is struggling with that. On the other hand, for many of the young engineers, the young co-ops, and so on, who have been my privilege to work with over the years, it means they have a lot of opportunities available to them in the industry.

Goldman: That's so true. Now, suppose you met someone for the first time, and it's their first IPC meeting; what's your advice to them?

Pauls: I would have to say go find an old dude, buy him a beer. I still remember going to my first IPC meeting, and gosh, that's about 36 years ago. You're walking around and everything is new and overwhelming. You don't

know what's going on. Now, I was very fortunate. Do you remember Susan Mansilla?

Goldman: Yes I do, a great friend.

Pauls: Very much a giant of the industry as well. She was one of my coworkers. She took me under her wing. I guess what I would say is for anyone coming in new, if they don't have someone like that, find someone. The IPC staff is very, very good. If you come up to an IPC staff member, and you said, "I'm new to this. This is my first IPC meeting. In my company, I'm responsible for electronics cleaning. What should I be going with?" First, we've got this guy over here, Doug Pauls. Follow him around. Ask for a mentor, a guide. Generally speaking, I think one will be provided, but don't be afraid to ask a question.

Goldman: Good advice. Now, part of this award is a scholarship to the university or the college of your choice. Have you made a selection?

Pauls: Oh, I have. It was pretty easy for me. My choice will be the Materials Science and Engineering Department at Iowa State University. Now, I'm not an Iowa State University graduate at all, but I have had the great fortune of working with that department over the last 21 years while I've been at Collins.

You and I have talked in the past about our most excellent co-op students. We have young material scientists and engineers oftentimes, well, late sophomores, juniors, seniors. Probably 95% of them are materials engineers, who then come and spend eight months with us, a semester and a summer. We have worked very, very hard to make that a fantastic experience for them. I think I have learned as much from those students as they have learned from me.

When I thought of a department that would be deserving of this, the Material Science and Engineering program that has provided so many of these wonderful co-ops for us immediately came to my mind.

Voices of the Show: Nilesh Naik, Sava Holdings, Ltd.

Interview by Andy Shaughnessy

Andy Shaughnessy caught up with Nilesh Naik, a longtime IPC board member, and asked him how he felt about being back in San Diego. Nilesh, like so many others, couldn't have been happier.



Andy Shaughnessy: I'm here today with Nilesh Naik. What brings you to IPC APEX EXPO?

Nilesh Naik: Actually, I'm grateful that there's an actual show, an in-person show. I am delighted to be here. I definitely missed it last year. I don't think I've missed an IPC show since its inception. I just wanted to be back, be amongst industry members and leaders, and just understand where we're going with everything. I'm excited to be back.

I'm delighted at the turnout as there are a good number of people here. Unless you come here, you

don't understand what's going on. You have to be that learner and be willing to figure out what's going on. That's exactly why I'm here.

Shaughnessy: I'm just really glad to see that so many exhibitors brought their machinery.

Naik: Yes, absolutely. Not only that, but they brought good, interesting machinery. I have a little bias more to the board side, but again, it's just good to see a lot of board shop guys rather than just equipment for the PWB industry. There is some exciting stuff and some interesting technologies.

Shaughnessy: All right. Well, it's good to see you again.

Naik: Absolutely.

Goldman: Very nice. Have you any parting words or final thoughts that you would like to throw out at us or at our readers?

Pauls: To sum up all of this, I'd like to take a lesson from Dieter Bergman for this award. The more that we can work for the betterment of the industry, the more that we can do to advance our knowledge and share it, the more that we can do to create cooperative relationships, the better off we will be as individuals, the better off IPC will be as an organization,

and the better off we will all be for or within our industry itself. That is a lesson that I think Dieter had taught me. I think that's a lesson that applies to all of us now.

Goldman: That's very nice. Doug, thank you so much for your time and for your wonderful thoughts here.

Pauls: You're welcome, Patty. Happy to talk with you.

José Servin, Vitesco Technologies

José Servin has worked as an IPC member for more than 14 years in the development of the Electronics Assembly Norms. As a member of the IPC A-610 and J STD-001 working groups, he became chairman of IPC A-610G and J STD-001G Automotive Addendums that complements the norms for automotive industry since 2018. He holds MSc and Ph.D. degrees in soldering materials from the Autonomous University of the State of Morelos. Now, he is a Level 3 Senior Process Engineer at Vitesco, Cuautla, Mexico. He has worked in electronics assemblies for more than 16 years in SMT, BE, and electronics component manufacturing.

Patty Goldman: José, congratulations on receiving the Dieter Bergman Fellowship Award. It's quite an achievement. What was it like to get that phone call from John Mitchell?

José Servin: It was a surprise. I didn't expect it. I thought he wanted to talk maybe about the committees, or any additional support, something like that. I never thought that it was about the award. It was a very great surprise, and it's very nice.



Goldman: Dieter Bergman was a tireless worker and apparently, you are also.

Servin: Certainly, I like to work. Also, I like doing what I do in IPC.

Goldman: Please, tell us about your involvement at IPC.

Servin: My history with IPC started in 2008 or 2009. I don't really remember the first time

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that I visited IPC committees. I got the invitation from Constantino Gonzalez who was the chairman for IPC-A-610 at that time. I knew him because he was giving a training course in our company. He mentioned his IPC involvement. For me, it was quite interesting, so I told my boss that it would be a great opportunity to participate in IPC meetings.

I have to be sincere. In the beginning, I was a little shy because my first language is not English. I know the IPC committees are very strong especially when there is a lot of discussion, and everything is going fast. In the beginning, I was quiet. I sat in the back of the room trying to catch everything, making my notes. And, of course, I did try to give some contribution, such as writing emails or sending the proposals. For me, it was a great experience.

Little by little, I started my involvement in IPC. I began to know people there, and to expand my network, I would say. I met people from NASA and the military, for example. I never thought I would meet people from NASA, the Army, and from several universities in the U.S. Also, we talked about the similar issues, similar topics, something that we have in production, something that we have in the company.

This allowed me to grow from both a professional and personal point of view. I have met and right now have very good friends on the committees, so it's very, very satisfying. I had the chance to make some contributions, for example, to include something specifically for the automotive industry in IPC. This discussion was maybe a couple of years ago, and finally, IPC had agreed to participate in this addendum. To me, it was also a nice surprise that I was appointed as chairman. It was very hard work at that time. Right now, we have a very good spec as a result. Many people are happy around the world because we included missing criteria, new components, and so on.

I mean, it seems like after many years somebody couldn't grow, but right now I'm still

growing in IPC. Maybe I'm not, I would say, the person who's always arguing something or doing something. I'm quiet. I always try to contribute in my way, writing things or something. I could make this for many years in IPC.

Goldman: I think one of the interesting things about committee work that people may not realize is that you can make a real contribution for yourself and for your company. I'm sure that's been your impression also. Besides the fact that you're learning all the time, meeting a lot of people from a lot of different companies, and learning that way, you're also contributing. You can have an effect.

Servin: Yes, that is interesting. It's very satisfactory. I remember that the first contribution I made in IPC was a small change of criteria. We had a lot of these questions on those criteria, two or three sentences. As I say, I started slow. But suddenly, I saw this contribution was accepted by the committee. It was funny because I was not there to defend it to this committee, but the committee really liked my contribution.

Goldman: Surprise.

Servin: Yes, surprising when I saw the standard. I could talk to my boss and say, "This is the contribution that we made." The impact is when you have this discussion, maybe with our customers or with our suppliers, you can use this to help us to agree. And I know, when something is in IPC standards, discussions are stopped. People are accepting it because they know how important these standards and specifications are. That is the impact. Everybody in electronics, if they've been involved in the electronics industry for a few years, will know about IPC. They know what IPC is.

Goldman: Yes. I would say, if someone disagrees or doesn't like a standard, they should get

involved in that committee and they will learn that either they're wrong, or else the committee learns that maybe they haven't covered something.

Servin: Yes, it's true. The committee structure will help to ensure that it will have something useful for everyone, but we need to participate. If not, we won't be able to get all views and the document would have missing topics. All who participate in the committees are learning more, such as during the initial or final discussions with committee members, because they are from several industries—aerospace, military, automotive people, etc. In the end, the standards are helping all to agree on quality and therefore making our assemblies safer and better.

Goldman: José, there is a scholarship with this award to the university or school of your choice.

Have you chosen a school? Tell us about your choice.

Servin: Yes, I have. The school is Yecapixtla's School of Superior Studies from Morelo's Autonomous State University. This is a small school where I teach in my extra time; however, professors and staff are eager to make it grow, and make it an important choice for students in my state [Morelos, Mexico]. We are constantly improving and looking to create better things. There are only two careers and one of them is related to electronics and assemblies so the scholarship will be in the areas that IPC focuses on. I think it is important to support these efforts and initiatives to make a small school better and our industry grow.

Goldman: Thank you so much for your time and insights, and again, congratulations. It has been a pleasure talking with you. **S&T**

IPC APEX EXPO: Conference Speakers Speak Out

Qualification Protocols for a Sustainable and Innovative Release Aid Within the PCB and CCL Laminating Press Process

Presenters: Clothilde Manzano, Ph.D.,
Marketing Development Manager

Ahlstrom-Munksjö Sébastien Esnault,
Product Engineer, Atlantec, Group ACB

What is the most interesting question that your IPC APEX EXPO presentation answers? How can we improve the environmental footprint of PCB producers when considering only consumables? In this way, could we replace the standard plastic film used as release sheet during PCB lamination by a more sustainable and cost-effective release sheet?

What is your answer to that question, and why? Replace the traditional plastic release films by a new generation of release sheets: the release parchments. The release parchment, OptiLayup, is made of 100% cellulose, is biodegradable and compostable. Last but not least, it is cost efficient and has shown very good performance for IPC Class 3 PCB production.

What is the most important piece of advice that you have for your audience? See beyond and do not be stuck to your first impression. Innovation is a journey and even a tiny step is useful for every stakeholder!





Conversations With Two IPC President's Award Winners

The IPC President's Award is given to IPC members who have exhibited ongoing leadership in IPC and have made significant contributions of their time and talent to the association and the electronics interconnect industry. Individuals can receive this award only once.

The award is a personal honor to recognize the winners' selfless dedication to the electronics industry in terms of their time, expertise, and leadership. It is these people's selfless dedication and hard work that promote the progress and development of IPC and the industry.

The recipients are: Zhiman (Susann) Chen, Zhuzhou CRRC Times Electric Co., Ltd.; Joe Kane, BAE Systems; and John Walls, Aegis Software. Interviews with Zhiman (Susann) Chen and Joe Kane follow. The editor of *PCB007 China Magazine* interviewed Zhiman about this award.

Zhiman (Susann) Chen

Zhuzhou CRRC Times Electric Co., Ltd.

Interview by Edy Yu

I-CONNECT007

Susann Chen has been engaged in electronics and electrical manufacturing for more than 26 years. She is the member of IPC TAEC-Global, Chair of IPC ASSC, Chair of IPC/WHMA-A-620C-Rail Transit Addendum, co-chair of 7-31f China Task Group, vice-chair of IPC-A-610G-Rail Transit Addendum, and an active member of many task groups. For years, she has been dedicated to broadening and deepening IPC's influence in international scope and committed to devoting more efforts to the contribution of IPC mission and aspirational goals. She has exhibited ongoing leadership and has made significant contributions of her time and talent to the association and the electronics interconnect industry. She cooperates with IPC China to successfully convene technical conferences



Zhiman (Susann) Chen

and competitions, prompts the in-depth cooperation between IPC and the rail transit industry in China, encourages the participation in IPC trainings and events, and is committed to prompting crossover cooperation.

Edy Yu: First, congratulations on your receiving this year's IPC President's Award. Please tell us about that.

Zhiman (Susann) Chen: The first feeling of receiving the call was, of course, amazing. For myself, I'm honored to make the modest contribution to such an admirable and respected platform like IPC, and I am even more overjoyed to get such high recognition. However, compared with those truly admirable grandmasters, I know that I just received this honor because I happened to be present on the occasion. This honor should be to all peer experts who devote themselves to the development and application of IPC standards, and to the broader and in-depth sustainable future development of IPC in China and all over the world. And I will be more committed to that cause.

Yu: Could you please review the origin of your cooperation with IPC?

Chen: The cooperation started at the beginning of this century, but can be traced back to the 1980s, when IPC standards such as IPC-A-600 and IPC-A-610 were first introduced into my company. For the last 20 years, I have been working hard to promote IPC standards development and application, training and certification, skill competition, and summit/forum in China, especially in the rail transit industry. There are indeed a couple of significant moments. One is at the end of 2018, when we obtained the approval from IPC and started to set up 7-31b-R and 7-31f-R, together with more than 200 experts from nearly 100 Asian companies, to develop IPC-A-610G-Rail Transit addendum and IPC/WHMA-A-620C-Rail Transit addendum, which is the first time both in rail transit industry and in Asia. Also at the end of 2018, I had the honor to join the TAEC Global Committee with six other experts from America, Europe, and Asia, to conduct administrative business on IPC technical activities. At the beginning of 2021, I was

appointed as the chair of V-ASSC (Asia Standard Steering Committee) to guide the development and application of IPC standards and explore innovative ideas on serving the profitable development of IPC Asia members. These opportunities enabled me to systematically participate in working with IPC at all levels from a global perspective. It can be said that the shared sense of mission and values led me to cooperate with IPC and enjoy it.

Yu: What are the standards committees you currently participate in, and what are their main responsibilities and operations?

Chen: I have actively participated in or follow dozens of task groups, with main concerns in electronic process and reliability, Factory of the Future, social responsibility, and sustainable development. Now I'm in charge of V-ASSC, 7-31b Rail, 7-31f Rail, and 7-31f CN.

As chair of V-ASSC, I have been working with Asia's top subject matter experts over the past year, to help IPC Asian members to engage in IPC's Global Standardization platform, discuss regionally hot topics and new ideas, and incubate standards development. We also communicate with European experts on transportation electronics reliability, advanced packaging, and other issues.

By leading the development of 610G-R and 620C-R standards, we are committed to applying the most practical advanced standards to the rail transit industry in a more practical way, with the experiences and solutions of China's high-speed railway, as well as my experience as the project leader of IEC standard "Railway applications—Rolling stock—Rules for installation of cabling." I'm so glad to see that both drafts have passed FDIR and PSB ballots in late 2021 and early 2022, respectively, and we look forward to the anticipated release in spring 2022.

As I chair the 7-31f China subcommittee, I am dedicated to encouraging the Chinese experts

to contribute to the upgrading of relative IPC standards, as well as participate in international standardization activities. At the same time, we are carrying out various discussions, research, and activities to improve the understanding and application of IPC standards.

Yu: In recent years, you have participated in the development of global standards on behalf of CRRC and China's manufacturing industry. Please tell us about the experience and significance.

Chen: My colleagues and I have long been actively engaged in international standardization activities of IEC (International Electrotechnical Commission), ISO (International Organization for Standardization), IEEE (Institute of Electrical and Electronics Engineers), and IPC (association connecting electronics industries), with focus on electric technology and reliability, smart manufacturing, and sustainable development. International and industry advanced standards are very important to ensure product quality and reliability, and play a key role in internationalization and market competition. With open, collaborative, and integrated innovation becoming the mainstream, connectivity and synergy across supply chain, industrial chain and value chain have become the trend. Nowadays, standards are often established before the market matures. Thus, it is even more urgent to actively participate in international and industrial standardization activities and keep track of the development frontier and dynamic trends.

Yu: Thank you very much for your participation in our interview. I hope the pandemic will end as soon as possible and you can better participate in the development and promotion of global standards.

Chen: Thank you.

Joe Kane

BAE Systems

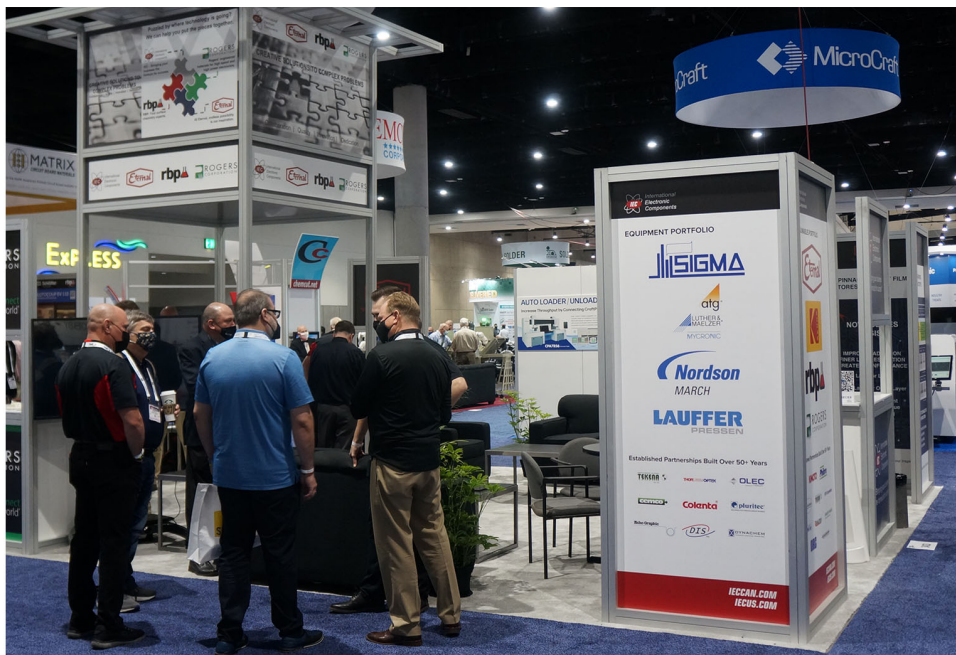
Interview by Patty Goldman

I-CONNECT007



Joe Kane is a senior principal engineer with BAE Systems in Endicott, N.Y., working in process engineering and supplier quality for electronics parts and assemblies. He has been active in IPC standards development for more than two decades, primarily with assembly and joining, cleaning and coating, product assurance, and printed board committees.

He is proud to have worked with great teams to develop several revisions of assembly and soldering standards J-STD-001, IPC-A-610, and IPC/WHMA-A-620. As a member, and later chair of the D-35 subcommittee, he helped write the original IPC-1601 and Rev. A guidelines, and most recently IPC-1602, Standard for Printed Board Handling and Storage. As chair of 7-35, he is leading a team to revise IPC-AJ-820A



Assembly and Joining Handbook, and as vice-chair of 5-45, he helped complete the forthcoming IPC-7801A, Reflow Oven Process Control.

Patty Goldman: Joe, congratulations. You're up for one of the significant awards at IPC, the President's Award. I sure would like to know more about all your IPC experiences.

Joe Kane: Sure. I first got involved in IPC because I was responsible for some of the workmanship instructions for our business. Originally, they followed the old military specifications, MIL-STD-454 Requirement 5 and MIL P-28809, and things like that. When the government began canceling MIL specs and adopting industry standards in their place, back in the mid-'90s under the so-called Perry Initiative, IPC took over with J-STD-001 and IPC-A-610.

I was very surprised and happy to learn that we could have input to those things, which wasn't possible in the past, because it was pretty much government fiat. You did what they said, and you didn't know why. You could appeal and maybe your appeal could be heard, and maybe it might show up in the spec, but it was not under any particular revision cycle. The whole process was very opaque. No one really knew what was going on unless they were directly involved.

I started getting involved in some IPC meetings, primarily J-STD-001 and IPC-A-610. Some of my responsibilities changed, and I started taking on assignments in bare boards as well as assemblies, so I got involved in some of those committees. Eventually I led the bare board storage guideline that evolved into the IPC-1602 standard. I also got involved in the Assembly and Joining Handbook IPC-AJ-820. It was created to pull together some best practices from various IPC handbooks, along with a bit of explanation for some of the requirements and some additional detail that wasn't in the specs themselves. I got to lead that committee. It was a steady and gradual progression,



getting more and more involved and meeting some of the people. I started by showing up for meetings and weird things happened after that.

Goldman: You kind of get sucked in.

Kane: Exactly.

Goldman: And it's all good because you learn so much.

Kane: Yes. Every meeting, I learn something new. We think we know what's going on in our own shops, but every now and then you get a chance to challenge your own assumptions, question why that's the way it's always been done. There are lots of smart, experienced

people at IPC meetings, with different takes on things, and we're able to use that here in our own business, and we can share our experiences and knowledge too. That can be something that's useful to someone else.

Goldman: That's nice. What was it like to get the phone call that you won the President's Award?

