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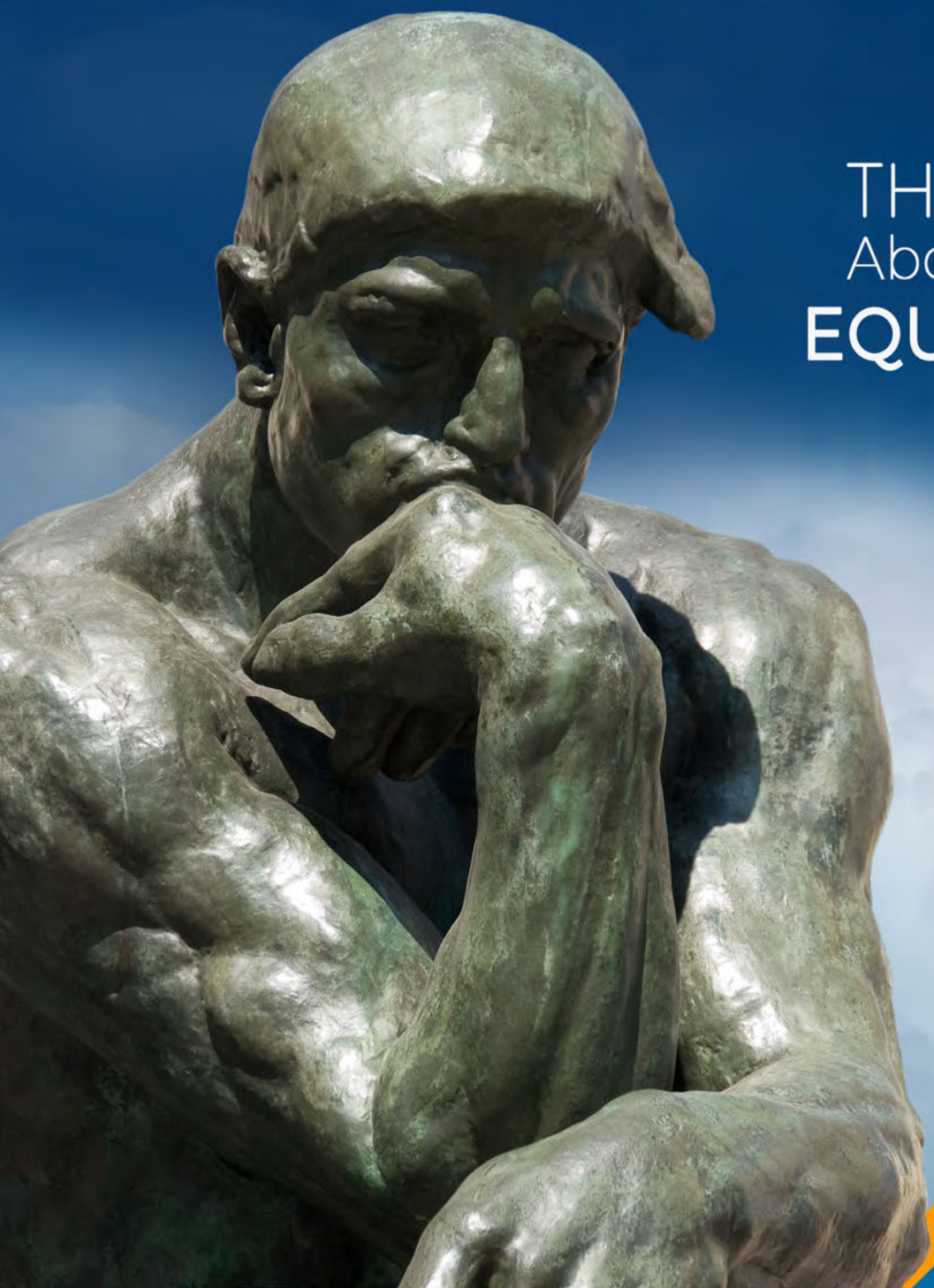