Kane: That was kind of strange. "John Mitchell wants to talk to you." I had no idea, and it was quite a surprise. I really didn't know what it was about. Honestly, I half-expected to hear, "We're looking for some new blood. We need new committee leaders," and that may eventually happen, but really, I wasn't expecting it, and it's an honor. I do appreciate it. You participate and you do your best, and I suppose, at some point, it's nice to have some recognition that you're actually doing something constructive and that's appreciated by your peers and by the staff.

Goldman: That's good. Any other thoughts on IPC and working on committees?

Kane: Committees can be fun; we have some laughs. I've gotten to know some of the people who are involved, committed, and participate. I enjoy the committee work even if it's over the phone, but I particularly value the face-to-face meetings where you get the side conversations, and it's an immersive experience. I'm glad they're doing IPC APEX EXPO live this year. It's been two years. It was good meeting at SummerCom in Milwaukee, but APEX EXPO will have wider participation. I do enjoy it. These are smart, interesting people, and it's a pleasure to interact with them. I imagine it's something like a Star Trek convention. You mingle with your fellow nerds, and nobody else gets us.

Goldman: You all speak the same language and nobody outside this industry speaks that language, that's for sure.

Kane: Yeah, except we don't do the weird uniforms or anything like that.

Goldman: Well, not yet. Thanks so much for your time and congratulations again. **SET**

IPC APEX EXPO: Conference Speakers Speak Out

FIDES Reliability: New Approach to the 'Process Factor' During Product Development

Presenter: Murilo Levy Casotti, Senior Product Development Engineer, Embraer

What is the most interesting question that your IPC APEX EXPO presentation answers? How to control electronic hardware reliability during product development.

What is your answer to that question, and why? A reliability control approach, considering rounds of



evaluation during the product development phases.

What is the most important piece of advice that you have for your audience? Following the 26 recommendations that this work has yielded is the most important piece of advice I could give attendees for achieving successful high-reliability electronic hardware.

IPC Student Director: Three Things IPC APEX EXPO Taught Me



By Paige Fiet

TTM TECHNOLOGIES

IPC APEX EXPO 2022 was my first in-person APEX EXPO event, and it surely did not disappoint. The show this year was packed with high quality technical courses, engaging professional development courses and, of course, an admirable show floor exhibition. This year APEX EXPO really resonated with me, and I would like to leave you with three insights I learned while attending.

1. Inspiration comes from meeting other young professionals.

Nothing is more encouraging to me than meeting with peers who have the same excitement for the industry as I do. IPC has done a wonderful job retaining talent with the help of its Emerging Engineer Program. Engineers in

their first five years in the industry are paired with experienced mentors for three years as they navigate networking, APEX EXPO, career building, and much more. This was my second year in the program with my mentor, Mike Carano of RBP Chemical Technology.

While at APEX EXPO, mentees and mentors are asked to complete a passport that allows the mentees to fully indulge in all the conference has to offer. Some of the courses and events on the passport include activities I might not attend on my own. My favorite events from this year's passport included breakfast with the other Emerging Engineers, participating in the STEM outreach event for local high school students, and of course, the trivia networking night. Each of these events

created an opportunity to meet and greet with others who are in similar places in their careers. Nothing is more inspiring to me than seeing an associate present a technical paper or receive a sought-after promotion. I like to think that if they are capable of tremendous accomplishments, I am too.

2. The importance of being an active participant in standards committees.

The first committee meeting I joined was IPC-610/JSTD-001. As a newcomer to the industry, it was nothing short of intimidating. The meeting lasts for days and there are so many people in the room. How do you keep track of all their names, and what do you mean there's a difference between a lead, wire, and a conductor? Nonetheless, what I witnessed was truly fascinating. In what other industry are you able to sit in a room with your competitors, suppliers, and customers to discuss how products are to be manufactured?

Once I wrapped my brain around the verbal tennis match in front of me, I learned that even though these committee meetings can create heated discussions, at the end of the day everyone wants what's best for their companies and the industry. The committee members who aren't vocalizing their opinions will be forced to manufacture their products to standards that they had no say in creating. Sitting in committee meetings should not just be checking boxes; rather, committee memberships should create action for all attendees.

After following up with other committees (many smaller than IPC-610, I should note), I learned that engaging in committee meetings also increases the awareness to the biggest concerns in industry. There may be issues in a process of one company that can be resolved through the experience of another. We can't know of issues that may have been resolved by someone else if we aren't willing to voice them.



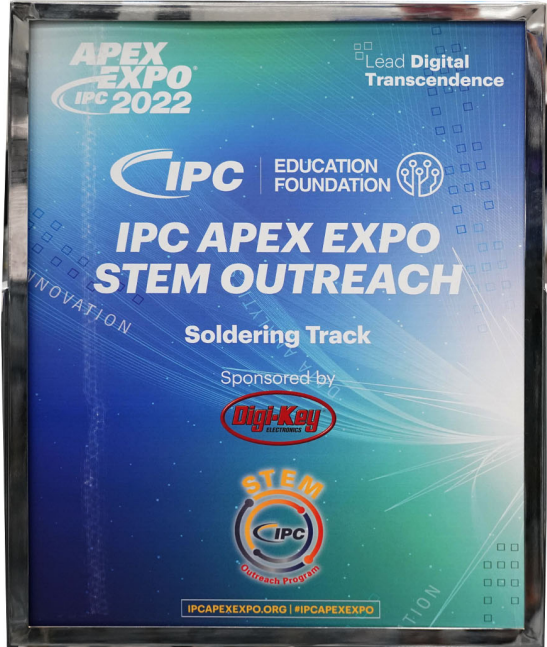
3. The gravity needed to actively advance the electronics industry in the United States.

My favorite speech from APEX EXPO came from Joe O'Neil as he accepted his Raymond E. Pritchard Hall of Fame Award. One of the most noteworthy stories Joe told was about his seat with the "giants" of the industry during a lunch at his first APEX EXPO. He explained his awe as he watched the biggest competitors in the industry work as a team. Joe was shocked as they offered each other help if one of them needed to use another's equipment to keep production moving. The executives from Joe's story had the insight into a dying industry in the United States. They realized they weren't competing against each other for business but with each other to maintain a spot for PCB manufacturing in the U.S.

This point was reiterated to me as I sat down with Happy Holden. Happy and I discussed how PCB manufacturing technology is 10 to 15 years behind the technology in Asia. We then analyzed ways the United States could increase their technologies and Happy hypothesized advances to the industry that I may see in my career.

All in all, APEX EXPO was a wonderful experience. I am saddened to not have been able to meet all my virtual connections in person but am looking forward to IPC APEX EXPO 2023 in San Diego. **\$ET**

Paige Fiet is a process engineer at TTM Technologies Logan Division.





IPC Education Foundation STEM Outreach



By Charlene Gunter du Plessis
IPC

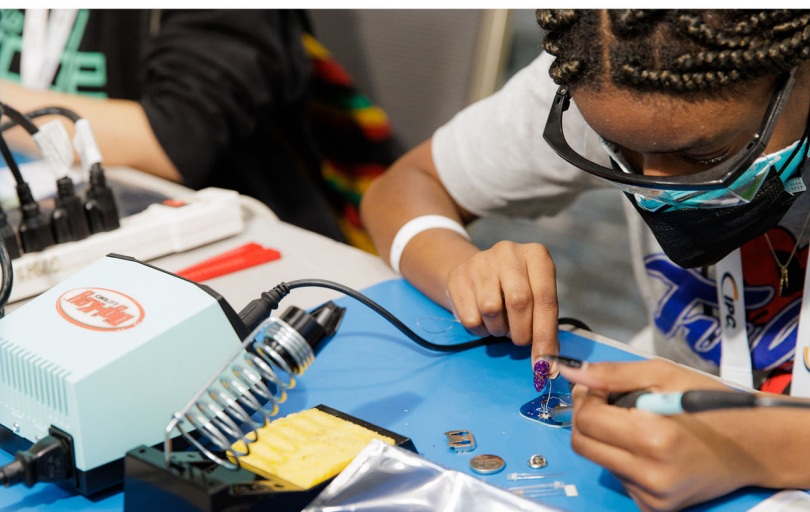
The IPC Education Foundation (IPCEF) hosted its annual STEM Outreach event on Thursday, January 27 at IPC APEX EXPO in San Diego. Due to COVID restrictions and regulations on field trips, the Foundation unfortunately could not host all the schools and students as initially planned, but we were thrilled to welcome nearly 80 students from e3 Civic High School, San Diego.

The day was packed with several hands-on technical activities, career exploration, and industry engagement. The students participated in educational tracks with a focus on soldering, PCB design, a roundtable discussion, and a tour of the IPC APEX EXPO show floor. IPCEF believes that these kinds of activities raise awareness of the skills needed and opportunities available in the electronics manufacturing industry.

The event began with an inspirational video

and personal keynote address by Sean Patterson, president of the Americas for Nano Dimension, about the industry, the company, and their future goals. The Career Panel Luncheon, sponsored by TTM Technologies, was broadcast live to approximately 600 attendees, and was moderated by John Mitchell, IPC president and CEO. The panelists representing the industry, sharing insights and personal career path journeys, were Matt Kelly, IPC; Christina Rutherford, Honeywell; Chance Tiner, TTM Technologies; Aviram Iancovici, Nano Dimension; and Jason Fullerton, CAES.

Matt Kelly, IPC chief technologist, encouraged students to consider pursuing internship opportunities and said that “an internship is as valuable as earning your degree or qualification.” Jason Fullerton echoed it by saying that an internship opened his eyes to what he really wanted to do as a career.





“I changed my major from an industrial engineer to a manufacturing engineer and this change suited me better,” he said. “I learned what I wanted to do in the factory, and I was able to identify that before I was pigeonholed into something I wouldn’t enjoy for the rest of my life. The second most valuable thing I learned was that I was able to work with industry experts that were in the industry for 10, 20, 30 years who became mentors to me.” Chance Tiner added that hands-on experience and projects add value to a resume and that any form or qualification in computer science would be extremely valuable or beneficial in terms of career opportunities today.

Perhaps even more impactful, the students were able to engage with industry professionals during the roundtable career discussion where they had the opportunity to engage with IPC’s Emerging Engineers, mentors, and industry representatives. Several students asked questions to a diverse group of industry professionals who provided answers, often prompting other professionals in the room to share their experiences.

The IPC Design Booth was a prominent stop on the show floor tour and representatives from Altium and Upverter Education educated the students on PCB Design. The students and teachers also had the opportunity to learn more about the PCBeTheChange Student Design Competition as the winners of the high school and college/university divisions were showcased at the booth. To learn more about the winners, [click here](#).

The student participation and awards were

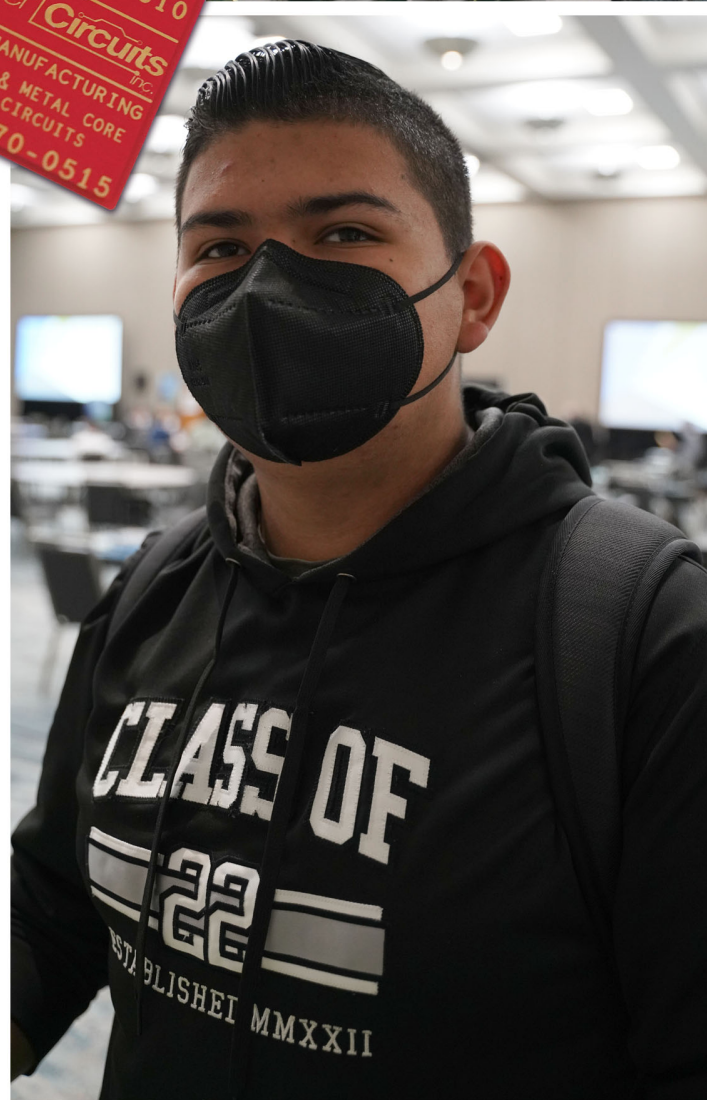
made possible through the generous support of our event sponsors: TTM Technologies, CAES, DigiKey, Google, Mycronic, and I-Connect007. In-kind donations were made possible by Nano Dimension, Novagard, Omron, Zestron, Kyzen, and Chemcut. We are truly grateful for their support and participation in the day’s activities. This event was also made possible by the wonderful support of many volunteers who gave their time to be there for the students. The IPC Emerging Engineers and IPC Emerging Engineer Apprentices, IPC staff, and industry representatives volunteered during the soldering activity, roundtable career discussion, and ushered the students on the IPC APEX EXPO show floor. IPCEF donated \$1,000 to e3 Civic High School along with three soldering stations, rulers, and Innovation textbooks sponsored by DigiKey to encourage soldering and STEM activities in the classrooms.

One of the students of e3 Civic High School thanked IPC and the IPCEF for this event on behalf of the scholars in attendance saying, “Thank you so much for having this event. It was the best day ever and we enjoyed the experience very much.” The students and teachers left feeling inspired. We believe that we planted the seeds of the possibility for an emerging workforce to consider the electronics manufacturing industry a viable career path. We look forward to hosting more students at the 2023 STEM Outreach Event. **S&T**

Charlene Gunter du Plessis is senior director of the IPC Education Foundation.







New IPC Excellence in Education Award Presented to Tabbatha Greek, Honeywell Aerospace

Interview by Patty Goldman

I-CONNECT007

The IPC Excellence in Education Award is given to individuals who have made a significant contribution and demonstrated leadership in workforce development while building a culture of continuous learning within their organization and across the electronics industry.

Tabbatha Greek serves as the Master IPC Trainer for Honeywell Aerospace, where she runs a private IPC Training Center. She has been involved with manufacturing training for more than 15 years. Through her experience, she recognized that the industry needed a better way to bridge the skill-gap in electronics manufacturing. After discussing the issue with IPC, they began work on an introductory course written specifically for operators. Tabbatha continued collaborating with IPC to address the challenges that trainees face when they are new to the industry. Once IPC had released the new online Electronics Assembly Operator course, her team was the first to become certified and provided valuable feedback for further improvements on the Workforce Development Training series.

Patty Goldman: Tabbatha, congratulations on your award.

Tabbatha Greek: Thank you so much.

Goldman: IPC created a new award this year called Excellence in Education, and you are the first recipient, so that's a big deal. What were your thoughts when John Mitchell gave you a call?



Greek: His administrative assistant contacted me and said that I needed to have a five-minute call with him. I thought, "Okay, what's going on here?"

Goldman: Uh oh.

Greek: When John told me about the award, I was stunned. He probably got off the call and thought, "She's not excited about this at all," but it all just seemed surreal.

Goldman: I understand. The award is given to individuals who have made a significant contribution and demonstrated leadership in workforce development and so forth. What is your involvement with IPC, and how long have you been working on this?

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BY TAIYO

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Greek: I became an IPC trainer in 2014. Our site was requiring several of the IPC CIS programs and our training department needed help transitioning our workforce over to the new training program. I was literally pulled out of the dark, as I was a test technician who worked in a darkroom all day. The IPC certification programs were completely new to me, so I was a bit intimidated. However, I found that teaching the programs that they have set up is fantastic because they are pre-packaged and consistent across the industry.

After I became a Master IPC Trainer, David Hernandez had contacted me and wanted to hear how things were going and what thoughts I had about the programs. Through those discussions I explained that living in a rural community, many we hire are new to the electronics industry. When we would put new hires through the CIS classes, there was an obvious skill gap that we were struggling to bridge with them because the courses are written for engineers. I asked David if there was any plan for foundational training that would give those new to the industry a baseline. The IPC team set to work to develop this amazing Workforce Development Training series. We had many calls about what problems we needed to resolve. The whole process was amazing since I had never had a business relationship with a company like that before.

Goldman: Have you been attending IPC meetings or committee meetings or anything like that? Helping to build the program?

Greek: I have been involved with a couple of Task Force committees in the past. However, this project evolved through “Voice of the Customer” type meetings with the education department at IPC.

Goldman: How have the programs been working out since you’ve been working with IPC?

Greek: I honestly couldn’t be happier with the way things turned out. When COVID initially hit, we were not allowed to do classroom training, but I still had people that I had to keep certified. We work in aerospace; you can’t have gaps. The workforce training series was in development at the time so I contacted David to see if it could be released early. Since it wasn’t quite ready for production, the team allowed us to start doing the beta testing.

We were able to provide feedback to them, to fix some bugs, and things like that. We were the first group to go through once it was in production and all my students loved it. I was worried at first because I was used to being in the classroom with my students and I wasn’t sure how much they would retain. When they come in for the in-person skills development portion of their certification, I would tell them a requirement and they would say, “Oh yeah, I saw that in the video.” For someone who has never touched a soldering iron in their life, it takes a while to build those skills. Since they’ve seen it so many times on those videos, it’s like they walk in knowing what’s going to happen and they can prepare for it mentally. There’s a lot less stress and anxiety with my students. Like I said, they’re retaining more and it’s just a fantastic program.

Goldman: Is most of your certification for assembly?

Greek: For the most part, I work with our assembly groups. However, as an MIT, I also certify other trainers and engineers in our network.

Goldman: I take it that the training materials are then available to your



people whenever they want them, whenever they want to review or refresh.

Greek: Yes, and they can go back and review the material.

Goldman: It's interesting that you don't really get to IPC meetings but have still contributed a great deal—as evidenced by this award. Do you have any additional thoughts on the award or on IPC?

Greek: I think of it as the squeaky wheel award. I am just thrilled that IPC was so willing to take what trainers were saying and really take action to resolve those issues.

Goldman: Maybe a squeaky wheel but also the beta tester, providing input, working on the program, and providing feedback, which obviously helped shape the training materials. I don't know if that makes you a squeaky wheel, but maybe like a steering wheel?

Tabbatha, it's been very nice talking with you. Thanks so much for your time and again, congratulations.

Greek: It has been great talking with you. Thank you so much. **S&T**

Automotive Initiatives Make Headway at IPC APEX EXPO

By Tracy Riggan

IPC SENIOR DIRECTOR, SOLUTIONS

A significant number of automotive activities made notable strides at this year's IPC APEX EXPO. Several committees dedicated to creating and updating automotive addenda for existing IPC standards, like assembly processes, PCB fabrication, and high-voltage cable, met and were led by companies like Toyota, Bosch, Continental, and Elmatica. Automotive dedicated groups, like the Cold Joining/Press-fit Task Group, also met and discussed inclusions in its next planned revision. As part of the IPC-6012 Automotive Addendum Task Group meeting, the group brainstormed high voltage considerations in the next revision or as separate standards, building on discussions that took place during task group meetings in conjunction with productronica 2021.

Additionally, automotive was a component of educational programming, with several courses and technical papers presented throughout the week. The Press-fit Technology Deep Dive course



outlined key design processes and how to use the standard for process, quality, and design/development engineers for manufacturers and OEMs who use electronic components. Vern Solberg, Solberg Technical Consulting, conducted a course on PCB design which addressed flexible and rigid-flex applications and design principles for automotive use environments. Automotive leaders also

took the stage on innovative technology, electrical test methods, and artificial intelligence in the SMT inspection process.

The IPC Transportation Electronics Council (ITERC) met to review global industry survey results and discuss necessary next steps for assuring automotive electronics reliability. The council, comprised of automotive OEMs and key automotive suppliers, engaged in thoughtful discussion about standardization and industry needs. The group generated a dynamic list of action items.

To learn more about or become involved in IPC automotive initiatives, contact TracyRiggan@ipc.org.

The IPC STEM Event Inspires



Interview by Barry Matties

I-CONNECT007

Once again, IPC APEX EXPO featured its successful STEM event, organized by the IPC Education Foundation, and sponsored by several companies, including I-Connect007. The event had nearly 80 students in person for a hands-on introduction to our industry. After the welcoming comments, the students broke into groups for different activities. While some enjoyed a guided tour of the show floor, upstairs the other students learned how to solder. Then they rotated so that they all had the same opportunities.

These students, many of whom were having their first exposure to the world of electronics, kept focused on the task in front of them—solder a small circuit board that would make a connection for two LEDs to illuminate on the opposite side of the board.

Students sat four to a table, a hot soldering iron next to them, a paper full of instructions, and a chance for some true hands-on learning. As the students worked, volunteer IPC committee members and Emerging Engineers roamed around, helping students where needed and remembering back to their own first experiences in the industry.

Of course, when you set several people at a table to complete the task it can quickly turn into a fun competition. We caught up with two students who did just that (See the video on page 112).

Though this a STEM introduction event, we learned that several of the students we talked to had little intention of pursuing a career in electronics. Nonetheless, the exposure to the industry demonstrated that possible careers

are much larger than they may have imagined before attending the IPC APEX EXPO event.

When asked about their career paths, here are some of their responses:

- I want to be film director
- I'm looking for nursing
- Marine biology
- A career in the film industry
- Probably a STEM field
- Owning a business, having my own business
- I don't know, but something in the music industry hopefully
- Apprenticeship, electrician

During the event we also interviewed one of the teachers who brought her students to this event and past events. She expressed her desire to continue bringing students to the event because it broadens their horizons and demonstrates new opportunities.

Barry Matties: Hello, nice to meet you. You're the teacher of these students?

Melissa Woods: I'm the internship and workforce development coordinator at e3 Civic High, a charter school here in San Diego.

Matties: Is this your first year here at the STEM event?

Woods: Actually, this is my third year, if I'm not mistaken, coming here. I usually bring just a small group of kids. But all the time when I bring kids, they love it. And they come back and say, "Oh, okay, I might consider this." And I believe, of the three years, I've only brought maybe 15 kids each year. But of that group, we've had a couple actually go ahead into this career path.

Matties: The students who continued their path, are you still in contact or are you aware of where they're headed in their careers?



Woods: I'm not still in contact with them. I just know that when they graduated, they said that this is what they're going to be pursuing.

Matties: And why is your school taking part in this program?

Woods: We want to make sure that we give our kids opportunities to see different paths, ones that they may not be aware of so they can make informed decisions on their future.

Matties: That's excellent. We need more of that, don't we?

Woods: Yes.

Matties: Good. Well, congratulations and thank you for being here. We really appreciate and welcome you.

Woods: Thank you so much. I appreciate the opportunity to come and bring students.

In the end, the event is very important to the future of our industry. We certainly appreciate all the efforts of the IPC and the volunteers to make this possible. **S&T**

IPC APEX EXPO From a College Student's Perspective



By Hannah Nelson

VALPARAISO UNIVERSITY

My name is Hannah Nelson, and I am currently a junior electrical engineering major at Valparaíso University. I was given the honor and privilege to attend the IPC APEX EXPO as the new student director on the IPC Board of Directors. The student director position is used as a voice on the board for all IPC student chapters. It is a way to bridge the barrier between the educational system and the elec-

tronics industry and bring students toward the Factory of the Future. By attending APEX EXPO, I was given the opportunity to expand my knowledge regarding the needs of students who are heading into the industry.

The experience I was given through APEX EXPO was unlike anything I have ever experienced. I met several individuals from around the globe, from China to France to Canada.

I found it incredible to connect with people around the world through one common denominator, electronics standards. Being surrounded with such a diverse range of individuals has not only given me the opportunity to connect and learn more about the industry, but also become an essential part of the Factory of the Future.

I was able to attend professional development and technical courses, and participate in the voting process for committee meetings. I even had the opportunity to get outside my comfort zone and talk to people working for companies such as NASA, Honeywell, and Lockheed Martin. This semester, I started taking Dale Carnegie, and one of the most important things he says is to listen to others more than talking about yourself. I took that principle into action, and it helped me feel comfortable talking to different CEOs, learning the secrets to their success in the industry. I was even given the opportunity to sit at the front table looking out to the audience of the awards ceremony and be recognized as the student director on the board of directors for IPC. As



a college junior, at first it felt intimidating (and it still partially is), but I feel like this place and these people are where I am meant to be. The best feeling of all is that the environment at APEX EXPO felt like a home away from home. Now I know that I can make a change in the way education is viewed in the industry, and I can't wait to see what the future holds.

Continues on page 112

IPC APEX EXPO: Conference Speakers Speak Out

Solder Alloy Contribution to Robust Selective Soldering Process

Presenter: Gerjan Diepstraten,
Advanced Technology Manager, ITWEAE

What is the most interesting question that your IPC APEX EXPO presentation answers? Some new solder alloys were recently introduced into the market. Some are low-solder temperature alloys, but a variety are also high-reliability alloys that cover the gap after eliminating SnPb. However, some of these alloys are not compatible with selective soldering. This will be explained in my presentation.

What is your answer to that question, and why?

The answer is that some alloys have concentrations of Cu and or Ni that generate needles, and the composition of these alloys falls apart.

What is the most important piece of advice that you have for your audience? Select a lead-free alloy that has a stable composition and low risk of decomposing. I offer recommendations for the most advantageous solder process conditions and solder composition management.

While at APEX EXPO, I was given so many new opportunities to expand my own horizons. I was given a mentor, Jason Keeping, who gave me several opportunities to expand my network and help me learn more about what goes into the industry. He encouraged me to attend events that were meant specifically for networking, such as Trivia Networking Night and the ice cream social on the show floor. I also attended the Women in Electronics networking event. This event gave me the opportunity to connect with several other strong women in the industry and learn that I was not alone—they are or have experienced similar issues in their own careers. I was even given the opportunity to attend the STEM education event, where I taught high school seniors how to solder. At this event, I was able to give my own experience in the industry and saw the excitement in their eyes. Through these events I learned that I want to help encourage more women not only in college but as young as middle school to get involved in the STEM field.

Overall, this experience changed me not only in a professional sense, but also as an individual.

Just as Dr. John W. Mitchell had said, I need to surround myself with good people to grow in this industry. I learned that through hard work and putting yourself out there you will be able to prove yourself and fight for what you want in your own career path. I also learned through Nilesh Naik not to undersell my worth in the industry. The most important thing I learned was to treat employees and employers like they are real people. I have always felt like it was difficult to talk to these people, but after having dinner with the Board of Directors. I soon learned that the CEOs of these diverse companies are not only known for their dedication to the industry but also for being genuine individuals. They welcomed me at their table and supported me in my future endeavors. APEX EXPO has taught me that I have the opportunity to bridge the gap between engineering school and the workforce. I can bring more employers to schools not only around me but around the world, and I can help students thrive in their future careers.

Hannah Nelson attends Valparaiso University as a presidential scholar, where she is pursuing



an electrical engineering degree with a mathematics minor. She serves as the president of the IPC Student Chapter at Valparaiso. Nelson is also the public relations chair for IEEE and a Hesse tutor for STEM education. She is

a corporate intern and parallel co-op engineer for Caterpillar, Inc. In addition, Hannah is a year-one Emerging Engineer in IPC's Emerging Engineers Program. **S&T**

Voices of the Show: Bob Neves, Microtek Laboratories China

Interview by Nolan Johnson

Nolan Johnson gets insight from Bob Neves, president of Microtek Laboratories China.

Nolan Johnson: Welcome Bob, so glad to see you here.

Bob Neves: Good to see you. So good to be seen, I think.

Johnson: That's my question, are you glad to be here?

Neves: Absolutely. It's been two years since we've really come face to face at a show like this. I was at IPC SummerCom in Milwaukee and that was our first toe in the water with getting back together. It was nice to have people there, but here it's really nice to get back in and see that the technical committee sessions are better attended and we're meeting face to face rather than on Zoom. It's been effective, but it's just nice to put a face to voices and see how people are doing.

Johnson: I agree. Personally, you and I were just getting introduced to working together as we went into lockdown. So, most of what we've done has been through teleconference.

Neves: That has created a tool that I don't think is going to go away, even if the pandemic goes away. Moving forward, I think we're going to be using the things we learned during the pandemic. It should be interesting to see how we integrate the face-to-face with the digital presence and maybe that will make digital presence a little better, rather than just a blank thing on a square on a Zoom screen; maybe we'll get more of a telepresence. Maybe *Star Trek's* holodeck will finally make its presence known in our universe.

Johnson: Right. Speaking to you as a board member with IPC, what are some of the objectives that



you want to see accomplished here with this edition of IPC APEX EXPO?

Neves: Well, the needs of our industry haven't gone away. The pandemic has not reduced the needs of our industry; in fact, in many ways it's made it more challenging for our industry, from a supply chain standpoint, education, and hiring standpoint. From the IPC board's perspective, I believe we want to continue to create an environment with the IPC that helps our members address the issues of the day, whether that's

government relations, education, hiring, standards development, obviously here at the trade show itself, getting new equipment on the floor, or getting people to improve their manufacturing processes. It's been sad that we haven't been able to do as much as we wanted to do, but now that we're right here at the edge of moving forward, we decided we would move forward with the trade show.

Obviously, it's not as well attended as it could be, given the circumstance, but it is better attended than we expected and does give an opportunity for the people who are willing to come out to get more of a sense of normal again and you get to recognize how people look, just looking at their eyes. That's the hard part for me. I know this person under the mask, but it just doesn't click in my brain, so we need to make the font on the badges a little larger.

Johnson: There's a good one.

Neves: I'll put in the larger name badge font recommendation for our next gathering because it's a little harder to recognize people by just seeing their eyes. If my phone can't recognize me with my mask on, then how are other people going to do that?

Johnson: Thank you for your insights.

Neves: Thank you, Nolan.





IPC EMS Leadership Summit: Peer Solutions to Supply Chain and Labor Development



By Tracy Riggan

IPC

EMS leaders gathered for the EMS Leadership Summit on Monday, January 24 at IPC APEX EXPO. Expert and peer presentations on priorities ranging from the economy to the supply chain, cybersecurity, and software were interspersed with peer-to-peer discussions on several key topics.

Supply Chain Challenges a Top Concern

Though the Supply Chain panel consisting of Tom Edman, TTM Technologies Inc.; Alex Iuorio, Avnet; and Tom Vanderheyden, TTI, Inc. could not provide a clear end to the current supply chain constraint, the EMS audience was

grateful for an open and spirited discussion. The panel suggested that a Just in Time (JIT) strategy will need to be used in combination with other strategies like managed inventory, and that design owners will need to be more active in the future.

All agreed that steps can be taken to improve the situation, including automation of forecasting, programs to mitigate cash problems, and most importantly, building relationships with distributors and manufacturers. The panel encouraged the audience to provide more visibility and insights through web-based services to allow them to help drive better decisions

and be trusted advisors. As Vanderheyden commented, “True partners manage through a crisis together.”

Economic and Policy Impacts Highlighted

IPC Chief Economist Shawn DuBravac provided a comprehensive overview of the current economic and supply chain situation, commenting that while the supply chain crisis has probably peaked, a lot will remain elevated. Jack Calderon and Chaim Lubin, Lincoln International, also shared that there is a high level of mergers and acquisitions (M&A) activity with EMS consolidations rising significantly and market values increasing, though market valuations are being challenged under current supply chain conditions and are expected to level off. Additionally, they shared that the “super-cycle” will continue to be a key driver of industry growth and M&A.

Chris Mitchell, IPC’s vice president of global government relations, shared the stage with colleagues Alison James and consultant Jared Weaver of Salt Point Strategies to update the group on the many relevant advocacy initiatives and activities both in the U.S. and globally. Weaver delved into legislative developments around the U.S Innovation and Competition Act (USICA), the CHIPS Act, and the Supporting American Printed Circuit Boards Act.

Mitchell and James covered environment and trade regulations and stressed the importance of knowing European regulatory initiatives, even for those not directly engaged with customers in the EU. Mitchell updated the group on North American-focused activities, including original research like IPC’s recent 2021 North American Advanced Packaging Report and new research on the loss of the PCB industry in the U.S., “Preventing the Loss of Another Key U.S. Industry Requires a Holistic Solution to the Semiconductor Crisis.” Member supporters of IPC advocacy initiatives confirmed IPC’s increasingly influential voice in Washington.

Potential Industry Solutions From Peer Roundtable Sessions

The highlight of the day, according to attendees, was the opportunity for roundtable discussion which focused on solution sharing, leader development, and industry growth. Leader development, as well as labor acquisition and retention, were top of mind with the group as they shared tips and brainstormed ideas both at the company and industry level. Some of these ideas built upon IPC Vice President of Education Dave Hernandez’s update on currently available educational programming for EMS companies, including the Electronics Assembly for Engineers and Electronics Assembly for Operators courses. Inspired by the supply chain panel, the group also generated potential supply chain constraint solutions and alliances on which discussions are expected to continue. Many additional best practices were exchanged during the evening’s lively networking dinner.

CMMC Implementation Tips Appreciated

While the Cybersecurity Maturity Model Certification (CMMC) has been a moving target, Todd Brassard, Calumet Electronics, and Ryan Bonner, DefCert, laid out considerations



and tips for both CMMC and general cybersecurity preparedness, touching upon requirements like the 320 assessment objectives which apply to CUI assets as well as security assets. While there is no turnkey solution, Bonner advised being content with kickstarting new process areas and building into them, as the substantial price tag and 12–18-month timeline can be daunting. Bonner highlighted that the challenge isn't implementing the technology but rather the procedures and documentation. The IPC Trusted Supplier Program was also mentioned as a resource.

Manufacturing Technology and Business Tools Best Practices Highlighted

The EMS Steering Committee is continually searching for industry peers who have unique or proven approaches to solving process or business challenges. This year, the group wel-

comed quoting software users Deb Gude of Spartronics and Charles Capers of Zentech to share their direct experiences with multiple tools. Additionally, former EMS peer, Robert Toppel of eElectron, outlined robotic automation best practices for low- to medium-volume electronics manufacturing.

More EMS/Contract Manufacturer Content Planned

To keep the industry up to date, build on discussions, and address timely issues, the EMS Council is planning updates throughout the year. To stay informed of IPC EMS Council content and updates, contact [Kelly Lawrence](#), IPC member success advocate. **S&T**

Tracy Riggan is IPC senior director, business development, solutions.

IPC APEX EXPO: Conference Speakers Speak Out

High-Temperature Thermal Cycling Reliability Testing of a High-Reliability Lead-free Solder Alloy

Presenter: Jasbir Bath,
Support Advisory Engineer,
Koki Solder America

What is the most interesting question that your IPC APEX EXPO presentation answers? The most interesting question the presentation answers is thermal cycling assessment of lead-free solder joints with an increased temperature limit of +150°C. Data at this higher temperature limit is limited in the industry with a need for data in this area based on increased product temperatures in the field.

What is your answer to that question, and why? Results showed that the high-reliability lead-free



solder alloy Sn3.5Ag0.5Bi6In0.8Cu (SABIX) had better thermal cycling reliability during -40°C to +150°C temperature cycling compared with lead-free Sn3Ag0.5Cu alloy. This was due to the elemental additions in the developed alloy helping to provide ductility in the solder joint as well as a strengthening effect.

What is the most important piece of advice that you have for your audience? You need to fully evaluate your material choices when assessing the reliability of your products, especially for high reliability applications, to help avoid product issues in the field.

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Supply, Sustain, Socialize:

The Three S's of IPC APEX EXPO 2022



By Zac Elliott
SIEMENS

IPC APEX EXPO 2022 brought many exhibitors and attendees to San Diego to explore state-of-the-art solutions in electronics manufacturing. Three key themes emerge in my mind as I reflect on the expo—supply chain, sustainability, and socializing.

Supply Chain

Because of the recent chip shortages, much attention has been given to the stressed supply chain that all manufacturers are now forced to

manage. As manufacturers are driven to look for second source and alternate parts on the market, there are significant concerns about supply quality and cost. The new acquisition, Supplyframe, was the most popular topic in the Siemens booth, drawing attendees interested in managing these risks and improving their design-to-source capabilities.

Another supply chain topic receiving significant attention is counterfeit materials. The current chip shortages provide the perfect envi-

ronment for counterfeiters to slip inauthentic materials into the component supply. While the IPC and industry leaders work on the design standards and risk management protocols needed to improve the situation in the long term, innovative technology can provide immediate risk management solutions. One solution that I found particularly interesting utilizes artificial intelligence to inspect every individual component through the SMT machine's existing component alignment images. The technology creates a digital footprint of each component and can detect and prevent the placement of any component that does not match the set manufacturer, lot, age, and more.

The supply chain is often perceived as something external—components come in and products go out. Yet at APEX EXPO, there was also a strong focus on the internal supply chain used to manage all the logistics needed to store, transport, prepare, consume, return, and dispose of materials in the factory. Automation is key to the internal supply chain, with many exhibitors offering robotic storage towers, smart storage shelves, and autonomous vehicles to store, transport, and return mate-

rials. The increased focus on the automation of internal logistics is opening a new, growing domain for information processing within the factory, known as intra-plant logistics or IPL. As manufacturers implement automation, there is a real need to coordinate between the schedule from ERP, the consumption of materials on the line, and the automation layer to enable a lean delivery flow of materials. I expect to see the IPL domain growing over the coming years.

Sustainability

I was happy to see sustainability becoming a focus at the show. For many years the electronics industry was considered the savior for less environmentally friendly industries. Automation and digitalization provided a path to “go green” by streamlining manufacturing processes, managing power consumption, and reducing emissions. However, as the pace of churn in consumer products has increased and as technology is moved to large data centers in the cloud, the waste produced by electronics and the carbon footprint of the electronics industry is receiving more scrutiny.



In the equipment vendors' booths, equipment power consumption is becoming a key differentiator with the competition. Attendees looking to invest in new equipment are starting to consider the cost and emissions required to operate the machines and factor these into the total cost of the investment.

I was happy to see sustainability becoming a focus at APEX EXPO. For many years the electronics industry was considered the savior for less environmentally friendly industries.

On the software side, there are many trends impacting sustainability. New manufacturing execution systems (MES) can track energy consumption during manufacturing and provide the analytics needed to improve power usage. In addition to monitoring power consumption, manufacturers are looking to software to streamline their production schedule or even reorganize their factories to eliminate waste, improve power consumption, and reduce emissions.

Socialize: Meeting in Person, Finally!

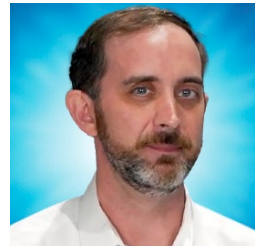
IPC APEX EXPO 2022 provided the perfect opportunity to meet face-to-face with colleagues, clients, and partners from whom we have been separated for the past two years. After working almost completely remotely since the pandemic began, I nearly forgot how productive it can be to sit with a partner to discuss a challenge, or the understanding that can be gained over a drink or bite to eat.

I was pleasantly surprised by the attendance

at the show. I had expected a small crowd of attendees who were very focused on solving specific problems. What I found were much larger crowds with broad interests. Many visitors to the Siemens booth came in groups with cross-functional representatives from engineering, operations, quality, and procurement, indicating that the challenges being encountered today and the opportunities for improvement reach across organizational boundaries with requirements affecting all parts of the business.

Looking Ahead

Attending IPC APEX EXPO 2022 was the perfect way to start the year. It was a great opportunity to talk face-to-face about the challenges and opportunities in the industry. I'm already looking forward to APEX EXPO 2023. **SET**



Zac Elliott is technical marketing engineer for Siemens Digital Industries Software, and an I-Connect007 columnist. To read past columns or contact Elliott, [click here](#).