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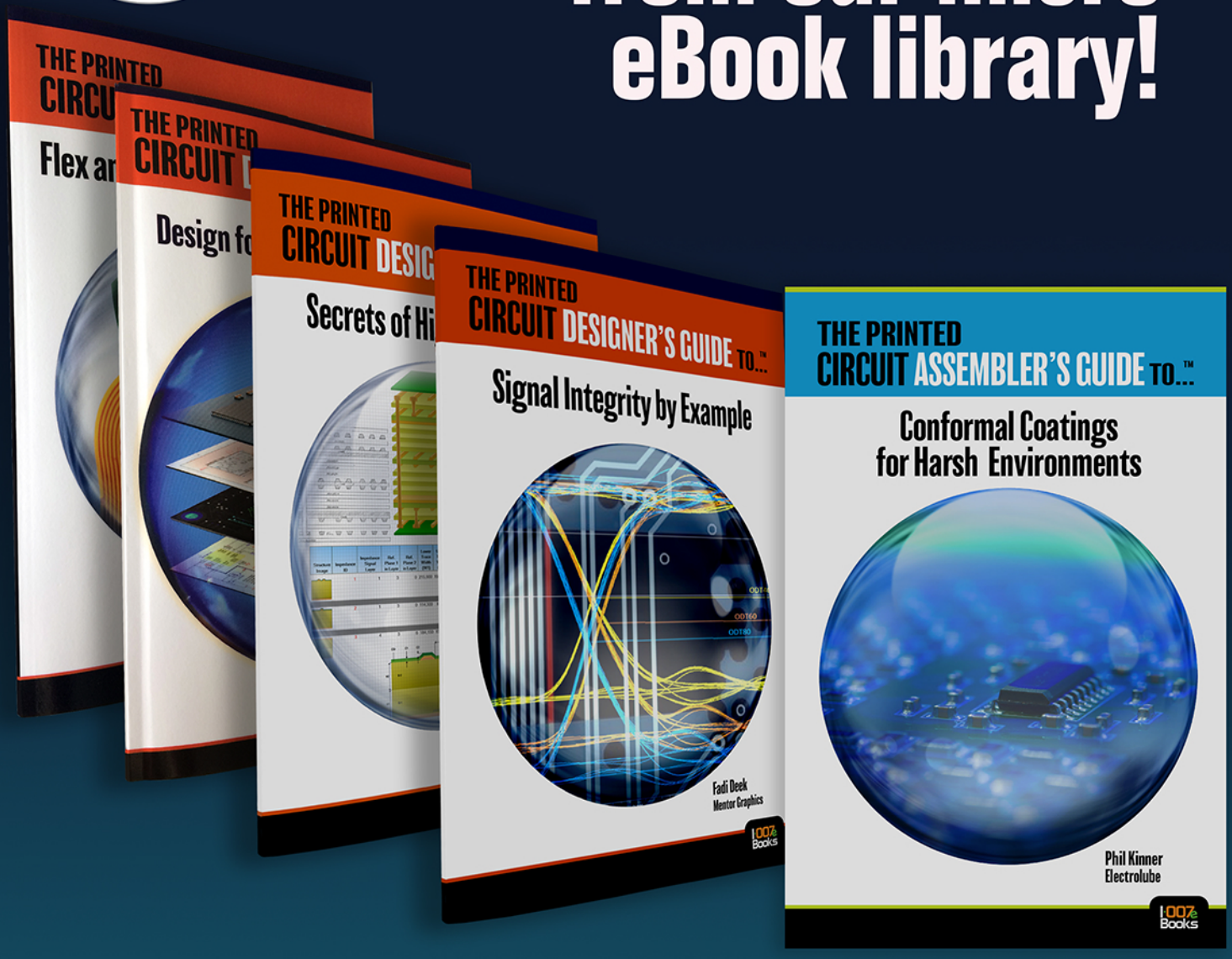

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New Equipment

This month's issue of *SMT007 Magazine* looks into the key considerations when investing in new equipment—not just the latest and greatest machines available, but how buying decisions are made, what to buy, and when to buy it.

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Focus on the New

Editor's Note Column by Stephen Las Marias
I-CONNECT007

Hello, 2018! Wow, it seems like it wasn't too long ago when I was writing about the optimism of the electronics manufacturing and assembly industry going into 2017. Now, here we are again at the beginning of the new year, looking at new trends, disruptive technologies, and emerging markets for 2018.

First things first!

I am sure you have noticed our name has changed from *SMT Magazine* to *SMT007 Magazine*. Not only did we update our magazine's name, we also refreshed the interior pages of the publication, as well. As an I-Connect007 publication, *SMT007 Magazine* fits nicely with our other publications, which also carry through with the naming convention starting this month: *PCB007 Magazine* and *Design007 Magazine*. We hope you enjoy this fresh new look.

What else have we been up to?

Last month, our team attended the HKPCA & IPC Show in Shenzhen, China, to talk to industry leaders in the PCB supply chain about trends and technologies to watch for in the coming year.

The consensus is that everyone's excited about the continuing growth in the electronics assembly industry. Last year, the industry was beset with the copper foil shortage. While the same shortage can be expected this year, given the strong growth of the automotive electronics industry, manufacturers and suppliers remain bullish that this same growth will fuel other aspects of the electronics manufacturing industry. Show attendees and vendors were also generally excited about 5G, highlighting the pilot deployment of the first 5G network at the 2018 Winter Olympics in South Korea. Other notable technologies with expected growth include medical electronics, and the proliferation of devices for the Internet of Things (IoT).

This Month's Lineup

In this issue, we have taken a close look at the many facets and considerations associated with investing in new equipment. Do you buy new equipment just to say you have the latest systems in your processing lines? Of course not. But what are the key reasons that will drive you to invest in new equipment, and what decision process goes on behind the scenes that justifies your investment in these new machines?

In a recent conversation, Eltek USA President Kathy Nargi-Toth says that when it comes to making decisions on investing in new equipment for the factory, manufacturers should