Additional content from Siemens Digital Industries Software:

- [The Printed Circuit Designer's Guide to... Stackups: The Design within the Design](#)
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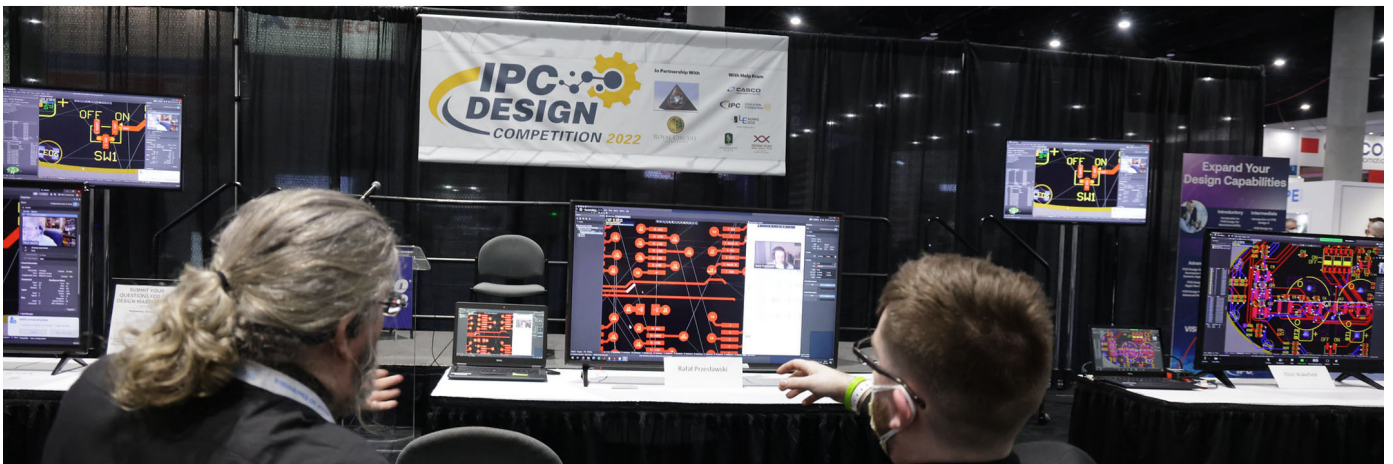
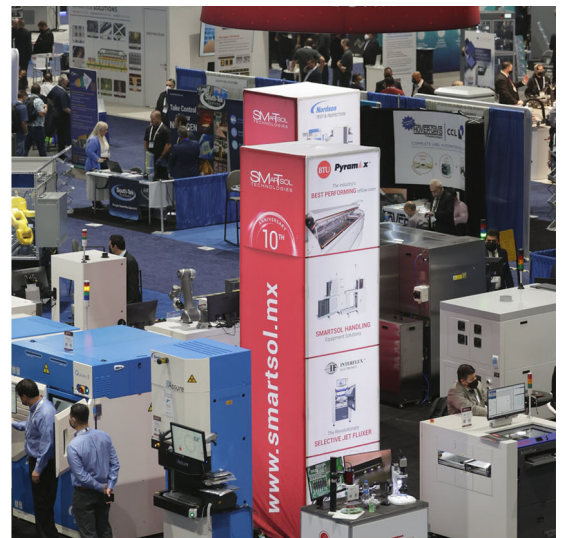
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IPC APEX EXPO: Conference Speakers Speak Out

Impacts and Challenges of AME, From Design to Data

Presenter: Michael Schleicher,
PCB Designer, SEMIKRON

What is the most interesting question that your IPC APEX EXPO presentation answers? How will a PCB made with additively manufactured substrates be designed in the future?

What is your answer to that question, and why? To achieve the benefits of additively manufactured electronics (AME), a new way of thinking about design and new design tools are needed. The classic multilayer PCB design process is not adequate



for additive, because no copper layers are used in additive manufacturing. These designs are produced “dot per dot” in lateral and vertical dimensions.

What is the most important piece of advice that you have for your audience?

The additively manufacturing process is not comparable in terms of cost with standard manufacturing processes, especially for large series. The benefit comes from the higher integration, adaptability, and lower space requirements for the customer application. To exploit this benefit, a new tool and manufacturing chain is required.

Jessie Vaughan: An Emerging Engineer in Practice



Jesse Vaughan, Technical Sales Engineer and year three participant in the IPC Emerging Engineer program, shares with Nolan Johnson how this experience has accelerated his career path.

IPC APEX EXPO: Conference Speakers Speak Out

Lead-Free Low-Temperature Solder Paste for Drop Shock-Critical Applications

Presenter: HongWen Zhang,
Manager of Alloy Group, Indium

What is the most interesting question that your IPC APEX EXPO presentation answers? The need for a low-mid-temperature solder, addressing the drop-shock-critical application without loss in TCT reliability.

What is your answer to that question, and why? Durafuse LT and the second-gen pastes, reflowing as low as 190°C peak temperature, provide excellent drop-shock performance (at least comparable



to SAC305 and two orders of magnitude superior to BiSn+) and the comparable TCT (-40/125°C) to SAC305.

What is the most important piece of advice that have for your audience? For any applications of drop-shock-critical and low-mid-temperature-flow required, Durafuse LT will be the exclusive solder solution. It can be used for step-soldering following SAC soldering or directly for mainboard soldering to replace SAC305 pastes with reflow profiles of wide range of peak temperature from 190°C to 245°C.



John Mitchell Keynote Review: The Future is Now

By Pete Starkey

I-CONNECT007

“Welcome to APEX EXPO. It’s a thrill to be together again, here, now, in San Diego!”

The energy and enthusiasm of IPC’s president and CEO, Dr. John Mitchell, was clearly evident as he paced back and forth on the rostrum during his morning keynote address to open up the 2022 show.

Acknowledging the invaluable contributions of the IPC staff and dozens of industry volunteers in making the event possible, he declared it a testament to the importance placed on industry collaboration, profes-

sional development, and technological progress—fundamental constituents of a community drawing insight and inspiration from one another and committed to building electronics better in every possible way: technologically, environmentally, and economically.

He reflected on the state of an industry that is growing bigger and faster than it has for years, in spite of circumstances that have scrambled supply chains and caused shortages of materials and components amid rising costs.

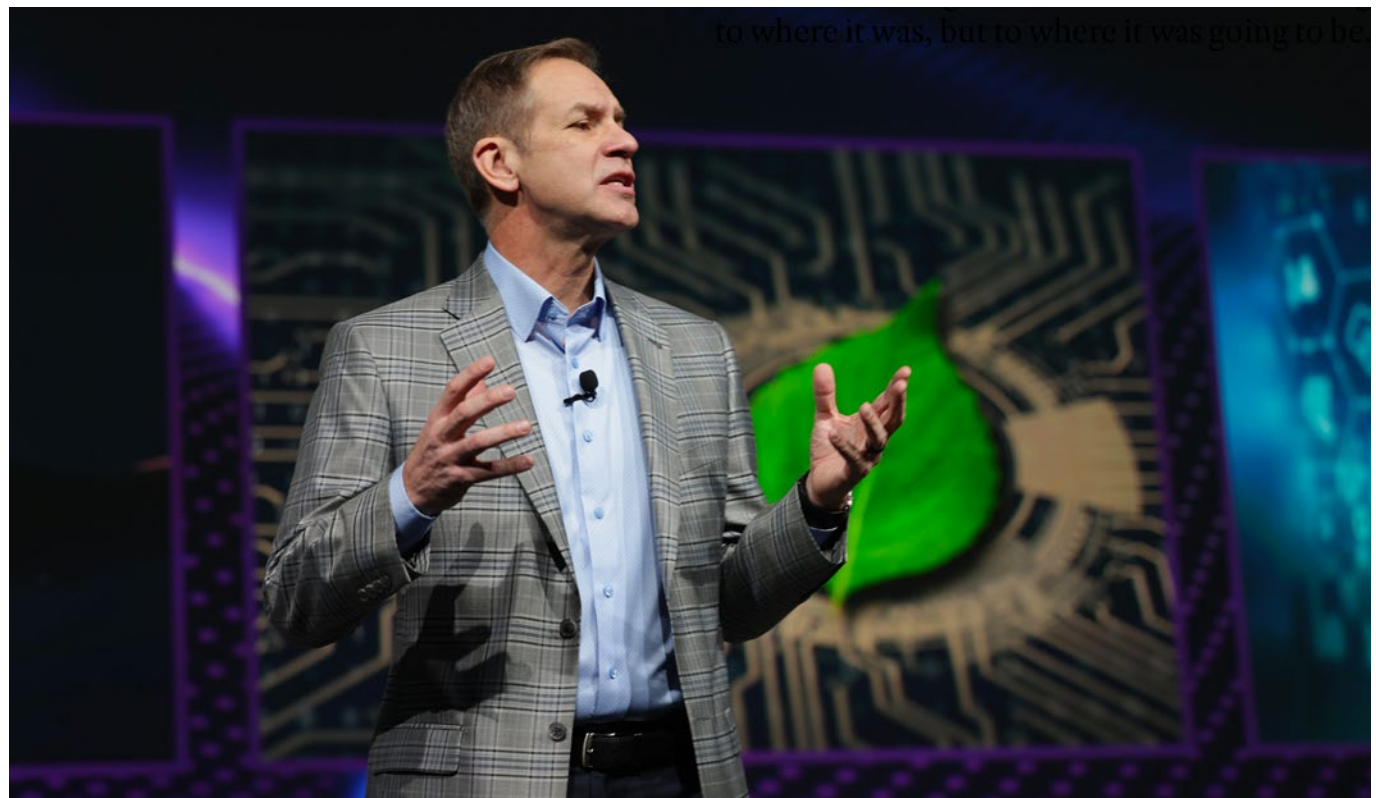
Nevertheless, there are many opportunities. Worldwide, there is an increasing demand for durable goods, including electronic devices, and there is an increasing proportion of electronics in almost everything. Digital transformation can be seen in most sectors of the economy, especially telehealth technology and real-time telemedicine, which has been accelerated by the pandemic. There have been enormous advances in electronics in the automotive sector and its related infrastructure. Solid growth is predicted and now is the time to put in place the tools and the people needed for the industry to thrive in years to come, a collective drive toward the Factory of the Future.

Mitchell was confident that electronics manufacturers are ready to meet future demands with grit, ingenuity, and determination. But succeeding in the electronics industry is never easy. Companies cannot rest on their laurels; competition is too tough, and the pace of innovation is too fast.

He was enormously impressed with the powerfully creative ways in which young people are

using technology. That spirit is necessary now more than ever because the industry is changing faster than ever. Industry similarly needs to embrace change with purpose and passion, or risk being left behind. He included an analogy of riding a bicycle at increasing speed along a road that has become progressively more perilous. A modest incline after a sharp climb could be perceived as a “false flat,” and what might have been seen as an opportunity to relax a little actually presented a further challenge that could sap physical and emotional energy.

Companies could find themselves in a “false flat” situation, in the mistaken belief that “the future is tomorrow” instead of realising that “the future is now.” The traditional practice of sitting back and waiting for larger organisations to chart the future and invest in the paths to new technology is no longer appropriate; it could easily result in being left behind with outdated skills and superseded technology. “Companies that expect to lead tomorrow must not only deliver the goods promised tomorrow, but also be planning and preparing to meet the





demands of the market the day after tomorrow.” Mitchell’s sporting analogy was a baseball fielder diving to catch the ball: not moving to where it was, but to where it was going to be.

His list of drivers to be understood and addressed included technological requirements, operational efficiencies, customer expectations, supply chain resiliency, and skilled workforce, as well as ESG (which I later learned stood for environmental, social, and corporate governance).

Somewhat surprisingly, he took time to admonish his largely North American audience: “You’ve got to stop thinking of the Factory of the Future as something way down the road. It’s now. If you’re not working actively toward it, you’re going to be left behind.” He reminded them that because Europe and Asia had longer-term vision, North America is already five to 10 years behind. Europe has recognised that a digital transformation is fundamental to its future economic security.

Returning to his list of drivers, Mitchell discussed each one in detail, beginning with technological requirements and referring to the recently published report analysing the North American semiconductor and advanced packaging ecosystem, authored by IPC’s Matt Kelly and TechSearch’s Jan Vardaman. The fact that advanced packaging was a strategic consider-

ation for PCB and EMS companies reflected how far the industry had progressed in packaging density, demanding finer and finer conductor traces while maintaining quality and reliability amidst rapid innovation. Keeping pace will not be cheap. Yesterday’s manufacturing equipment will not meet tomorrow’s demands. Cleaner environments, greater automation, new materials, and new processes for additive and semi-additive manufacturing will all be required.

Operational efficiency was the next topic explored by Mitchell, with a neat example of a hospital’s intensive care unit learning lessons from the Ferrari Formula 1 pit crew, gaining an outside perspective in order to recognise obvious improvements they could make. He touched upon “big data,” new process theories, and communication between machines in introducing IPC’s CFX open industry standard, which is being adopted by the major equipment manufacturers and is leading the way in communication for the Factory of the Future. CFX was already bringing down costs and increasing productivity in electronics manufacturing. The prospect of combining its benefits with artificial intelligence was exciting.

Digital transparency enhanced customer expectations, enabling them to effectively see the factory floor from afar, to receive real-time

data on the progress of their orders, and to consider product design modifications. It could present some security risks but offered opportunities for trust and collaboration across the supply chain.

Supply chain issues will persist. The pandemic has disrupted a great many just-in-time arrangements, a reminder that supply chain resiliency doesn't come without trade-offs. Mitchell believes that companies will now rethink their supply-chain optimisation strategies to balance resiliency vs. risk, and digital transparency will assist in quickly identifying and resolving problems.

Not many in the audience, myself included, admitted to understanding the meaning of ESG. Mitchell predicted that, before long, everybody will be familiar with environmental social governance, and explained that investors are increasingly applying these non-financial factors as part of their analysis process for identifying material risks and growth opportunities before making investment decisions. IPC has already launched an ESG steering group to enable members to stay ahead of ESG obligations.

Mitchell confessed that the workforce challenge is his favourite topic. All the exciting changes already discussed in relation to the Factory of the Future are contingent on one thing—a skilled workforce. The challenge can be considered as two general challenges each with two areas to focus: talent acquisition and talent retention. Acquisition requires two actions: a pipeline of incoming talent and efficient onboarding of that talent. How do you bring in and effectively train people quickly? He was gratified to hear from the industry that IPC's operator training programmes have helped thousands into the industry. Retention presents two challenges: pathways for career progression and upskilling in an ever-evolving work environment. People genuinely want to get better.

A clear message for the Factory of the Future is that change is going to be a common

occurrence going forward. New skills will be required constantly. IPC will continue to work with the industry to help educate candidates as early as possible.

Mitchell's concluding question: So now what? The Factory of the Future is not "a goal to be achieved," however contradictory that might sound. There is always something new on the horizon and it will continue to evolve. "We must all become future-focused, every day," he said. "Now, more than ever, the industry needs each of you to shape the future. If you're not shaping the future, your competitors will be. Or worse yet, people in government offices with very little understanding of our industry, will be shaping our future for us, as they have in the past." **SGT**



Voices of the Show: Jerry Reitz, Chemcut

Interview by Barry Matties

While touring the show floor at IPC APEX EXPO, Barry Matties visited with Jerry Reitz at Chemcut, who demonstrates a new robotic arm that's easily programmable and frees up engineers to do other important work.

Barry Matties: We're back here at APEX EXPO after two years. What are your feelings about what's going on?

Jerry Reitz: I think it's great to be back, especially the break that we've had from it and everything that's going on. Business is good. I think people are looking to move on and get back into it.

Matties: It's really exciting. What do you expect to get out of this show?

Reitz: To just get back into it, see more customers, see new things, and introduce new products that we're offering.

Matties: Now, we're here at your booth and I'm looking at a robotic arm. Is this a new addition this year?

Reitz: At the beginning of the year, we partnered with a company out of the United Kingdom, and we're going to start offering it as a part of our material handling package.

Matties: So, the simplicity of this thing is quite good?

Reitz: Absolutely. You don't have to have any previous experience to program it. It can be done manually, or it can be done through the software that comes with the robot.

Matties: Now, one of the things I often hear about, particularly in our industry, is people say, "Well, automation isn't for me. We're small. We're prototypes. We're this. We're that." But this level of automation



is something that everybody should be considering. Would you agree?

Reitz: Absolutely, especially in the job market today. It's not meant to replace people. That's the first misconception. What we're doing is freeing up people. Instead of having a good technical operator that may have more experience and can do other technical jobs, he's now able just to load it, walk away, and let it do its thing. It takes out errors. A lot of times operators are placing it wrong, not intentionally, obviously, but it takes a lot of those errors away. That's the main goal here.

Matties: The other thing I'm noticing about this is footprint.

Reitz: Yes, a very small footprint.

Matties: It actually fits at the end of the machine. It's simple to install and simple to program?

Reitz: Yes. It can be taken off this machine, so if a customer doesn't want to buy multiples right away, he can take it off one machine, place it on another machine, and program it. After just a few minutes, he's ready to roll.

Matties: Is this machine capable of running or operating two machines side by side?

Reitz: Yes, absolutely. You can pull from one machine and move it over. The disadvantage of it obviously is the reach. You have a reach range difference, but we have customers that we've demonstrated to, where they're pulling from one and actually placing onto another machine.

Matties: Outstanding. How many units have you placed so far?

Reitz: We have about six right now that we're put-

ting in and we have a lot of potential prospects. The demos are what we are heavily into currently.

Matties: What sort of price point are we looking at?

Reitz: For what you're looking at right now, the base price for the robot, the stands, the whole package with the tablet and everything, is around \$25,000 to \$30,000.

Matties: So, what would you expect for ROI?

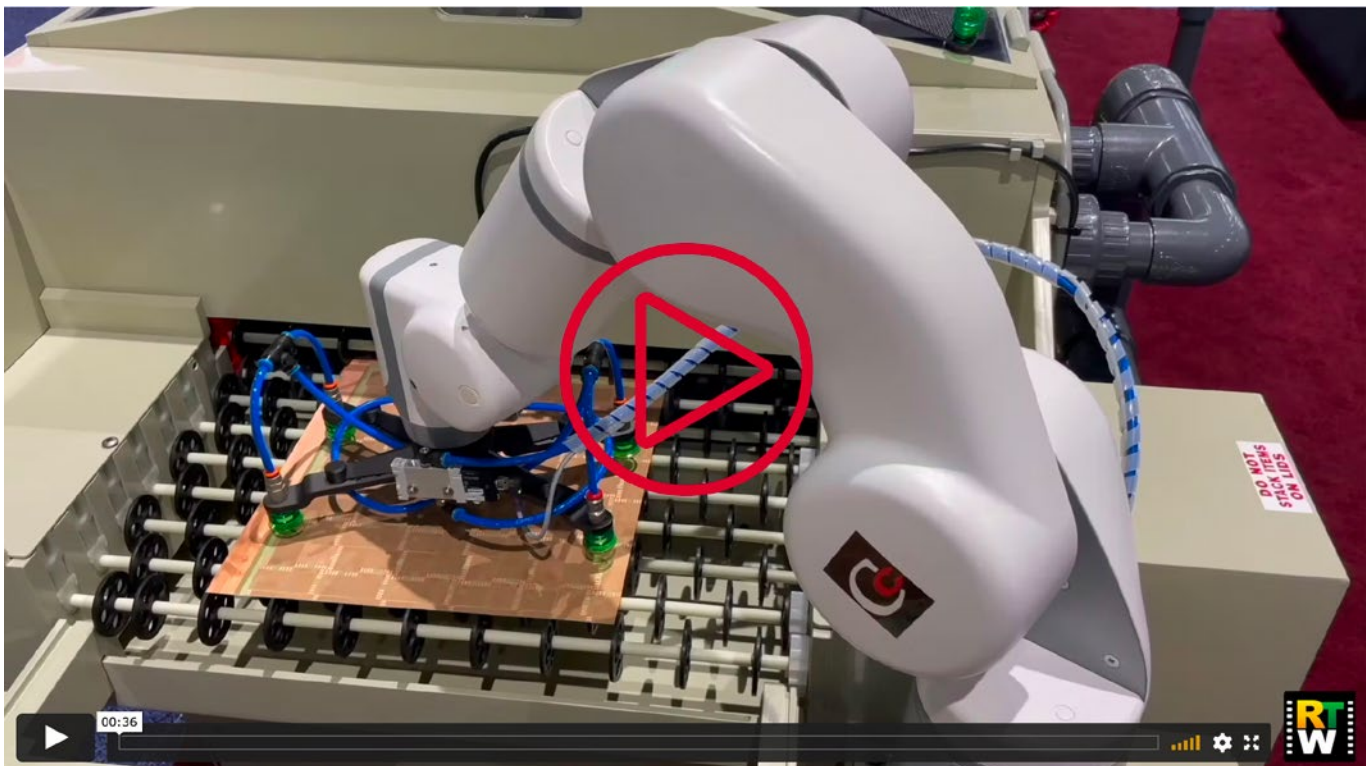
Reitz: Oh, less than six months, easily.

Matties: Also, it's not just the hard dollars. It's the soft cost of the employee now doing brain power work.

Reitz: Absolutely. That is the key. In many shops we go into, the shops are shrunk. They're using engineers now to feed panels and unload panels. Now, that engineer is free to do other things and more technical work.

Matties: I really appreciate you taking time to show me what you're doing here. Thank you so much.

Reitz: Not a problem. You're welcome.



Focused on Training



Corey Lynn

By Barry Matties

I-CONNECT007

During the STEM event at IPC APEX EXPO 2022 Barry Matties had a chance to talk with Corey Lynn of the IPC about training and education.

Barry Matties: Corey, you're the IPC marketing director for education. Is that correct?

Corey Lynn: Yes, I'm in the education group.

We work with workforce training, electronics assembly for operators, those kinds of products.

Matties: You're working with people who are in the industry and/or already employed?

Lynn: Yes, it's for businesses to help train their employees. A lot of those employees are brand new, maybe an engineer that's moving from a

different industry, or is coming straight out of college.

Matties: In John Mitchell's keynote, he talked a lot about the skills gap and how the IPC is helping to fast-track people from zero to operator level.

Lynn: That's a training curriculum called Electronics Assembly for Operators. There are about nine modules that take a student or new employee from zero knowledge about the electronics industry up to understanding safety ESD, and understanding the industry as a whole. One of the modules explains to them where they live in the industry, what role that they're playing, and how their actions can affect the product down the line, whether that's ESD safety, how to identify components, how to look at a bill of materials, or how to start to build things.

Matties: This is a program that an organization would bring in and then share with its potential or new employees?

Lynn: Absolutely. It's made for industry by industry. We partner with the industry, finding those subject matter experts; we've got trainers all over the world, with some of the biggest companies. Those folks come to us and say, "Hey, we've got this issue," and we've got a bunch of people who are really good at building learning materials. Their focus isn't so much on the technical side, but the learning side. How do you teach people this? We've done a good job of creating modules of learning and instruction that take a new hire from zero knowledge about the industry, so they end up being one of your more productive people; we get them on the floor faster. You're saving money when it comes to time off the line, but you're also getting a quality employee and that's going to lead to better quality products.

Matties: You're really focused on best practice and approach anyway?

Lynn: Absolutely.

Matties: What's the success rate? How do you measure your success?

Lynn: Well, that is a great question, because you're always looking for ROI on your training. What we saw with some of the people that piloted and some of the very early adopters of our program is we had one group that was able to cut about a day and a half out of training. That's getting people on the line faster, keeping them off the line for less time. Time really is the easiest one to measure. But do you also look at your line as far as seeing a reduction in rework? Do you see better quality product coming through? What are your inspectors seeing? That's a hard thing to document, but over time you should see better results.

Matties: Now, your program is really foundational, and the expectation is that the company will then augment that with their own programs, or do you have a continuation program to take them to the next level?

Lynn: That's a good point, because these are programs and learning tools that a trainer at a company uses in their arsenal of teaching tools. It's flexible enough that if your operator needs an understanding of wiring cable assemblies, there's an additional module that covers that. The trainer can customize the learning specifically to the jobs that their employees are doing. When they can do that, it helps them integrate that tool within their whole toolbox. There are additional things as well. If you want to learn how to navigate A-610 and your operators need a little bit more understanding of A-610 and how to navigate that document, the vocabulary of that document, there's an additional class for that; also for the

J standard, the WHMA, the WHMA standard, and the A-620.

Matties: You have a wide array of offerings in education. How does a fabricator or a manufacturer learn and understand the offerings and how to sort through those to find what's best for them?

Lynn: There's a lot of information online, of course. But Mike Hoyt, our learning advisor with the education team, is talking to people every day about how they can use these products, what some of the better tools are that we have, really understanding what the customer

is trying to accomplish, and then be able to say, "These are the tools that we think can add value for you."

Matties: You're really just communicating with them, understanding what their needs are and then presenting a customized package, if you will, to suit those needs?

Lynn: Absolutely.

Matties: Thank you very much.

Lynn: Thanks for the talk. S&T

IPC APEX EXPO: Conference Speakers Speak Out

Advances in Multi-level and Multi-material Additively Manufactured Electronic (AME) Circuits and Devices

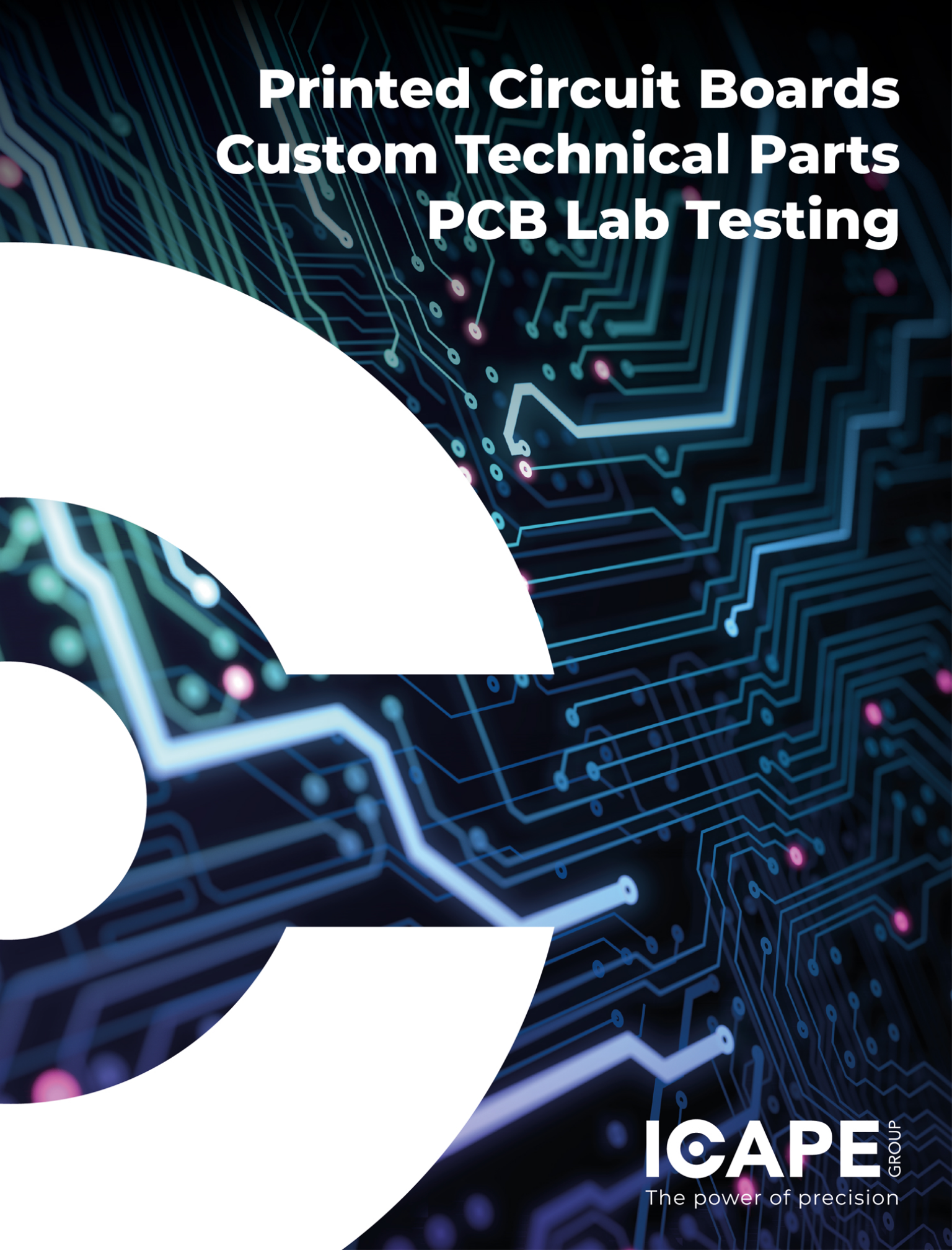
Presenter: Jaim Nulman, CTO and EVP,
Nano Dimension

What is the most interesting question that your IPC APEX EXPO presentation answers? How can AME (additively manufactured electronics) help advance the electronics industry?

What is your answer to that question, and why? AME is a 100% digital and additive process, with multi-material and multi-layer capabilities that enable the design and manufacturing of electronic circuits and devices with structures that are very difficult, expensive, and almost impossible with any other technology. With AME, the limit is only the creativity of the designer and the capabilities of the fabrication equipment. These will increase the potential to improve packing density for electronic components and the speed to production, not only for logic devices, but also for RF, and enabling the continued progress according to Moore's Law.



What is the most important piece of advice that you have for your audience? This is a new and very different manufacturing technology for electronic circuits and devices, so it is important to start working with it early in order to understand it, try out new design approaches and start taking advantage of its capabilities.



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Stakeholder's Paradise— Part Deux: **Show 'Review'**

By Kelly Dack, CIT, CID+

All in all, my columnist colleague Dan Beau-lieu's advice about making goals before attending a trade show was very helpful as I prepared to attend the IPC APEX EXPO this year. In my last column for *Design007 Magazine*, I mentioned I would be using this strategy to help get the most out of the show, with the objective of giving it back to you in the form of a post-show review.

Before leaving for the show, I submitted my unfinished column with a list of personal goals I'd hoped to accomplish, then hoped to write about as I am doing now. Here are seven things I accomplished:



1. Almost—but not quite—meet, interview, and sing a quick tech-song with IPC APEX EXPO keynote speaker and CBS tech correspondent David Pogue.

His keynote was a hotly anticipated event, and he did not disappoint. He spoke of new sensor technologies feeding the smartphone, EV, and robotics industries and how every new technology endured social and cultural resistance only to eventually be adopted by society and change the world. He mentioned early radio and television, then computer games and smartphones—at one time all emerging technologies—which older generations warned would harm or “rot the brains” of the adapting younger generation.

In case you didn't know, Pogue worked with Broadway musicals early on in his career and is quite a musician. He frequently holds speaking engagements and likes to incorporate his “chops” into his subject matter in the form of musical parodies. At the end of his keynote, the audience was treated to a delightful parody called “I want an iPhone,” sung to the tune of Paul Anka's “My Way,” made famous by his good friend Frank Sinatra. At the end of the day, I did not get an opportunity to interact with David Pogue; I walked by as I-Connect007 president Barry Matties invited Pogue into the I-Connect007 booth for an interview. I may not get to say “accomplished” on my Pogue goal, but I was happy to hear his take on technology.

2. Interview and thank the IPC Education Committee and the participants of the PCB design layout competition for all of their hard work in raising the need for designer education.

During the first day of the show, I met up with Patrick Crawford, who was busy running the finals of the IPC PCB Design Competition. Patrick introduced me to the judges for the competition while the finalists worked remotely, displayed on large, individual flat screen monitors, to finish their layouts. I had an opportunity to thank Patrick and the judges for resurrecting the spirit of the PCB design competition, raising awareness regarding PCB layout. Of note, none of the three designers in the competition had any previous training on the layout tools that were used for the competition. This fact alone speaks volumes for the easy-to-use modern layout tools.

3. Walk the APEX EXPO show floor, ask, and get answers about where CFX is going.

As I walked the show floor, I saw many triangular CFX signs indicating that the equipment and processes featured within the products are integrating with the smart factory data criteria. I was very happy to see that one of I-Connect007's own columnists, Dana Korf, was recognized by the IPC for leading the team, by starting and completing the new IPC-2551 International Standard for Digital Twins in less than a year's time. [Dana explained](#) that this standard provides the foundation for a complete bi-directional digital model for which the data from design and manufacturing can leverage for optimization of the design without a physical design prototype.

4. Connect via livestream with the AltiumLive speakers, thank them, and receive many questions from our livestream audience.

The IPC APEX EXPO show was run in partnership with the well-attended AltiumLive Connect 2022 show this year. While serving as a frequent guest editor for I-Connect007's Real Time with...IPC APEX EXPO show coverage, I also



served as the host of the AltiumLive event which was livestreamed to its audience from the APEX EXPO show floor. These collaborative partnership efforts served the entire PCB industry well. They fought against the pandemic issues to bring back live one of the largest PCB industry shows in North America, while AltiumLive simultaneously provided a livestreamed show, which not only covered design topics but made one of the best efforts I've seen to pull mostly live, design-oriented viewership to connect with the manufacturers, equipment, and process suppliers on the physical show floor. Stitching all this together into video content and print provides easy-to-find content for years to come. Thank you to the great folks at I-Connect007 who work tirelessly to provide overall industry coverage.

5. Connect and make good friends with at least 20 PCB stakeholders I have never met before on AltiumLive virtual networking.

Mission accomplished. There was no lack of new attendees to these shows. I will forgo the name-dropping for now, but I hope to introduce you to many of these fine PCB industry stakeholders in my [Target Condition column](#).

6. Gather with I-Connect007's Andy Shaughnessy, Nolan Johnson, and as many PCB industry folks as possible for spontaneous guitar jams.

From the show floor to the hotel restaurant, these were among some of my favorite down-

time activities. It's not always easy to lug your guitar onto a crowded airplane, but the camaraderie we felt during our jam sessions was always worth it. We made new friends along the way while strumming along to our favorite tunes.

7. Forget my NOOM regimen for a week and gorge on sushi.

I've always said that PCB industry events held in San Diego are great places to eat, sleep, and breathe all things PCB. What better place to seek out unique and even eclectic sushi creations? As it turns out I'm not the only one who had this hankering. One of my colleagues mentioned to me that he spent approximately \$190 on two finely-plated, certified sushi chef dishes. I was happy to head over to a moderately priced restaurant with a good friend, where we stuffed ourselves for around \$80. I also often popped over for local "grocery store sushi" for around \$12. It's a good step up from "gas station sushi" (of which I will not partake). Fortunately, I was able to keep my NOOM diet app from crashing due to the high calorie

intake by logging over 12,000 steps each day, and I returned home weighing one pound less than when I left for the shows.

There are no limitations for things to explore at these PCB industry shows with the exception of time. Taking Dan Beaulieu's advice to make goals for the show really helped me to seek out some new opportunities to connect. If I could add to Dan's advice from my own experience, hone your list down to a few goals and prioritize them accordingly. This year I made too many goals and physically could not complete them all. I will, however, slide them forward to next year. Always leave room in your schedule to explore the unknown and make new connections. **\$&T**



Kelly Dack is an I-Connect007 columnist. To read past columns or contact Dack, [click here](#).

IPC APEX EXPO: Conference Speakers Speak Out

FAS Chemistries and Materials: Their Essential Uses in Semiconductor Manufacturing and Products, Pending Regulatory Restrictions, and Response Strategies

Presenter: Kevin W. Wolfe,
Environmental Engineer, Intel

What is the most interesting question that your IPC APEX EXPO presentation answers? The most interesting question that the presentation addresses is, "What challenges will the electronics industry face from developing PFAS regulatory restrictions?"

What is your answer to that question, and why? The single biggest impact is likely to be disruptions

to the supply chain for any chemistries and materials that contain organofluoro molecular groups or materials like fluoro-polymers.

What is the most important piece of advice that have for your audience? My most important advice is to get your company involved as an active participant in an appropriate industry association with intent to thoroughly understand developments on PFAS regulatory restrictions, and to formulation meaningful actions and responses to them.

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Voices of the Show: Christopher Bonsell, Chemcut

Interview by Barry Matties

Barry Matties visits with Christopher Bonsell, a young chemical engineer at Chemcut, who's loving the variety that his job offers and the opportunities he's finding that he never imagined as a college student at Penn State.

Barry Matties: You are the process engineer, chemical engineer, at Chemcut. By industry standards, you're quite young. What attracted you to our industry?

Chris Bonsell: Honestly, I was introduced to Chemcut and the industry through some people I knew. They were involved with the company and then I started looking into it more, I realized it would be a great job. It's a very versatile industry and there's just so much to learn.

Matties: Yeah, there is. Tell me what a typical day is like for you as a process engineer.

Bonsell: Typically, I'm going back and forth between the laboratories. Normally we have customer visits, so they'll try to test different processes, but currently right now I am looking into how to better our machines so I will spend most of the day tweaking the machine, trying to find what will get you a better outcome on your products.

Matties: How do you define what a better outcome is or what's the parameter or metrics that you are setting for yourself?

Bonsell: Usually the main thing I'm focusing on is etch uniformity and the idea of trying to get a better etch throughout the entire panel. With larger panels, it's harder to get a flat curve because usually it etches slower in the middle than it does on the edges. Essentially the metric is just to try to get the lowest standard deviation as possible and we compare that to the bottom performance because you have gravity helping you whenever you're trying to edge the bottom of a panel vs. on top where you have a puddling effect.

Matties: Right. Now I've seen other companies do flip, so they etch one side at a time.

Bonsell: Yes.

Matties: To solve that, I've seen vertical takes on this. Puddling is something that's quite difficult to solve. How are you approaching that?



Bonsell: That is one process that Don Ball, one of our other chemical process engineers, is working very hard on, but one of the things that we use to counteract this is intermittent spray. This is a process where we let the panel pass through a little bit and then we will shoot etchant into the middle at a high pressure to start etching in the middle of the panel and get that started before it goes through the rest of the process. With this, you get a pre-etch before, that way you don't have a big amount. It kind of covers that middle part.

Matties: When you look at your career, where do you hope to be in five to 10 years?

Bonsell: I want to have a big hand in the research and development, trying to make sure that we end up making equipment that can produce a better product. I really want to help make advancements in, honestly, all industries. If we can try for thinner, flexible circuits, for example, because I know that's always a drive. Just trying to make sure that we can make a product that can put forward more technological advancements.

Matties: Now tell me about your degree. Where did you go to school?

Bonsell: I went to Pennsylvania State University.

Matties: Wonderful. And what's your degree?

Bonsell: It is in chemical engineering. I graduated in August 2018.

Matties: How long have you been with Chemcut?

Bonsell: I've been with Chemcut for about three years.

Matties: What has been the most surprising thing about this industry for you?

Bonsell: The thing is, when I was in college, I didn't know about this industry at all. It came to me as a little bit of surprise. When you're in chemical engineering classes, you don't learn about this kind of stuff. You know, you're usually learning about normal reactors, distillation columns—basically more of the actual chemicals industry instead of the actual manufacturing. I think that was one of the biggest surprises.

Matties: Right. So, when you entered school, what was your hope or dream job, if you will?

Bonsell: Honestly, I didn't exactly know what I wanted to do. I always wanted to get involved with



research, but I didn't know where that was going to take me.

Matties: Well, welcome into the industry. This is great. This is your first IPC APEX EXPO then?

Bonsell: It is my first one.

Matties: It's been two years since we've had the show. What's your initial impression?

Bonsell: Honestly, it's very impressive. I like it here. It's very interesting to see all these companies here and how many people have come and just how many people are interested in what we have to offer.

Matties: The robotic arm that you guys are introducing is...

Bonsell: Yeah, I'm sure that is quite flashy.

Matties: At this moment, everyone needs us. As you know, finding employees in companies is quite challenging. It's nice to see such a young man here in our industry and we certainly welcome you.

Bonsell: Thank you for taking the time to chat with me about this.

Matties: It's my pleasure indeed.

IPC APEX EXPO: Conference Speakers Speak Out

Re-balancing of the Electronic Equipment Manufacturing Industry

Presenter: Hiroyuki Watanabe,
Senior VP, NEC Platforms

What is the most interesting question that your IPC APEX EXPO presentation answers? If you feel that achieving the high level of secure manufacturing required by the DoD and the government is too difficult for your small- or medium-sized factory, we will show you a proven way to achieve secure manufacturing in your small or medium-sized factory. For larger factories, we will provide you with tips on how to control the security of your supply chain and point you in the direction of solutions in the process of rebalancing the manufacturing industry of the future.

What is your answer to that question, and why? The technical approach is NIST SP800-171 itself. What we show is the application to real factories, considering the characteristics of real factories. In particular, we focus on raising the level of SME, i.e., the level of secure manufacturing from zero to one, so that anyone can do it.