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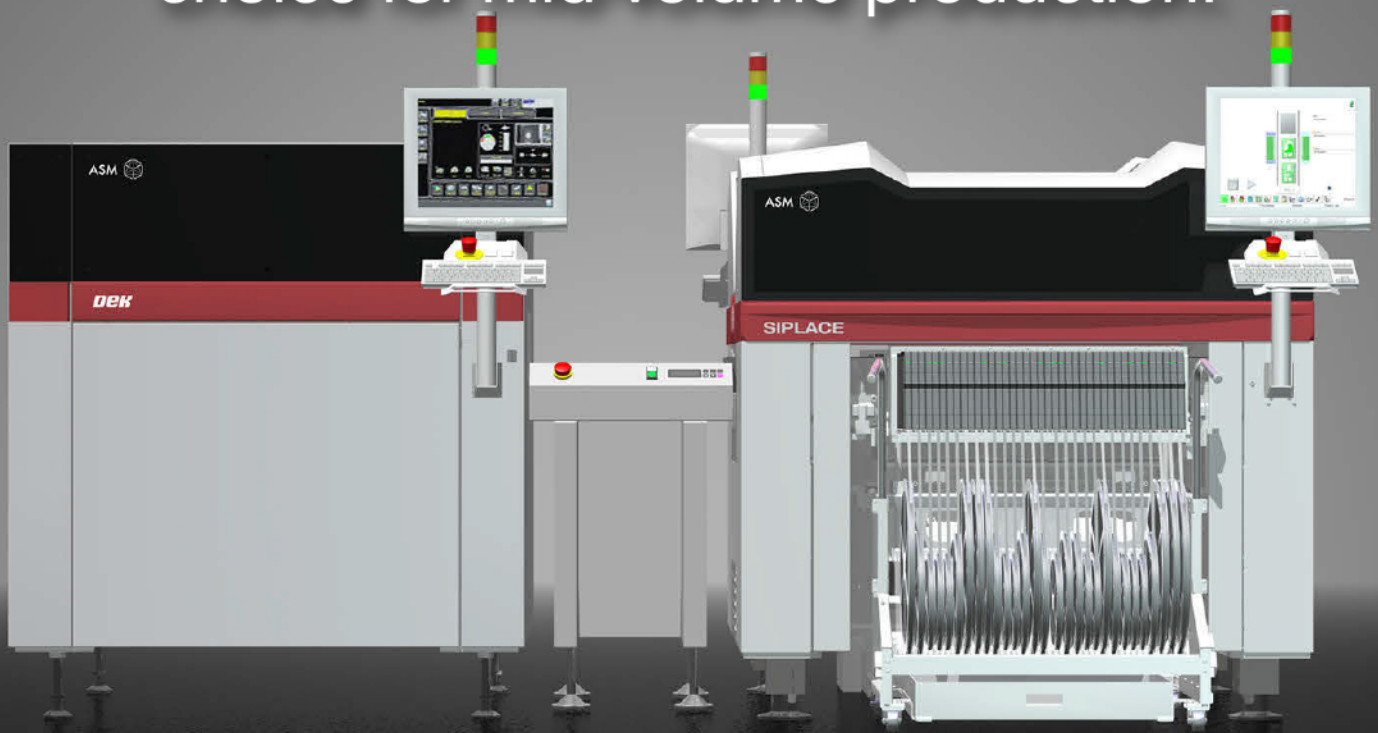

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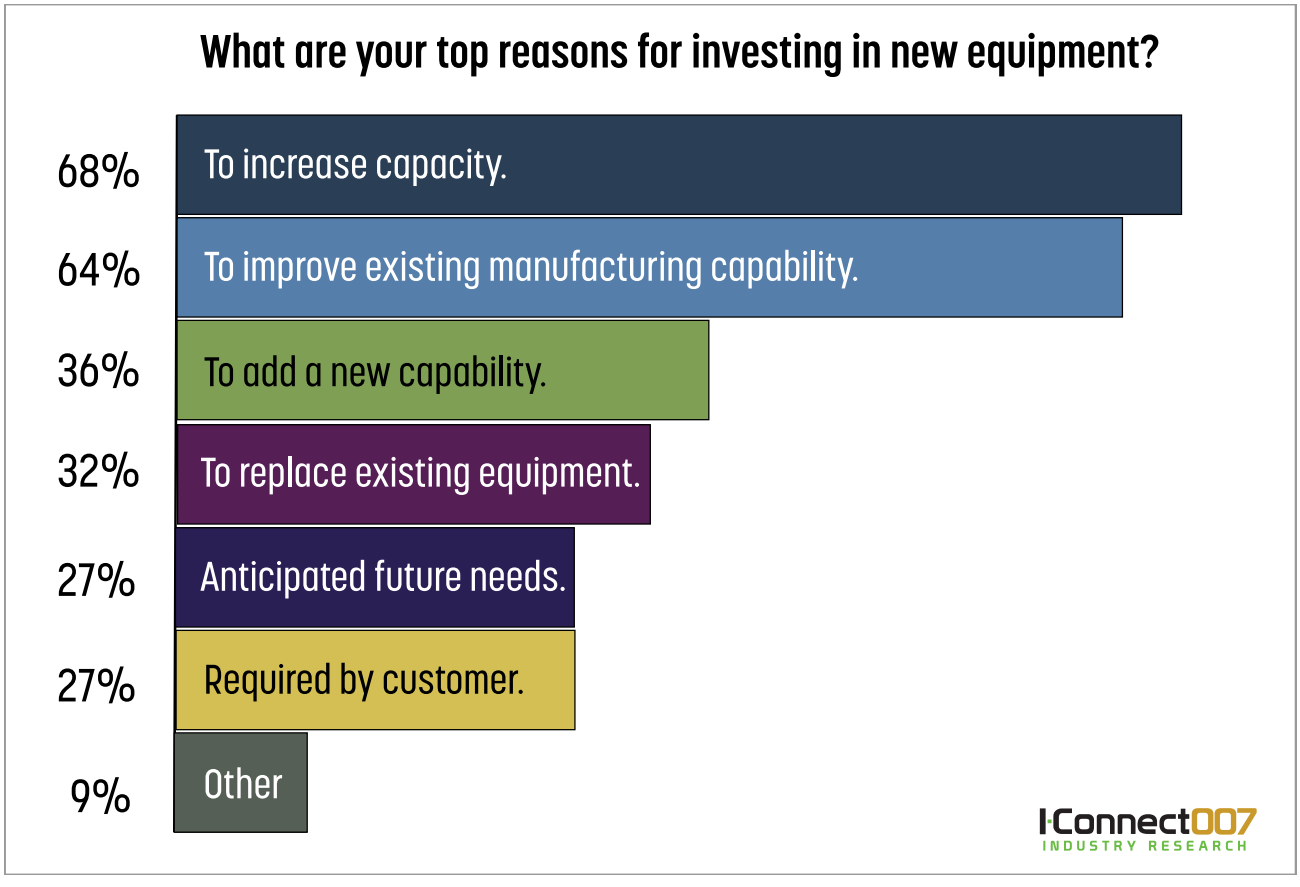
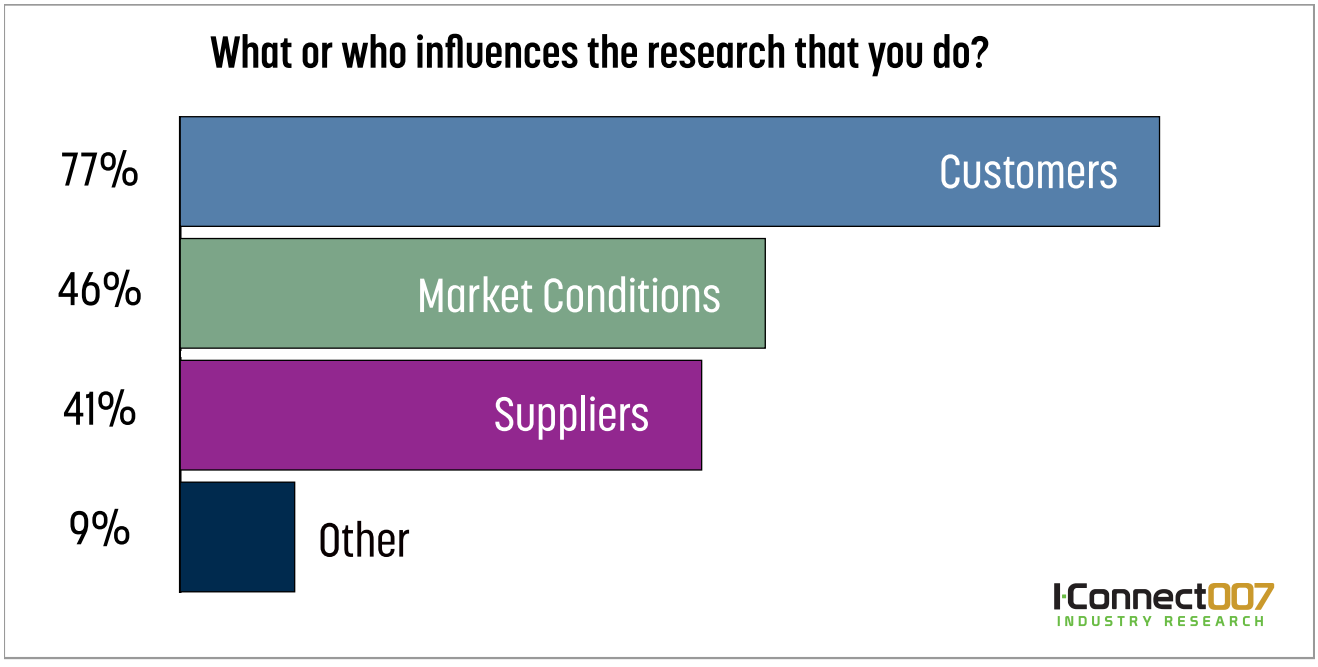
have some sort of an evaluation procedure. But first and foremost, she says companies should know what the end goal for the equipment is. "If it's a bottleneck fix, the leadership should come from operations and engineering. The decision is based on what is needed to improve productivity for one process or another. If it is technical development, and advancing the process based on a current need that has already been identified, then engineering and product development are tasked with developing the evaluation criteria. And if it is something that is needed for a next generation product following a roadmap, the company should conduct research to better understand what's out there and what is being worked on and may be available in 12-24 months," she explains.

Matt Turpin, president and CEO of Zentech Manufacturing, meanwhile, says companies should not buy a piece of capital equipment unless they know what problem they're trying to solve—whether it's a technology problem or it's a process problem. "Maybe it is an efficiency problem. Know what you're trying to solve, and then, whether it's your evaluation requirements with the capex supplier, share those goals with them and how you're going to evaluate it," says Turpin.

I spoke briefly with Victor J.S. Chang, executive director of WKK, during the recent HKPCA & IPC Show in China. He says in this extremely competitive environment, the decision to invest in new equipment is based on how companies can streamline their production in terms of technology and management. Companies nowadays have more choices of new equipment that are smarter and offer more advanced functions to help them manage their processes better. He notes that trends like Industry 4.0 and the move towards automation provide manufacturers visibility and better understanding of what's happening on the production floor. This, in turn, is what's driving equipment manufacturers to become more competitive and put more R&D effort into improving their equipment designs.

In our recent survey on this month's topic, one of the questions we asked focused on the





key reasons for investment in new equipment. A majority of respondents said they consider increasing capacity and improving their existing manufacturing capability as top reasons for investing in new equipment for their production lines. Others cited the need to add a new capability and replace existing equipment, along with reducing handling and improving quality.

In another question, we asked what or who influences the research into new equipment to buy for their factories. The majority of respondents (77%) say it's addressing the customers' needs that influences their research for new equipment.