What is the most important piece of advice that you have for your audience? The future is changing and rebalancing, and the transformation of SMEs and developing countries is the key. The methods presented are feasible, and I hope that all factories will take the first step toward realizing them.





IPC APEX EXPO: Conference Speakers Speak Out **Eco-Design for a Circular Economy: Best Practices in the Electronics Industry**

Presenter: Karsten Schischke,
Group Manager, Fraunhofer IZM

What is the most interesting question that your IPC APEX EXPO presentation answers? We are motivated to be part of the solution, not of the problem, when it comes to sustainability in our sector. How to turn this motivation into action items? How to get a grip on eco-design for a more circular economy?

What is your answer to that question, and why? Get an overview of environmental life cycle impacts of your products first. This will help you to identify priorities for future improvements. Next, eco-design is a team sport and benefits from a broad cooperation within and beyond a company. Ask your suppliers to get involved and to join your journey. A spirit

of cooperation can create significant momentum for change.

What is the most important piece of advice that have for your audience? Learn from others and develop an eco-design strategy, which fits to your type of business and product portfolio. Several such examples from leading enterprises, large and small, have been documented by an iNEMI project team, supported by IPC, throughout 2021. You might need to align your product strategy with a more circular business model, building on servicing, maintenance, repair and/or refurbishment of products, to get the most benefit from your eco-design improvements.

Top 10 Takeaways from IPC APEX EXPO 2022



By Chris Mitchell
IPC

The recent surge in COVID cases provoked more than a few questions about what to expect at this year's IPC APEX EXPO. But as I traversed the San Diego Convention Center during the show, the top answer was clear: there were a lot of smiles! Sure, they were hidden behind masks, but they were evident in the eyes of everyone I met. Attendees were thrilled to be back together in-person, sharing ideas as freely as elbow bumps. IPC is a community, and APEX EXPO is the place where we build it.

Equally exciting was all the great content on tap for attendees this year. Against that backdrop, here are my top 10 highlights from IPC APEX EXPO 2022, from the perspective of someone engaged in advocating for this industry.

1. Hall of Fame Award: Industry statesman Joe O'Neil was this year's inductee into the

IPC Hall of Fame. Joe's achievements in business are well-recognized. Less recognized is his work for the industry. Joe has served on IPC's Board of Directors, Government Relations Committee, the IPC Education Foundation Board, and the IPC Thought Leaders Program. In his heartfelt and modest speech, Joe thanked the industry titans who mentored him



early in his career and challenged everyone to stay on top of industry trends, grow in their careers, and advance the industry. Congratulations to Joe on a well-earned award.

2. Technical Conference: Many participants said it was the best technical conference in years. That's a testament to the IPC staff and volunteers who organized four tracks and set a very high bar for the papers delivered. The four tracks focused on Factory of the Future implementation; PCB fab and materials; quality, reliability, test, and inspection; and assembly materials and environment. Stay tuned for an announcement soon on how you can access these papers and past papers as well.



By the way, a special shout-out is due to Auburn University Ph.D. candidate Mohamed El Amine Belhadi, who along with peers authored the best student paper, "Reliability and IMC Layer Evolution of Homogeneous Lead-free Solder Joints During Thermal Cycling." Auburn is a center of excellence on all things lead-free, including the DoD's lead-free electronics R&D, for which IPC has secured federal funding.

3. EMS Leadership Summit: Last year, IPC brought on Mark Wolfe as its executive EMS advisor. Mark worked closely with IPC staff to shape this year's EMS Leadership Summit, and the content was compelling and timely



with a focus on supply chain, cybersecurity, workforce, and government advocacy. Industry leaders, including Zentech CEO Steve Pudles and TTM CEO Tom Edman, were featured throughout the day. What surprised me was the large number of new attendees in the room. A couple have already followed up with me to get involved in IPC's government relations.

4. Executive Agent Meeting: The DoD's Executive Agent for Printed Circuit Boards hosted its 14th Defense Electronics Supplier Roundtable. My top takeaway: The U.S. government's heightened interest in the electronics supply chain will drive changes in federal policy and appropriations in the months and years ahead. Expect more Biden administration supply chain reports that touch on our industry in February and March, as well as new rules governing how defense-related electronics must be sourced.

5. Show Floor: Overall registration for the show was down somewhat, but you wouldn't have known it by talking to exhibitors. Why were they so thrilled with this year's APEX EXPO? Attendees were looking to buy. Put another way, those who attended APEX EXPO came with clear objectives, making the quality of customer interaction about as good as it gets. And with economic growth projected to remain strong in the year ahead, many compa-

nies are struggling to meet demand, underscoring the need to make capital expenditures now.

6. STEM Education: Is there anything better than seeing young people have fun while learning? This year, IPC Education Foundation (IPCEF) once again invited students from the surrounding area to get hands-on soldering experience and learn about the industry. A highlight from the event is always the career panel, which this year was sponsored by TTM Technologies. If you missed it, follow IPCEF on social media; they'll be posting a video soon. Be sure to check out the talk by



Jason Fullerton of CAES about his compelling career trajectory. Jason also pitched in to help students hone their soldering skills.

7. New Research: IPC released three research reports during the show. On Jan. 31, IPC released a report by Joe O'Neil on the state of the U.S. PCB industry and the need for greater public-private collaboration around R&D. The report illuminates the way in which R&D often takes place on the factory floor during the production process and, as a result, companies fail to fully realize R&D tax benefits. On Feb. 2, in conjunction with IPC CEO



IPC APEX EXPO: Conference Speakers Speak Out Cyberattack Response BCP (Business Continuity Plan)

Presenter: Hiroyuki Watanabe,
Senior VP, NEC Platforms

What is the most interesting question that your IPC APEX EXPO presentation answers? In this presentation, we will show you how to prepare for a cyber intrusion into your factory, and how to effectively manage the entire supply chain, including small- and medium-sized enterprises.

What is your answer to that question, and why? It has been demonstrated that a factory's cyberattack response BCP can be achieved by adding a cyberattack-specific rapid detection strategy based on the natural disaster response BCP. By analyzing

the characteristics of the factory and the unique characteristics of cyberattacks and taking countermeasures, the details of the countermeasures were presented in a comprehensive and appropriate manner.

What is the most important piece of advice that you have for your audience? The weakest point in the supply chain is the entry point for cyberattacks. This presentation should be of interest to everyone, and it provides actionable steps that everyone can take.

John Mitchell's "state of the industry" keynote, IPC released its monthly global sentiment and economic trends reports. In the latter, IPC Chief Economist Shawn DuBravac forecasts approximately 4% economic growth worldwide in 2022. Both reports can be accessed on IPC's website under Industry Intelligence.

8. John Mitchell Keynote: IPC CEO John Mitchell warned the industry to avoid the "false flat," a bicyclist's term for a slight incline that looks flat. Meaning: If the road ahead looks relatively easy, it's not a reason to rest but rather to invest. IPC's Factory of the Future initiative

addresses the key drivers changing our industry: technological innovation; operational efficiencies; changing customer demands; supply chain resiliency; environmental, sustainability and governance (ESG) requirements; and workforce needs. All these drivers are forcing companies to modernize their operations to stay relevant in a rapidly changing global marketplace. The line in his speech that haunts me most: North America is 10 years behind Europe and Asia in the transition to the electronics factory of the future. Ten years! Check out his keynote [here](#).



IPC APEX EXPO: Conference Speakers Speak Out

Electro-thermal-mechanical Modeling of One-Dimensional Conductors, Whiskers, and Wires Including Convection, and Considering Tin, Bismuth, Zinc and Indium

Presenter: Robert L. Jackson,
Professor in Mechanical Engineering,
Auburn University

What is the most interesting question that your IPC APEX EXPO presentation answers? This paper predicts the current that a short caused by a tin whisker could conduct before melting.



What is your answer to that question, and why? An equation is provided that makes the prediction based on the size of the whisker.

What is the most important piece of advice that you have for your audience? Numerical and theoretical models can provide insights into the performance of complex systems, but they should also be verified with experimental studies.

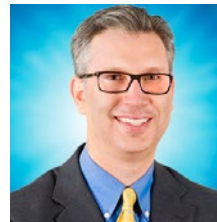
9. Substrates: Last November, IPC released a data-rich report on advanced packaging. The biggest takeaway from the report was the need for the U.S. to build IC substate capabilities and capacities, both to meet U.S. national security needs but also to accommodate increased domestic production of chips. So, it was exciting to speak to a handful of companies at APEX EXPO that are actively working to build new substrate manufacturing capabilities. One company, in fact, had an IC substrate in hand—fresh from the factory floor just two weeks ago. The progress that companies are making affirms just how dynamic and future-oriented our industry is.

10. Clumpy and Kloumpios Return: And finally, Clumpy and Kloumpios made their own return to APEX EXPO. Clad in red stocking caps with bushy pompoms, these bearded backpackers are accustomed to all manner of travel and all sorts of adventures. They've raised their public profile in recent years, but knowledge of their history is the privilege of a few IPC diehards. Want to join this secret soci-



ety? Start by tracking this motley duo's travels on Instagram at [@clumpyandkloumpios](#).

Thanks to the IPC staff and volunteers that made this year's IPC APEX EXPO a big success. See you in 2023 if not sooner. **\$67**



Chris Mitchell is vice president, IPC global government relations, and an I-Connect007 columnist. To read past columns, or contact Mitchell, [click here](#).

IPC APEX EXPO: Conference Speakers Speak Out

A Comparative Life Cycle Assessment of Stretchable and Rigid Electronics

Presenter: Gustaf Mårtensson, Ph.D.,
Expert Complex Fluids, Mycronic

What is the most interesting question that your IPC APEX EXPO presentation answers? Can a change from rigid to stretchable design of electronic systems have an effect on the ecological impact of their production?

What is your answer to that question, and why?
Yes, since the change in the manufacturing process



and production materials carry with it a significantly lower ecological impact.

What is the most important piece of advice that you have for your audience? Initiate a life cycle analysis of your product design or manufacturing process to understand where the sustainability impact affects you or your customer.

I-Connect007
GOOD FOR THE INDUSTRY

REALTIME^{with...} IPC APEX EXPO 2022

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



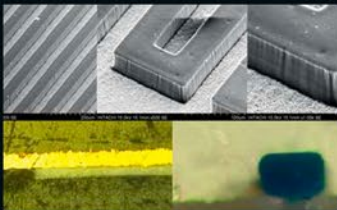
Solder Masks



Manufacturing Training



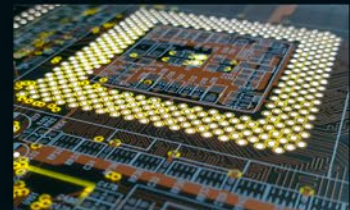
Moisture Management



Direct Imaging



EMS Quoting



HDI Technology

Learn more 

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.

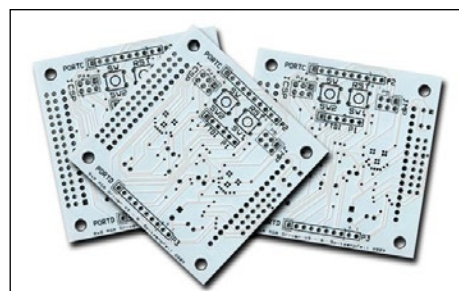
1 Selecting the Right Solder Mask

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](https://www.taiyo-america.com).

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

by **Blackfox Training**

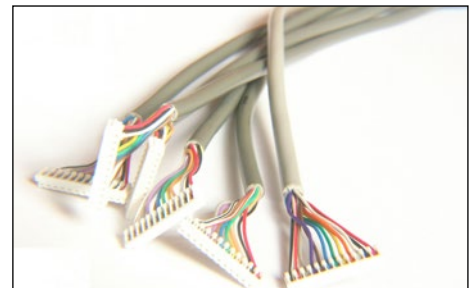
Electronics manufacturing companies need skilled and certified workers to perform the intricate and important tasks required to build modern electronic equipment. Here, we explain five ways to gain these workers:

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



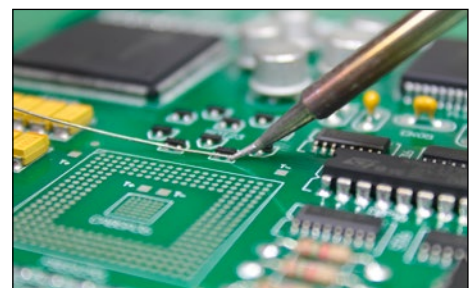
2 Fill Training Gaps with Customized Courses that Focus on Basic Knowledge and Skills

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://blackfox.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.



Celebrating 30 years in business, Bürkle North America distributes and services Bürkle GmbH and Schmoll Maschinen equipment which includes IMPEX and LHMT. BNA distributes equipment lines for multilayer lamination, drilling, cutting, routing, imaging, registration, automation and measuring. [Visit Bürkle North America online.](#)

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:

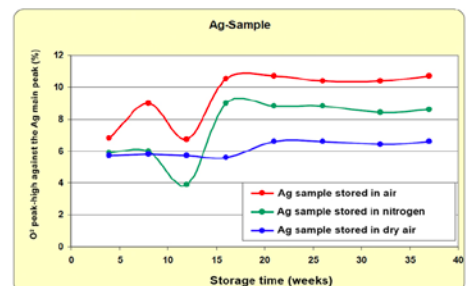
1 When Component Moisture Levels Become Critical, Encapsulant Damage Can Occur During Reflow

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 N₂. This is because water is the more aggressive bearer of oxygen than tightly bonded O₂ molecules. Removing the moisture removes the catalyst and prevents the corrosion process.



Super Dry Totech EU® 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.

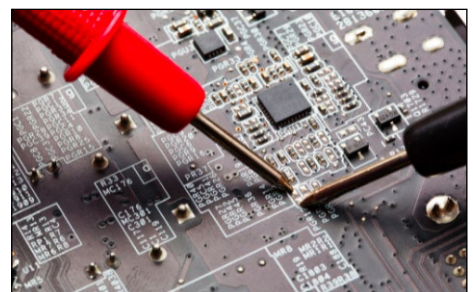
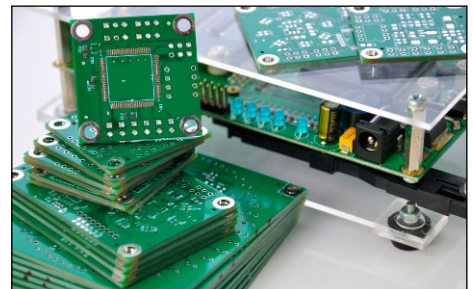
The Top Five Things You Need to Know About

EMS QUOTING

by CalcuQuote

EMS companies: You can now provide complete, instant, online quoting for your customers through your website. PortCQ is the future of EMS quoting.

- 1** Allows Customers to go From RFQ to Orders in Minutes
- 2** Includes BOM Costing, Labor and Overhead Estimation, and Configurable Margin Rules
- 3** Turns Your Website into a Lead Generating Digital Asset
- 4** Allows Your Team to Focus on Real, Valuable Business Opportunities
- 5** Ties into QuoteCQ for a Seamless Transition



1 Allows Customers to go From RFQ to Ordered in Minutes

Sometimes winning a quote is about showing how responsive you can be. With PortCQ, you can be always available and instantly responsive to your customers. Your customers will love the digital e-commerce experience that lets them check out with an order so they can iterate product revisions and go to market faster than ever before.

2 Includes BOM Costing, Labor and Overhead Estimation, and Configurable Margin Rules

CalcuQuote is the original all-in-one RFQ Management System for EMS. The same comprehensive quoting engine that has worked for 200+ EMS companies can be available through an intuitive web experience for your customers. They can submit their own RFQs, price their BOMs and get a complete quote entirely on their own. And you stay in control of who has access to it and how much information to share.

3 Turns Your Website into a Lead Generating Digital Asset

“Contact Us” forms are for the 1990s. The modern customer wants a value-added web

experience. Instead of having people just submit their info and wait for a sales call, it is better to engage them when you already have their interest. PortCQ allows you to automatically capture that interest and convert it to lead generating action.

4 Allows Your Team to Focus on Real, Valuable Business Opportunities

Keeping your quote team busy doing quotes is not value-added until those quotes turn into orders. A high performing quote team prioritizes winnable RFQs. By having interested leads and customers manage their own RFQs, you reduce the amount of time you spend on non-value-added activities. PortCQ reduces “distraction quoting” so that you can focus on real business opportunities.

5 Ties into QuoteCQ for a Seamless Transition

You have full control over who accesses your online quoting portal, and a parallel view is available for you inside of QuoteCQ. You can use your quote team’s expertise to improve the self-service quotes that your customers do, pick up where they left off or simply have them send you the RFQ details and BOM through your site.



CalcuQuote provides quoting and supply chain software for the EMS industry by optimizing operations and implementing sustainable digital solutions. CalcuQuote serves 200+ EMS companies.

The Top Five Things You Need to Know About

HDI TECHNOLOGY

by **ICAPE**

HDI stands for high density interconnect. Surprising as it may seem, there is no precise definition for this class of PCBs. It really is a variety of technologies that can be combined in unique configurations. The general distinction is that an HDI structure has a higher density of interconnect characteristics than a conventional PCB.

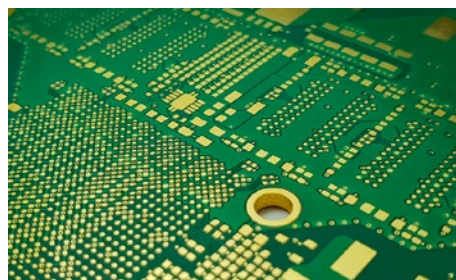
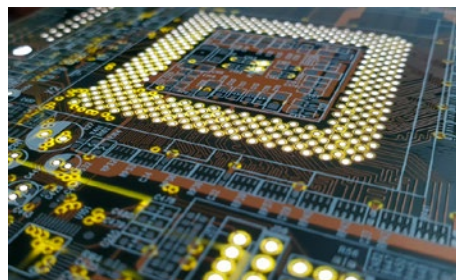
1 Common Characteristics and Elements to HDI PCBs

2 Make Space a Priority

3 Many Different HDI Via Types

4 A Wide Panel of Applications and Industries

5 Advantages: Flexibility and Density—Signal Integrity and Reliability



1 Common Characteristics and Elements to HDI PCBs

Some of the common elements to HDI PCBs are the following: combinations of via types such as buried, blind and through-hole; fine traces and spaces; shorter interconnecting traces; tightly spaced passives (or even embedded passives or passive substrates), as well as coreless constructions (very new concept); and multiple level constructions (not a single thickness).

2 Make Space a Priority

Considering space when designing HDI PCBs means more than inserting as many components as the board can possibly fit. Determining the amount of space between specific components and optimizing for additional room is a technique that allows you to minimize thermal stress and EMI. Via diameter, pad diameter, and track width should all be considered at the beginning. Not making space a priority might lead you to completely redesign your HDI PCBs.

3 Many Different HDI Via Types

We erroneously think of blind micro vias as being the definition of HDI. While these tiny vias (<150 micron) are always present in HDI designs, they are only one of the processes that could be used in an HDI design.

In practice, an HDI design has many of the possible via structures such as through-hole, buried, blind and microvia, as well as stacked and multi-level.

4 A Wide Panel of Applications and Industries

HDI technology is often used in critical system industries such as aerospace, medical devices, automotive or the military, or for high performance like the Internet of Things (IoT). The areas and use of the HDI PCB are not limited to these industries. Instead, the circuit board can be used for many things and on many standard products such as digital cameras, mobile phones, laptop computers, network communications, or touch-screen devices.

5 Advantages: Flexibility and Density—Signal Integrity and Reliability

The flexibility of the HDI components allows unique approaches to satisfy the demands. For example, “layered” structure,” where different functions could be on segments of the PCB and the technology of each segment could be very different. The reduction in overall size is also an obvious benefit of HDI, allowing more ergonomic and creative designs. HDI technology delivers enhanced signal integrity and is highly reliable.



ICAPE Group has grown to become one of the largest providers of printed circuit boards and custom-made technical parts in the world. Contact us at sales@icapeusa.com or visit us at icape-group.com.



IPC APEX EXPO: Conference Speakers Speak Out

Printed Circuit Structures, the Past, Present, and Future

Presenter: Michael Newton,
Director of Strategic Technology, nScript

What is the most interesting question that your IPC APEX EXPO presentation answers? How can direct digital manufacturing, aka 3D printed electronics, impact the PCB industry?

What is your answer to that question, and why? This presentation will show that direct digital manufacturing can create quality PCBs, while providing

a path to competitive pricing and green technology, and it will describe a more rapid transition from design to production.

What is the most important piece of advice that have for your audience? PCBs and PCB manufacturing are both evolving and may soon become disruptive to the electronics industry. Educate yourself about what is real, what is hype, and what is coming.



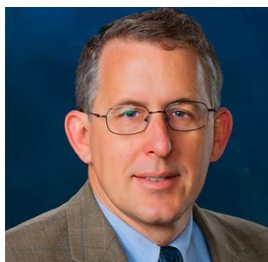
IPC APEX EXPO: Conference Speakers Speak Out

A Multiphase Model of Intermittent Contact in Lubricated Electrical Contacts

Presenter: Robert L. Jackson,
Professor in Mechanical Engineering,
Auburn University

What is the most interesting question that your IPC APEX EXPO presentation answers? This paper predicts what the use of lubricant in an electrical connector might do to electrical contact resistance if sliding occurs.

What is your answer to that question, and why?



Lubricant in an electrical connector can drastically increase the resistance by separating the surfaces by a non-conductive film.

What is the most important piece of advice that you have for your audience? Numerical and theoretical models can provide insights into the performance of complex systems, but they should also be verified with experimental studies.

From Ultra HDI and Compliance to the Resurrection of a **Baywatch** Star



By Elmatica's Team PCB Norsemen

How wonderful it was to meet in real 3D, face to face. The brilliant IPC marketing team had solved any awkward situations that might occur when a hugger meets an air high-fiver, by creating the rubber wrist bands in different colors, depending on your status: Okay with hugs and high fives, reserved, or please keep your distance. It was just brilliant.

For us, the feeling of boarding a long-distance airplane made us feel like teenagers again; we had butterflies in our stomachs, and excitement after months of preparations for the speeches and task group meetings. We were more than ready to take off.

Let the Calves Loose

We arrived in San Diego and headed straight for committee meetings, followed by a well-deserved margarita. At the International

Reception we felt like calves being let loose from winter isolation—hugging, handshaking, elbow-greeting, or nodding a hello. The enthusiasm among the participants was amazing. Digital events are cool, but nothing beats meeting in real life.

Elmatica senior technical advisor Jan Pedersen was a speaker at the Technical Conference, compiling an introduction to UHDI, followed up by Averatek DFM and AKM Meadville comparisons of subtractive and additive manufacturing methods. The next day, the topic was discussed in the D-33AP standards committee with a market report of UHDI PCB, or substrate-like PCBs, with a forecast through 2028.

Are Sampling Frequencies Outdated?

Let's rewind a bit first to November 2021. In a meeting in the European Standards Steering Committee, Jan explained the problem with IPC Class 3 requirements. Almost all suppliers

in Asia and Europe disregard the sampling frequencies required by IPC. Jan got the mandate to bring this topic forward to D-33A at IPC APEX EXPO, additionally supported by the China Standards Steering Committee.

In the D-33A/7-31A task group meeting on Monday, Jan. 24, Jan gave a suggestion to release the sampling frequencies for Class 3 into three levels, depending on the required confidence or risk level. This is similar to the Elmatica/NCAB approach with a small addition requiring two panels being tested in level B.

“We shall not reduce the risk level for those who need 100% confidence, but at the same time allow for a reasonable approach for volume production where process control and up to date inspection equipment compensates for the need of numerous microsections,” Jan said. The standard has to reflect modern production methods and allow suppliers to be honest and transparent regarding the sampling frequency they use.

The sampling frequencies are legacies from when the standard was created decades ago. With the development regarding advanced technologies and equipment, the need for such frequencies as we had back in the days is unnecessary.

How to Move Forward

We had a very good discussion and decided to review the proposal in an A-team and hopefully a test for implementation within IPC SummerCom on May 22.

Another topic close to our hearts is compliance and export control. CEO Didrik Bech is vice chair in the Cybersecurity Task Group and was a speaker at the Technical Conference, covering the subject, “Cybersecurity and Export Compliance in the PCB Supply Chain.”

It was delightful to experience the engagement and knowledge in the task groups, the increasing focus on transparency, and the need to ensure that what one orders is what one gets. Only by pushing this forward can we make sure the non-serious players in the business don’t get free play.

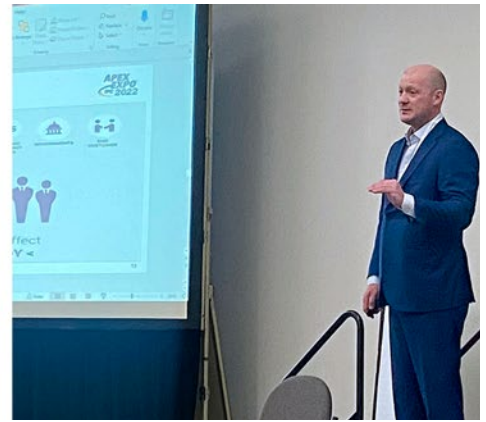
Use the NIST to Prepare for CMMC

It was so good and an honor to meet our fellow task group colleagues in the PCB supply chain. We discussed standards related to NIST SP 800-171B, CMMC and IPC-1791. We see the IPC-1791 as a great asset for people to prepare for the NIST SP 800-171 B and CMMC, however, it’s important that it does not conflict with export compliance regulations, but rather prepares the supply chain. The cost, the impact, and the opportunities of future regulations will be higher.

It’s important not to mix regulations set by governments with the IPC standard; however, by implementing this, one will be much more prepared to implement NIST SP 800-171 B and then later CMMC.

Another focus for Jan during the show was ultra HDI PCBs, a topic very close to his heart. “The focus is to present the ultra HDI PCB. I want to explain what ultra HDI is, what the group is doing, and what we want to achieve,” Jan said. “We want to create a guideline for substrate-like PCB and ultra HDI. This might end up in a new standard, however this is uncertain at the current stage. Now it’s mostly to create awareness, define what it is, and establish a guideline for purchasers and designers





so they can design, purchase, order and produce according to the guidelines the standards offer.”

The Awards Luncheon is always fun. The show floor was reduced a bit due to COVID, however, there was a crowd every day, with lots of activities and interviews. Jan did a [great interview with Happy Holden](#) on ultra HDI. Not surprisingly, for us the highlight was naturally when Jan received another award for his contribution to the Automotive Addendum.

Andres Ojalil, one of the staff liaisons of IPC, had this to say about D-33AA, IPC Automotive Addendum Task Group Committee Leadership awardee Jan Pedersen:

“Jan is an enthusiastic and productive advocate for the automotive electronics segment in the printed board industry. Under his leadership, the Automotive Applications Addendum to IPC-6012E was published in October 2021 and he is already working on Amendment 1 to address new technologies, test methods, and other needs in automotive electronics.”

High-Voltage Focus Group

Numerous task group meetings were conducted, hundreds of questions answered, lunches eaten while meeting new industry partners, and lovely SoCal dinners enjoyed in the evening. Bob Neves gave a very good intro to a suggested new CAF test for above 300V designs. We decided to go for an A-Team /Task group for the new test method. The group also decided to continue collecting failure modes.

The keynote speech from David Pogue, disruptive tech expert, was interesting, funny, and slightly worrying. The development of electronics, and the race of automation can at some points be a bit frightening to listen to. A world of drones, robots, and all sorts of technology to assist the promising race, the humans, with any hard or easy task, can cause curiosity but also questions like, “How can we make sure to maintain control?” “How can we make sure the technology doesn’t end up in the wrong hands?” or “Is our ability to consider the worst outcome and prevent it, really enough?” His tag line: “It’s going to be a wild ride,” explains



both the opportunities, challenges, and obstacles the industry and technology will face in the years to come.

Another keynote worth mentioning is the flaming one held by IPC President John Mitchell, pinpointing the Factory of the Future. As he said, it is now. It's like playing ball; to stay ahead you cannot stay where the ball is, you need to be where the ball is going. The big question is how to know where it will end up. As Mitchell discussed in his speech, many factors influence this. You have the influence of ESG, supply chain resilience, skilled workforce, technological requirements, operational efficiencies, and customer expectations.

Last year's pandemic situation has for sure shown us the strengths and weaknesses of the supply chain and forced us to think differently about securing an agile yet flexible supply chain.

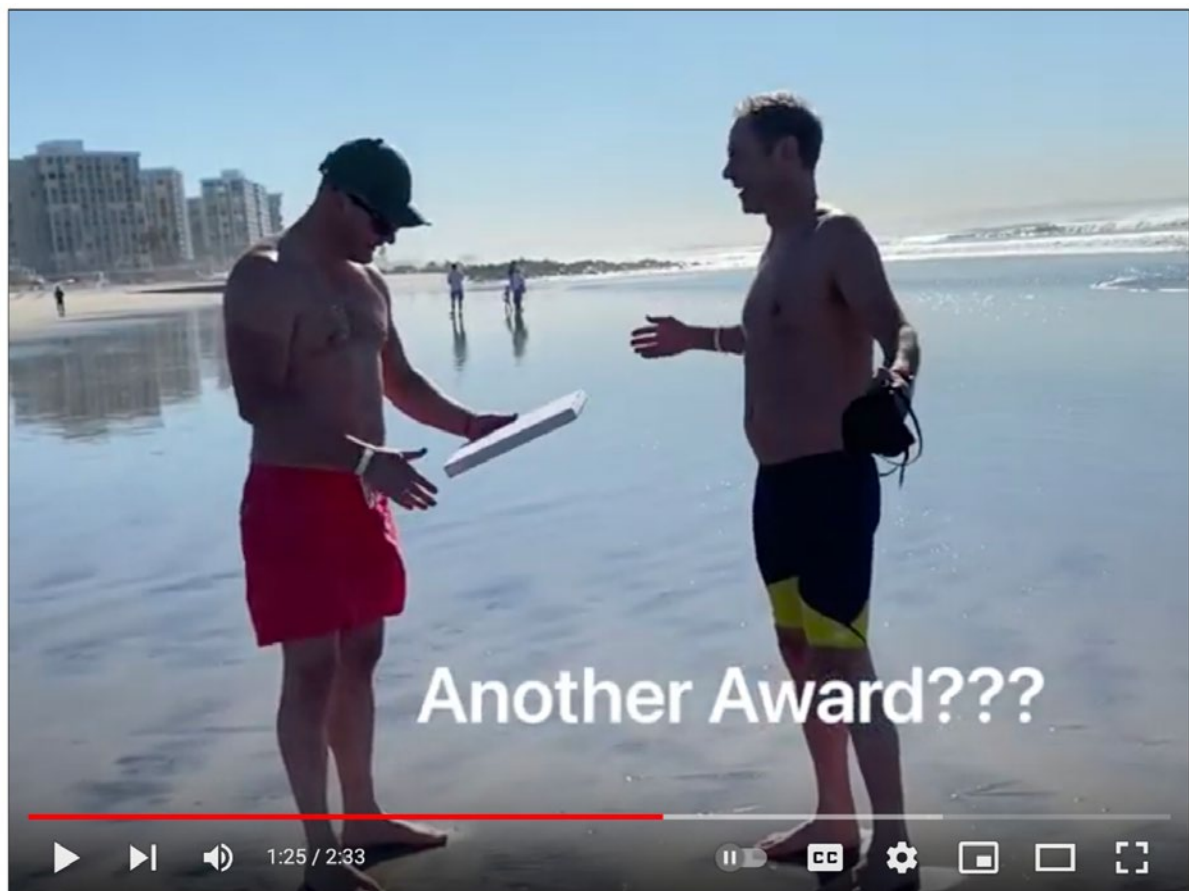
Undoubtedly we need to continue with a long-term perspective; as Mitchell said, many North American companies have had a too nar-

row focus on the quarterly reports and results, making the wide and futuristic perspective harder. The future is now; if one wants to join, jump onto the future express.

Another milestone or moment we will never forget is the filming of the sequel to Jan's video when he received the IPC Dieter Bergman Scholarship Award. The sequel stars John Mitchell in person, and we can tell, he knocks David Hasselhoff or any Baywatch babe into the sand. That man really knows how to run in slow motion at the beach. Thanks, John, for joining us on this crazy idea.

We left the conference and show filled with knowledge, new acquaintances, good memories, and new friends. Thanks for a great IPC APEX EXPO. See you in 2023. **\$€T**

Team PCB Norsemen consists of **John Steinar Johnsen, Jan Pedersen, Didrik Bech,** and **Raymond Goh.** To read past columns, or contact Elmatica, [click here](#).



IPC Design Competition Celebrates the Art and Science of Printed Board Design

By Patrick Crawford
IPC

In late 2021, printed board design engineers from around the world were invited to compete in IPC's inaugural PCB Design Competition. Intended to be accessible to anyone with a design tool and an internet connection, this new competition would challenge designers in two heats: an at-home, 30-day full board build, and an "in-person" four-hour routing challenge at IPC APEX EXPO 2022.

In the preliminary heat, 14 designers from all corners of the globe—from India to the Netherlands, Oregon to the United Kingdom—entered this new adventure last September. They were provided with a schematic, a component BOM, and a scope-of-work document, and were asked to design a board that was compliant with IPC's various board design stan-

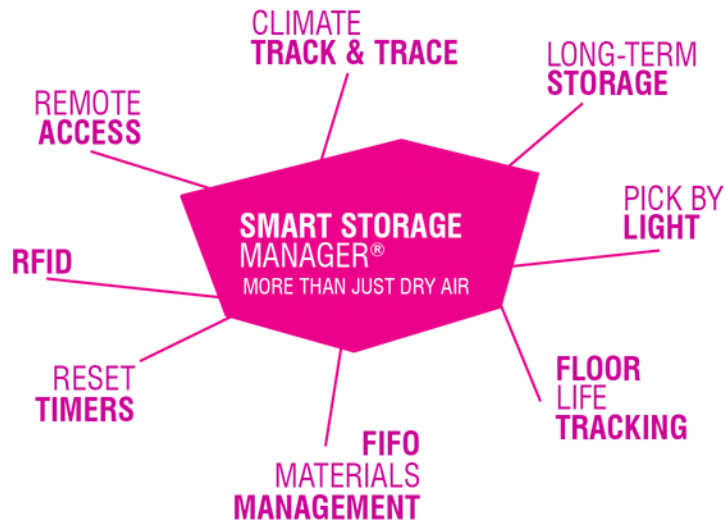
dards (and general best practices). The given schematic was representative of a motor control board and, while not electrically sound, included features intended to test the competitors' understanding of various design methodologies.

For the preliminary heat, competitors were allowed to use the design tool of their choice. A diverse array of tools was used—Altium Designer, Allegro, Eagle, Xpediton, and KiCAD were all represented. To be judged, the competitors were required to export their design in either Gerber, ODB++, or IPC-2581 formats.

Returned designs were then judged based on sections of IPC standards that were deemed relevant by a panel of volunteers who are



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experts in aspects of board design and heavily involved in the IPC standards development process. (In other words: these are some of the authors of the very same standards used to judge our competitors.) For example, the competitors were judged against IPC-2612 and IPC-2612-1 for proper schematics and symbols definitions, against IPC-7351B for footprints, against IPC-2221B for trace widths and clearances, hole and via design, and copper thickness, among others. Out of the 14 preliminary competitors, three were chosen to compete at finals: Elliot Wakefield, a hobbyist based in the United States; Nick Wallis, an electronics engineer at Tribosonics, based in the United Kingdom; and Rafal Przeslawski, a hardware development engineer at Xilinx, based in Germany.

The finals heat took place at IPC APEX EXPO in late January. Unfortunately, due to ongoing travel restrictions and uncertainty associated with the COVID-19 pandemic, the finalists were unable to attend in person. Instead, monitors were placed in the Design@APEX booth; each displayed a competitor's screen via a Zoom room. The competitors were asked to always keep their design tool on screen so the judges and spectators in the Design@APEX booth could observe.

For the finals heat, the competitors were asked to use Altium Designer. This allowed the judges to create a single project file as a starting point for the competitors, as well as enabling an expedited review of the submissions (as opposed to importing manufacturing files into a CAM viewer, for example). With only one night to judge the submissions, this quick-turn capability was essential.

The competitor's challenge was relatively simple: given a nearly complete board—missing only design rules, routing, and a few components left in the margins—they were responsible for completing the design. With only four hours to do so, completing the board was a careful balance of thoughtful component

placement optimization and design rule definition, and brass-tacks routing. The board design was that of a functional, programmable blinky-badge that was actually fabricated and on display at the show, a “golden copy” of the design, so to speak. In other words, unlike the preliminary heat, the final design was representative of a real-world, functional application.

After a short preamble on behalf of IPC, the competitors were off to the races.

I have to say that it was genuinely exciting to watch them work on their designs. At one point, a crowd of people were shouting at one of the monitors for the competitor to “Fan out! Fan out!” It felt less like “watching paint dry,” as I heard someone predict such a competition would be like, and more like a sporting event, or at the very least, off-track betting.

At the end of the four hours, each competitor delivered their project file, and signed off for the day. It was then the judges' turn, and after another two hours of deliberating, a champion was crowned: Rafal Przeslawski was the IPC Design Competition 2022 champion.

Going into next year, there are aspects of the competition that will be improved and streamlined to make it easier for competitor and adjudicator alike. Perhaps foremost on the wish-list for next year will be for the finalists to compete in person, and there is hope that this can happen. In any case, we are grateful for all who participated this year, and we are excited for next year and beyond.

If you would like to become involved and help build the IPC Design Competition 2023, email Design@IPC.org. **\$€†**



Patrick Crawford is the manager of design programs and related industry programs at IPC. To read past columns or contact him, [click here](#) or email PatrickCrawford@ipc.org.

Voices of the Show: Zack Burruel, Titan Circuits

Interview by Nolan Johnson

Nolan Johnson speaks with Zack Burruel about the challenges associated with shortages in parts and labor.

Nolan Johnson: Hi, Zack. Are you glad to be back at APEX EXPO?

Zack Burruel: Yes, I come every year, if it's available.

Johnson: What do you have for objectives and goals to accomplish at APEX EXPO this year?

Burruel: We're a small company, so I typically don't have time to meet other people in the industry on a regular basis. We are relatively new as well, so it's just a good opportunity to meet some new people within the industry. That's my main objective.

Johnson: It's the networking?

Burruel: Yes.

Johnson: Tell me about Titan.

Burruel: We are a small EMS provider in Phoenix, Arizona, that just got started about a year and a half ago. We're just going through the ups and downs of the industry with part shortages. We work with military, aerospace, and commercial customers—anyone that's looking for U.S.-made manufacturing.

Johnson: Obviously there are a lot of challenges we're facing. In the EMS Management Summit just now, they've just been talking about the supply challenges. What's your experience as a new startup with respect to sales and marketing and connecting with customers during these times?

Burruel: My experience is great. That's sort of my background, so I don't have any issue with getting incoming leads or anything like that. The biggest issue is getting parts. Even though last year was our best year, EMS-wise (we've been around for a year and a half for EMS), but we do sell bare boards and flex, rigid-flex boards as well. That's how we started. Titan Circuits is basically a DBA solely focusing on EMS. But going back to your original question, really,



it's been about parts, unfortunately, again.

Johnson: All conversations eventually lead back to parts.

Burruel: People will give us business, but they literally can't find the parts. So, then they have to redesign the board and we just go around and around the circle, and they're chasing their tails because one part is gone and then they redesign it, and then that other part is gone.

It's difficult for them to bite the bullet and just buy all the parts that they can and then redesign, especially for the customers we're dealing with. They're typically smaller OEMs. And they're not really OEMs, they're just smaller companies in general.

Johnson: Gotcha. Well, you're new and ramping up, so that means there's a lot of hiring going on. How has it been finding employees in this labor market?

Burruel: That's another issue, honestly, because I'm new to the industry and in the EMS world specifically. That's another opportunity where I wouldn't mind meeting these people who know someone who might hopefully know someone. As a business owner, it's very challenging because I feel like I'm wearing so many hats and recruiting is not on my list. The people that I want to come work for me are often at another company and most of the time it's in California, so it's hard to pull them because their income is probably typically a lot higher than Phoenix. Even though the cost of living is lower, it's hard to convince them, "Hey, make X there, but come here and make less and live better."

Johnson: Yeah. That can be a hard sell.

Burruel: It's hard to sell. I haven't been able to do that yet, so I'm hoping I meet some people here who know some people or that they directly know more than me and I can hire them.

Johnson: Thank you.

Burruel: You're welcome.