This issue also features an article by JJS Manufacturing's Russell Poppe, who discusses key considerations when selecting an X-ray inspection system. Then we have an interview with ULT North America CEO Wolfgang Koehler, who explains the need for extraction and filtration systems in electronics manufacturing environment.

We also have another Tip & Tricks article from Ken Horky of Peterson Manufacturing, as well as an article on assigning IDs within the Internet of Things, from Hubertus Grobbel of Swissbit AG.

Of course, our resident columnists Michael Ford and Bob Wettermann contribute their take on the latest developments and issues in their respective markets.

Finally, I'd like to highlight our IPC APEX EXPO 2018 Pre-Show Coverage section, wherein you can find our interviews with IPC leadership on what to expect at this year's show, to be held at the San Diego Convention Center in February. Read about the Emerging Engineer program, what's new in the IPC APEX EXPO app, as well as the technical tracks and exhibition highlights for this year's event.

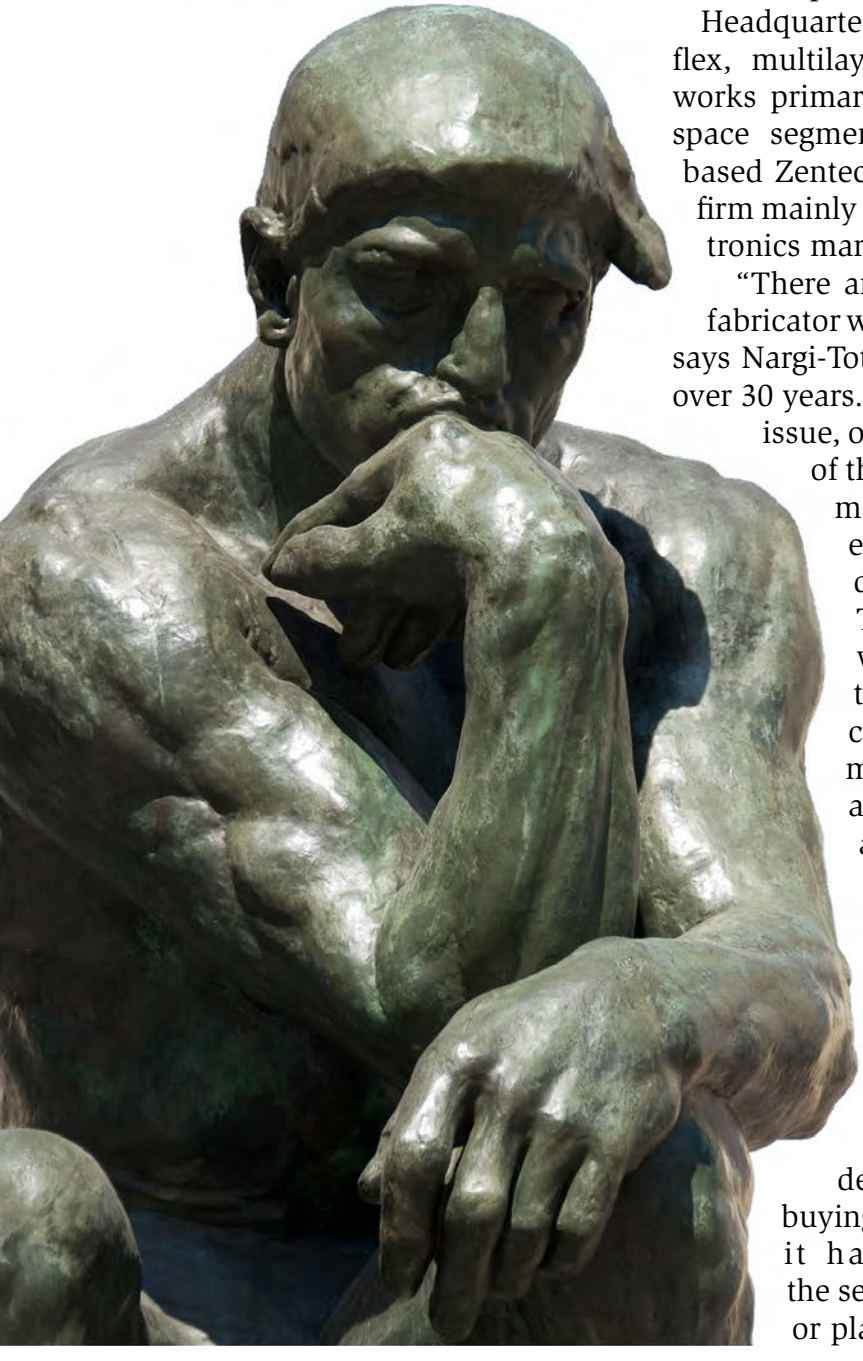
I hope you enjoy this month's issue, and our magazine's new look. Watch out for our next month's issue, which will be focused on knowing your customers, both internal and external.

With that, we'd like to wish you all a prosperous year ahead! We look forward to working more with you and supporting the industry in 2018! **SMT007**

Stephen Las Marias is managing editor of *SMT007 Magazine*. He has been a technology editor for more than 14 years covering electronics, components, and industrial automation systems.

Making the Right Equipment Selection

Feature Article by Stephen Las Marias and Patty Goldman
I-CONNECT007



For this month's issue of *SMT007 Magazine,* our focus is on equipment—not just on who's got the latest and the greatest, but on how people decide what to buy, when to buy it, and how those decisions are made. In preparation for this issue, we invited Kathy Nargi-Toth, president of Eltek USA, and Matt Turpin, president and CEO of Zentech Manufacturing to a discussion on the decision-making process for new equipment, and the key considerations for choosing the best machine solution for a process.

Headquartered in Israel, Eltek manufactures rigid-flex, multilayer flex, and HDI PCBs. The company works primarily with the military, defense, and aerospace segment, and medical electronics. Baltimore-based Zentech Manufacturing, meanwhile, is an EMS firm mainly focused on the mil/aero and medical electronics markets.

"There are probably three main ways that a PCB fabricator would evaluate new equipment purchases," says Nargi-Toth, who has been in the PCB industry for over 30 years. "The first would be to address a capacity issue, or a bottleneck. So, you're looking for more of the same, perhaps. The second would be to meet a technical challenge that your current equipment can't. The last one would be to do something that is new or revolutionary. That case would follow your roadmap and would be looking to purchase equipment that may not yet be available. In these cases, it is best to be working with your main equipment suppliers. Often, they are already looking at new techniques that can advance you along your roadmap. Most fabricators are doing some amount of each of these three types of purchases, depending on how the particular operation is focused."

According to Nargi-Toth, in Eltek's case one of the primary focuses is equipment that can handle thin materials. "There seems to be an overriding decision-making process when we go about buying a new piece of equipment. How does it handle flex material? How does it handle the sequential lamination, sub-composite layers or plated through-hole innerlayers? This mate-

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Kathy Nargi-Toth, Eltek USA

rial handing focus helps us concentrate on equipment that meets our overarching requirement, because we need to have equipment with 1-10 mil handling capabilities. As an example, we do a lot of hole filling, and we have been using one type of equipment for many years. But it wasn't as adept at handling the thin materials. So, when we looked to add more capacity we evaluated a different machine and found that gave us better fill, especially with those small holes, and was also better for handling thin material. The process, basically, is we have a need, we put together a proposal of what type of equipment we want to look at, we gather some samples, we run samples, we evaluate them versus what we have, and then decide. We've done that for our etching line, and we have done that for laser drilling. Basically, benchmarking new equipment against existing and looking at two or three different types of equipment from different suppliers in the same category. We just purchased another laser drill, and in that case, we did a survey of what was out there, and we ended up buying another machine like the one we had, because it best met our needs."

Being in the EMS business for about 35 years now, Turpin has already seen a lot of changes. According to him, in the old days—around 15 years or so back—an EMS firm could buy a set of equipment, and use the same set of equipment 10 years later. "Because technology just did not change that fast," he says. "Back in the old days, you had a lot more mom-and-pop shops. A lot of Tier 4s and Tier 3s, because it wasn't as capital intensive back then. It was great for an EMS business, selling from the equipment standpoint. I wouldn't necessarily say 'the good old days,' but there'd be times where you bought the equipment, you could run the equipment, and things didn't change that much. And then we entered a period where there was a rate of change, and we were like this until relatively recently, where you knew that there was new technology out there, but you could wait for a program, a customer, or an opportunity to come along before you buy. It's like, 'Okay, well, yeah I know that there are longer ovens out there. But if I get a 30-core layer board and it's a big enough program, I'll bite off and I'll buy a new oven."

Over the past five years, Turpin says you just don't need to wait for a program because there was enough research to figure out what you needed. "You had to become fast with the technology to even know how you'd end up quoting, because you can't just buy the equipment and start using it the next day. You have to develop a process around it. You've got to learn how to do it. You've got to hire people. In the EMS world, we are driven more towards having a technology roadmap, where we do need to plot out emerging technologies. Not just on the process side, but on the component side. Component suppliers are coming out with some crazy stuff that influences the equipment you need to process it. It is just creeping more into the EMS side."

As an example, Turpin said you cannot just get an oven only when you get a 34-layer board program. "You can't just have one oven, you need to have three ovens that can do heavy layer boards and highly integrated BGA technology on those boards. You need more than one rework machine to be able to rework BGAs that are on that. You have to get out in front of that," Turpin says.

One of the technologies that Zentech started looking at a year ago was cleaning technology. "We spent six months just looking at all the different versions. It used to be you'd see a couple of LGAs, a QFN, on a board. We've got some with hundreds of LGAs on a board now, and it forces you to a completely different cleaning paradigm where you can sort of clean it with the old stuff, but not really. So,

you really need to look at new technologies all the time. It's the same thing with 3D AXI. You can't use a manual X-ray system when you have a Class 3 board with 400 bottom-terminating components. There's no way any human being is going to accurately look at all those without glazing over. You need automated technology to do the heavy inspection on that type of work. You still have a human to do a sample to make sure you have compliant joints, but there's no way you can screen all those bottom-terminated joints manually," says Turpin.