Taking a Closer Look at Factory of the Future



By Happy Holden

I-CONNECT007

The Factory of the Future is a recurring focus of the IPC which has resulted in several important IPC standards, including the IPC-2591 Consolidated Factory Exchange (IPC/CFX). At IPC APEX EXPO 2022, this was on display at the Factory of the Future (F2) Pavilion, as well as mentioned in John Mitchell's keynote, four Professional Development Courses, committee meetings, and five technical sessions. I want to summarize these for you in case there is something of interest for you to follow up on.

F2 Pavilion Booth 1701

The F2 Pavilion was not just a line of equipment this year like it was in 2020. Instead, it consisted of a series of presentations by vendors on solving the real business challenges in assembly by identifying new technologies that modernize industrial processes. Several of these

new disruptive processes already exist, such as AI-enabled inspection, machine learning, CAD, 3D design, simulation, 3D printing, and more.

Participating companies included:

- Aegis Software
- Arch Systems
- Hodei Technology
- Instrumental
- ITAC Software AG
- ITW Electronics Assembly Equipment
- Keysight Technologies
- KIC
- Koh Young Technology, Inc.
- Mycronic AB
- Nano Dimension
- Yamaha Motor Corp, USA

They are IPC-2591 CFX Qualified Vendors (QPL), which provide assurance that CapEx purchases will meet your IPC-2591 CFX messaging implementation plans. The complete list of qualified models is available at ipc.org.

Professional Development Courses

There were four professional courses offered under this topic on Monday and Tuesday of the show. These courses provided more detailed training than the usual technical paper but are not available to be purchased after the show, like the bulk of the technical papers.

- “PD06: Introduction to Machine Data Analytics in the EMS Industry,” by Tim Burke, Arch Systems, Inc.
- “PD13: Fan-Out Wafer/Panel Level Packaging and System-in-Package (SiP),” by John Lau, Unimicron Technologies Corp.
- “PD19: Non-Contact Additive Technologies in Contemporary Electronics Production and Related Fields,” by Gustaf Martenennon, Graco.
- “PD24: PCB Design and Process Implementation for Advanced Semiconductor Package Technologies—Flip Chip, WLP, FOWLP, 2D, 2.5D and 3D,” by Vern Solberg, Solberg Technical Consulting.

Technical Sessions

Here I will list 20 of the technical papers regarding Factory of the Future. I’ve selected what I consider to be the top five and highlighted them with summaries.

S01/FF1 Session

- “Quality and the Smart Factory: A Study of Data-Driven Quality Management Across EMS Smart Factory,” by Robin Hou, IBM Corp.

With the advancement of emerging technologies such as AI, cloud, and blockchain, the electronics manufacturing industry is entering a new era of smart manufacturing. More



and more electronics manufacturing service (EMS) providers are investing in data and deep AI capabilities as part of their smart factory effort to improve production efficiency, process capability, and quality. These data and deep AI capabilities are often implemented through enterprise hybrid clouds to achieve high availability, high scalability, and low IT operational cost.

This paper discusses the status and trends of smart manufacturing implementation in the EMS industry, specifically focusing on quality management, as there are plenty of use cases of data and AI in quality management that are good candidates for smart factory implementation. It elaborates details with examples of several quality management use cases involving data, AI, and enterprise integration. In this paper, we also discuss the current maturity level and future trending and challenges in technology adoption and integration for smart factory in the EMS industry.

- “In Line Implementation of the Photonic Soldering Process,” by Vahid Akhavan, NovaCentrix.

Photonic soldering utilizes high intensity flashes of visible light to achieve wide area heating with exceptional uniformity. Solder paste is heated to its liquidus temperature

using radiative energy transfer, and light is converted to heat through optical absorption. This process can be made selective by exploiting the high absorptivity of solder pastes relative to most other printed circuit board (PCB) materials, or with the aid of shadow masks. The optical flash can be modulated digitally, with high temporal resolution, which enables highly customizable processing flows ranging from traditional to highly innovative.

Photonic soldering is compatible with standard high temperature lead-free solder alloys (e.g., SAC305) in combination with temperature-sensitive substrates (e.g., PET). The nonequilibrium nature of the heating process

enables thermal isolation of active regions from temperature sensitive regions. The resulting flexibility in material selection gives designers significant freedom and new options in outlining device architectures.

Previous presentations of this technology focused on the quality of junctions formed through this process. This paper focuses on the unique features of the photonic soldering process, as they relate to production line design and operation.

- “CFX Open-Source Hardware Initiative,” by Naim Kapadia, Manufacturing Technology Centre.

IPC APEX EXPO: Conference Speakers Speak Out

Empowering Digital Supply Chain Transformation by Utilizing Industry 4.0, Technical Standards, Smart Contracts and Blockchains

Presenter: Raj Takhar, Senior Subject Matter Expert, Assent Compliance

This presentation supports the potential integration of IPC standards to blockchains.

We used IPC-2591 as an example about how to integrate a given IPC standard to interact with a blockchain using the concept of defining a publicly accessible standard (PAS) to outline logical smart contracts, to automate the request and collection of data contained within the IPC standard. The potential of using a blockchain, is automation of back-office requests and processing of data, which can be collected via public or private blockchains. The design intent was to present a logical way of requesting data, using a given IPC standard, which defines a PAS pertaining to logical smart contracts, which when expanded across the entire IPC series of standards enables real-time data on products being assembled, with the potential to capture ever increasing requirements for reporting hazardous chemicals,



capturing uses and handling instructions as well real-time LCA data points pertaining to resources (labour, energy, emission type data points). Future predictions within the presentation highlight how a potential marketplace for data could evolve with multiple supply chain actors sharing data across blockchains,

with data provisioned by manufacturers / third-party solution providers, in the future, where dependent on a company's risk level acceptance criteria, multiple dimensions of reporting complexity and data validation may occur within a blockchain. Expanding the potential of existing IPC standards via blockchains is critical for the on-going success of these standards in the future.

The most important advice to our audience is to ask the questions, “Why could it not work?” and “What are the potential advantages or disadvantages you see with such a proposal?” Get in touch with me. I'd like to evolve the concept over the coming months and report back in the future with an updated version of the document.

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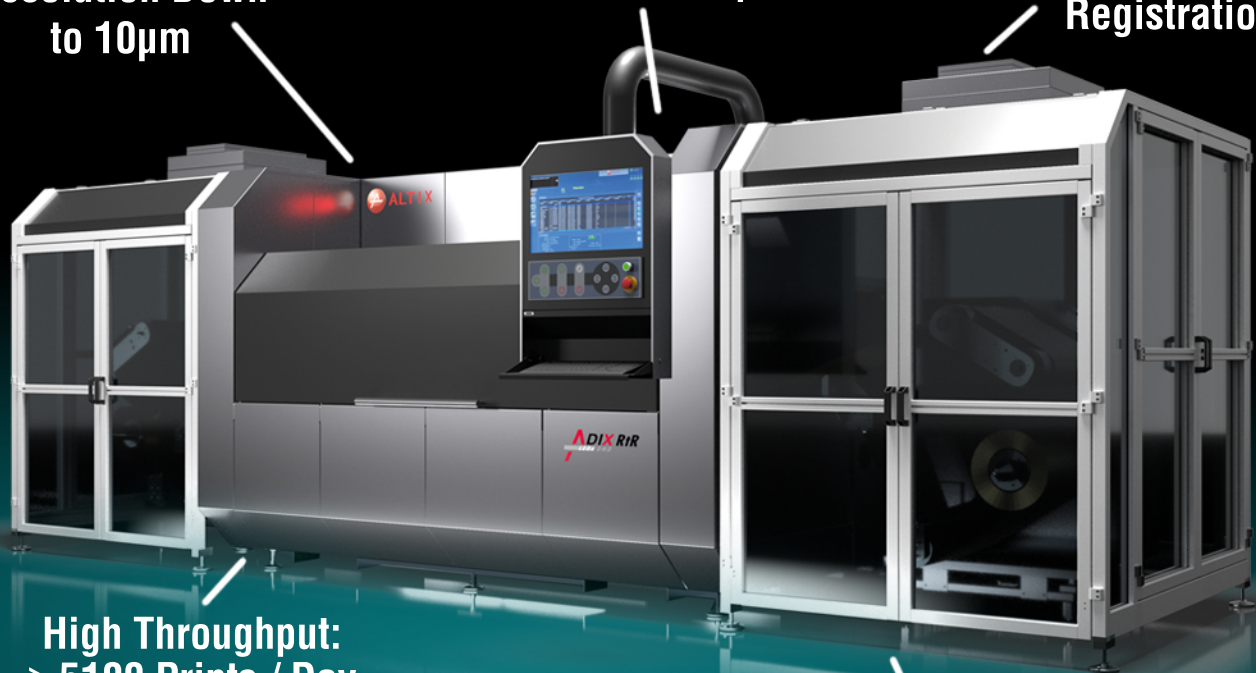
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The IPC Connected Factory Exchange (IPC-CFX) standard provides genuine plug-and-play IIoT data exchange between machines and supervisory systems across the shop floor. To realize the benefit of IPC-CFX, however, the whole value chain of production stations should be considered, as any missing link becomes a blind spot for even the most basic visibility and control.

The smart factory project for electronics manufacturing initiative was developed to create a sandbox to carry out Industry 4.0 use cases working with industrial members and partners. The Manufacturing Technology Centre (MTC) based in Coventry, UK, has carried out a project that outlines the implementation of IPC CFX to demonstrate the connectivity between the machine, the broker

and the dashboard. The main objective focuses on the implementation elements for the Adaptor machines and the RabbitMQ server. This includes configuration requirements and user guides around maintaining the delivered implementation.

The paper reviews the above example of the successful connection using IPC CFX, an SMT DEK printer and the Ersu Reflow 10-zone oven which are both classed as legacy machines due to their age and the operating system. The benefits to this are to allow legacy machines used in the electronics manufacturing industry to communicate, transfer operational data for track/trace, and monitoring while, in future add-ons, allow them to be agile and have autonomous ability to change parameters based on the live shop floor

IPC APEX EXPO: Conference Speakers Speak Out

Next Progression in Microvia Reliability: Reflow Simulation of PCB Design Attributes and Material Structural Properties at Design

Presenter: Gerry Partida,
VP of Technology, Summit Interconnect

What is the most interesting question that your IPC APEX EXPO presentation answers? It is now possible to simulate the reliability of a microvia design and material selection at the design stage.

This simulation can save years of pain and suffering and improve the odds of designing and fabricating a PCB right the first time.

What is your answer to that question, and why? Simulation of material selections and microvia attributes can predict if a design can survive the necessary reflow cycles at the intended assembly temperature. By characterizing the structural integrity of a microvia design, we can determine if a design and material selection is safe for final assembly. If



the simulation determines that the design is weak, the designer could modify the design to improve the reliability. A fabricator would be able to recommend the best combination of materials to improve the amount of reflows the PCB could withstand.

What is the most important piece of advice that you have for your audience? This new ability to simulate microvia reliability is both a revolutionary and evolutionary approach for HDI PCBs. We can now determine in 15–20 minutes whether a design is reliable, or a design or material change is required. For years, OEMs have lost product cycle time and large sums of money on designs that do not work or have high fallout in assembly or in the field. This new approach can prevent these occurrences in the future.



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situation. This will eventually lead to the “lights out” capabilities in the low-volume/high-mix electronics manufacturing industry.

- “Additive Manufacturing and Multiphysics Analysis for Single- and Two-Phase Cooling,” by Paul Bratt, ACI Technologies, Inc.

Thermal management must advance with the military’s requirements for increased performance, lower costs, and rapid technology changes. Combining multiphysics analysis and additive manufacturing optimizes the cost, weight, and performance objectives using validated models and advanced fabrication techniques. Thermal solutions that meet the complex requirements of the military must be incorporated early in the design process to preemptively address challenges using a system-level approach.

This paper compares the benefits of single-phase and two-phase cooling in high-power

applications. Novel additively manufactured designs were examined and experimentally tested to validate the multiphysics models. Best practice guidance will be shared.

S13/FF4 Session

“Artificial Intelligence and Machine Learning: Using Machine Learning for Anomaly Pattern Recognition in Manufacturing Processes,” by Shadi Kuo, Northrop Grumman Corp.

As the manufacturing sector is under constant pressure to satisfy customers’ demands in a competitive market by applying complex processes to meet manufacturing cost and schedule goals, the need to identify quality variables within processes is occurring at a faster rate. Locating the source of process variations becomes more challenging for engineers. Each day, the manufacturing sector generates tremendous amounts of data that provide valuable information. This data is crucial to supporting strategic business operations

IPC APEX EXPO: Conference Speakers Speak Out

The Gap Dilemma in the Technical Cleanliness of Electronic Assemblies: Why Foreign Object Debris on Electronic Assemblies is Not Bringing the Modern World to a Halt

Presenter: Dr. Marc Nikolussi,
Head of Engineering Assembly and
Interconnect Technology, Robert Bosch
GmbH



What is the most interesting question that your IPC APEX EXPO presentation answers?

On an assembled PCB, there exist metallic particles which are larger than the minimum electrical clearance distance. Is this a risk for an electrical short? Can these particles be fully eliminated by cleaning techniques?

What is your answer to that question, and why? Also, with cleaning techniques, these particles cannot be fully eliminated. The risk for electrical short has to be evaluated by the proposed risk assessment tool.

What is the most important piece of advice that you have for your audience? Providing evidence and transparency about the study on cleaning techniques. We show a strategy regarding risk assessment for such products in the automotive industry.

decision-making. Traditional ways of data interpretation are labor intensive and time consuming. Failure to accurately and precisely translate data will lead to subjective “opinion” or “speculation-based” decision-making.

In this paper, general opportunities are reviewed for the application of machine learning (ML) algorithms and methods to the test data troubleshooting process. A method is developed for analyzing data and identifying patterns that are consistent with poorly performing units. This method uses a “quasi-supervised” learning technique to identify drivers of variance within a dataset, visualize the trends among the primary drivers of vari-

ance, and establish some screening limits based on those trends.

The method employs principal components analysis (PCA) to review patterns, trends, and uses some knowledge of better or worse performing groups. The output is a set of screening limits that characterize parts likely to have similar performance. The method provides clear knowledge, visualization, and understanding of the trends that are driving failures or poor performers. In addition, it does not require the rigorous data capture that a true supervised learning method does. This method can be used on any dataset with observations in the rows and attributes/

Voices of the Show: Rachael Temple, Altemated

Interview by Nolan Johnson

Nolan Johnson catches up with Rachael Temple, who shares her first-time impressions of the show.

Nolan Johnson: How does it feel to be back at APEX EXPO?

Rachael Temple: Well, this is my first time here. It's kind of crazy. Lots of booths, lots of companies here. It's really exciting. I know this is the first time back since 2020 for everyone else. It's good to see all the companies that came out here. I know there are not many attendees and not as much as we'd prefer, but we're still getting good leads, meeting new people, and checking out competition as well.

Johnson: So, it seems like a good first impression, even though this is your first show here.

Temple: Yes. I would say.

Johnson: What do you want to take away? At the end of the week, when you go back home after being here, what will make it feel like it was a successful trip for you?



Temple: The big thing for me is to learn— learning about all the different services, machines, the people, connections. I want to see where our company fits into others, how we can provide services and products for them, how they can work for us, and just basically get out there.

Johnson: What are your impressions of being in this industry? We've gone through a long period of time where it was just not cool to be in manufacturing. Your thoughts on that?

Temple: Well, I'd say it's a lot to learn because I didn't study any of this. I didn't know about any of this. They don't really have this option at some of these schools to get into this industry. So, it's opened this whole realm, this whole world to me that I never even knew about, even though I'm part of my family company now and my dad has been involved. I had no idea it was this broad. I had no idea the number of companies and people involved and it's pretty cool to be out here and experience this and it's definitely interesting.

Johnson: Awesome. Well thank you, Rachael, I appreciate that.

variables in the columns if there is some knowledge of an identifiable batch that is better or worse than the others. A performance characterization on a batch of units was successfully performed to identify the anomalies within a dataset.

Additional papers presented in these tracks (FF1, FF2, FF3, FF4, FF5, and FF6) include:

S13/FF4 Session

- “Industry Trends and Application Requirements for Adopting Solder Paste Printer Changeover Automation,” by Wayne Wang, ITW EAE.
- “IPC-HERMES-9852 Lays the Foundation for Automated Flexible Production,” by Thomas Marktscheffel, ASM Gmbh & Co. KG.

S05/FF2 Session

- “Digital Twin/Data Transformation: Digital Twin: The Glue for Industrial Transformation,” by Joanne Friedman, Connekctedminds Inc.
- “Single Source of Truth (PathWave Manufacturing Analytics),” by Juliann Forbes, Keysight Technologies, Inc.

S09/FF3 Session

- “Innovative Technologies: Surface Mounting in Smart Molded Structures with Polypropylene,” by Outi Russnen, TactoTek.
- “A Comparative Life Cycle Assessment of Stretchable and Rigid Electronics,” by Gustaf Martensson, Mycronic.
- “A Study of AI Model Benchmarking for Quality Inspection Implementation in Manufacturing Using Edge Computing,” by Feng Xue, IBM Corp.

- “Towards Artificial Intelligence in SMT Inspection Processes,” by Marlo Peutier, Continental Automotive GmbH
- “AI for Electronics Manufacturing_V,” by Jay Taylor, Manufacturing Technology Centre, UK

S17/FF5 Session

- “Modernizing the Supply Chain: Factory of the Future Implementation,” by James Becker, Northrup Grumman Corp.
- “Improving Productivity with Automated Component Storage and Delivery,” by Patricia Heredia, Omron.
- “Empowering Digital Supply Transformation by Utilizing Industry 4.0 Technical Standards, Smart Contracts and Blockchain,” by Sukhraj Tekhar, Assent Compliance.

S25/FF6 Session

- “Cybersecurity: Cyber Attack Response BCP Trying to Make the Incident Response for the Factory,” by Hiroyuki Watanabe, NEC Corporation.
- “How Will Cyber Security and Export Compliance Control the PCB Supply Chain and How Can We Prepare for it?” by Didrik Bech, Elmatica.
- “IPC-2581: Secure Data Exchange Between Design and Manufacturing,” by Hemant Shaw, IOPC-2581 Consortium.

This was a good track of papers for those interested in Factory of the Future or better titled, “Creating your own smart factory now.” It complements the two keynotes from APEX EXPO talking about the new opportunities for higher performance that should be had by investing in these evolutionary technologies. **S&T**

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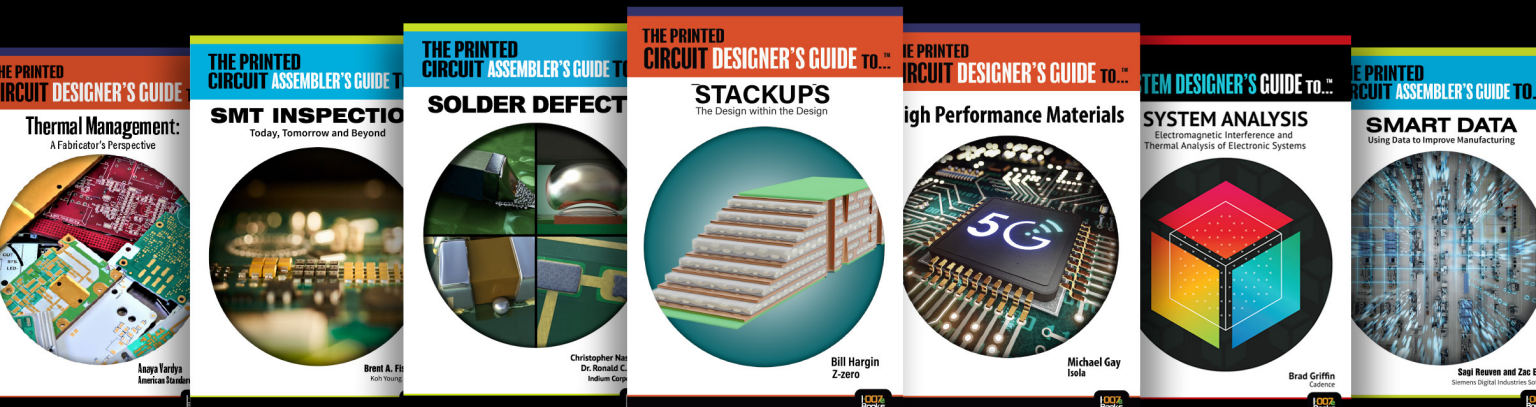
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