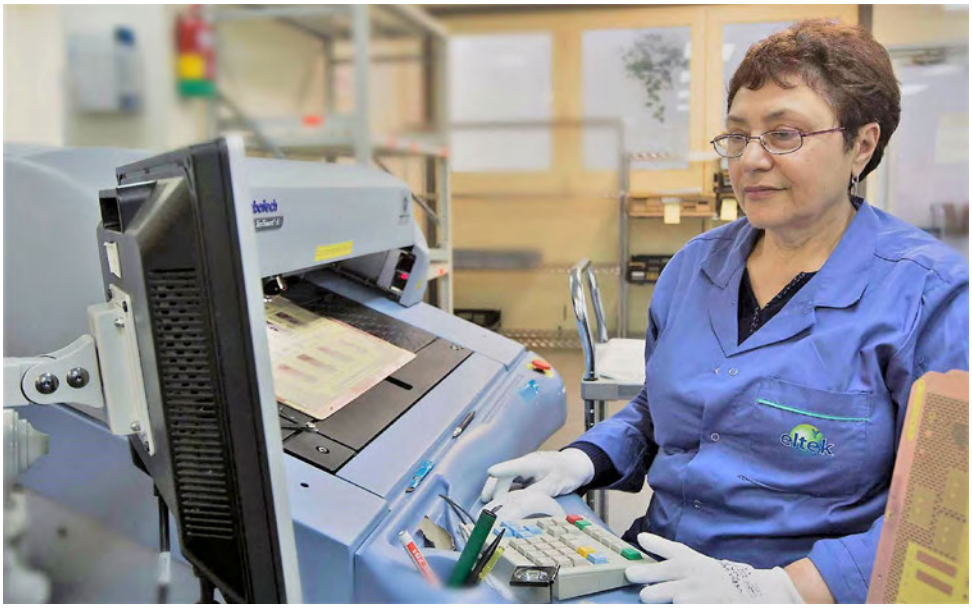

Figure 1: When investing in new equipment for the factory, manufacturers should follow a proven evaluation procedure. (Photo Courtesy: Eltek Ltd)

Challenging Equipment Suppliers

Do they ever make demands on their equipment or department to come up with something better for their processes?

Nargi-Toth says some of their equipment is 'machine #1,' which is when they have challenged their suppliers to give the industry something better. "I think many of the #1 machines that Orbotech has introduced have spent some time in Eltek," she says. "We had one of the first laser direct imaging machines they made, and the first direct imaging solder mask machine they made. It is very important for our industry that these types of relationships exist between fabricators and the supply base. We are constantly challenging our suppliers to give us something better than the machine that we just bought from them."

But sometimes, current technologies have notable limitations. "We've tried to get better handling, say, in a DES line, and there are some limitations in available equipment. It may handle a 1-mil dielectric layer, but it doesn't necessarily handle that 1-mil film when we remove 75% of the copper from it. So, I would say, from our perspective as a panel flex supplier, there are some limits in what's currently available to meet our requirements," says Nargi-Toth.

Automation Vision

How is automation, or the drive towards it, affecting the decision process in acquiring new equipment?

"In the EMS world and certainly in the military/aero and the medical side, your raw material expense is going to be around 60–70% of your revenue," says Turpin. "The number one expense, in our world, is raw materials. From an automation standpoint, you certainly want to be automated in terms of how you buy, plan and process your raw materials."

While direct labor is always important, Turpin says it's even more important to have a robust process that can make sure you have virtually no scrap. "You've got these $25–$40,000-dollar-apiece PCBAs running through your facility at relatively low profit, low contribution margin. You really can't afford to have any scrap. Your shift is focused less on labor to more on quality, reliability, and taking scrap down to zero. And, pretty much, rework down to zero, too, because you can't afford to hold onto these components for very long. You're more looking for velocity than you are efficiency on the

labor side. Having said that, you're always concerned about efficiency, but it's not like it was in the old days because labor, as each year goes by, is increasingly a smaller percentage of your spend. At least, in my world."

On the PCB side, especially in the flex area, Nargi-Toth says they look at automation as a way of removing the typical handling issues and increase product yield and production efficiency. "As Matt said, handling can sometimes lead to scrap. And while automation has its own set of problems, it is more controlled and predictable," she explains. "At the end of the day, handling is critical throughout the manufacturing operations. Removing handling-related scrap improves yields and in-turn that improves efficiencies and the overall competitive position for the company."

Removing handling-related scrap improves yields and in-turn that improves efficiencies and the overall competitive position for the company.

"And just to amplify what Kathy just said, anytime that we introduce automation, it's more about reducing variability, and increasing quality, reliability, reducing scrap, than it has anything to do with reducing labor content," says Turpin. "So that would probably be the main message I can suggest. It's automation for reducing variability and increasing reliability, not reducing labor."

No Longer Customer Driven

The decision to acquire new equipment was once driven by customer requirements, but not anymore. At least, not as much as it used to be, according to Turpin.

"Take the three periods of an EMS: First is what I call the good old days, when you could just chug along with the same set of capital for a decade or more. The second phase after that was really when it wasn't, 'Build it, and they will come' but 'if you get a program, you get a customer, then you go out and you buy the capital equipment to support it.' Now we've moved away from that to where you really have to get out in front of it. Generally, you have to get out in front of it with a technology roadmap, with some level of R&D. Because by the time a customer comes in with an opportunity, even though the equipment lead time may be four or six weeks, to do a thoughtful evaluation process takes a lot more than that. The capex is around automating a process—you can't just introduce a new piece of capital equipment to your process without doing a thoughtful process development, and analyzing it, training, making sure that you followed your due diligence to introducing that new process. By the time you stack up all those activities, the customer generally is going to wait if you're doing it on a wait-and-buy basis.

Having said that, we have one customer relationship where we do share our technology roadmap. We do have visibility into their engineering groups, and we do get to see where their head is at in terms of what the next thing may be, so we can pull from that. So, it's not wetting your finger and sticking it up in the air to see where the industry is heading. We can be a little bit targeted from a customer-needs standpoint, but we don't always have that luxury."

Advice for Designers

For Nargi-Toth, the best thing designers can do is engage early. "They need to engage early with the manufacturer. We can help designers best when we are brought on early and become part of the project team. It is important because the designer together with the board fabricator and assembler should be assessing the manufacturing trade-offs associated with new designs. Many times, the designers do not fully understand manufacturing constraints and if they wait to address them after a design is completed it will lead to delays. Designers often use simple DFM analysis as a first pass, but this approach is not going to fully address

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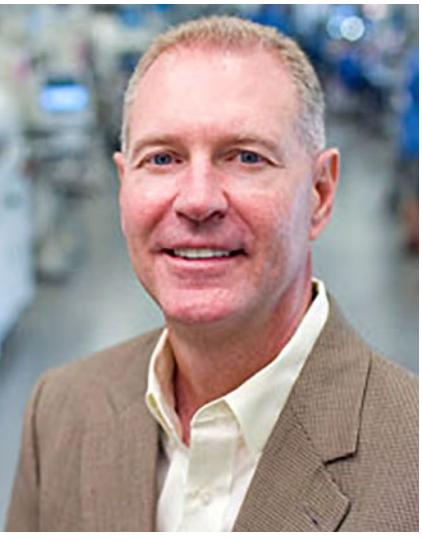


Matt Turpin, Zentech Manufacturing

more complex products like rigid-flex and HDI constructions. In these types of products, the material set is going to play a key role in how the boards are going to process and yield for tight tolerance items such as Class 3 annular ring or wrap plating requirements. For more complex designs you need to understand and select materials correctly, and design appropriately. Designers don't necessarily understand the myriad of manufacturing challenges the PCB producer must navigate when they are evaluating materials based primarily on electrical properties."

Turpin agrees. "That would be my number one: Engage with a PCB fabricator. And, at a minimum, understand their pain and their process, and, in general, what they can and can't do. Because the problem nowadays with PCB design is that the barriers to entry for somebody to call themselves a PCB designer are so low. There are so many people out there as contractors. More and more, even large companies are moving toward a contractor model. There are some bad designers out there that don't know anything about PCB fabrication, they don't know anything about what the EMS company has to do, and they come out with some really, really bad layouts that are almost unproducible," he notes. "And the problem is, with a lot of the ways the contracting worlds work, by the time it comes to Kathy and myself, the design has been bought and paid for, and you've got a customer that really doesn't even know what it is they're dealing with. Then we've got to be the bad guy to tell them that, 'No, this really isn't going to work, and you've got to do this, this, and this.' And it slows things down. Or worse off, they just don't have the time and they just try to build it as is. Or they go to some other bare board supplier that isn't going to ask the right questions, and just produce something that isn't manufacturable."

One of the issues that challenges manufacturers like Eltek is how we as an industry approach prototypes, according to Nargi-Toth. "If we look at the North American model today, we see a high number of prototypes that are being built in relatively small domestic factories. The fact is that even if they are not in the best facility in the world, they can make one or two of anything and the design has been manufactured and is vetted as manufacturable. However, when you bring it to the production manufacturer they may say, 'We can't build this in production." And by this they usually mean, the tolerances are too tight, the yield will be negatively impacted and the material utilization on a standard panel is wasteful. Net result is the cost is going higher than predicted, or the board needs design modification and ultimately the customers' end target for time to market, price or both is missed. It's an important factor that can get missed when dealing with the prototype. It's best to work with a factory that can help you bring the product from design to market right from the start," she says.

Turpin notes that the problem in the PCB fabrication side is that when you're building prototype quantities, the manufacturability sometimes gets lost in the equation. "Because when you're buying one board or three boards, it's either going to cost you a lot or it's going to cost you a whole lot. If it's going to have a high repeatable cost, a lot of times it won't get caught until later," says Turpin.

"Right, and then when it goes into production, nobody wants to carry that poor design forward," says Nargi-Toth. "In the prototype model, you don't care what your yield is. You never track it because you're never going to see the part again. You make it one time and you're on to the next one. When it comes to production and you're going to be seeing the same part number every month, you can't live with a poor yielding design. That is what we try to avoid by early engagement with our customers."

Figure 2: Investing in equipment is essential to keep pace with the driving forces of ever-evolving technology. (Photo Courtesy: Zentech Manufacturing)

Communication

Nargi-Toth says that now, more OEMs and designers get in touch with them early on. "I would say we engage with the OEM in about 50% of our relationships. We do a lot of work directly with the OEM, especially on the medical side, because we work together with them through the FDA process. We help them to lock down materials and processes. For these types of projects, we are involved with the designers at the beginning," she says. "With flex and rigid-flex projects, the designer wants you to be involved early because they have a concept and often they need our help to figure out how best to get what they need on the board and get the board folded into the final package. It becomes a mechanical as well as electrical design project from the beginning, so we certainly can add value by our early involvement."

Turpin prefers to get involved from the beginning. "Last year we acquired a design service bureau, so we could have the scale and the toolsets to be able to do the layout on pretty much any platform. And that has worked, so the extent that we can get involved in the beginning, do the layout up front, and take care of all those issues and make the bare board fabricator's life easier, make our life easier, and generally make it up. We're reliable, cost-effective, with quicker time to market," says Turpin. "In some cases, the OEM will have their own engineers. And, generally, when they're doing their own layout—which is probably half the time if we're not doing the layout—our customer has a dedicated designer who knows what they're doing, and they will almost always look for input before they release the final package."

"In other words, to do one final look through a DFM and DFA to bring out any things that may have been missed or, particularly with the new package types, we always get calls from designers in our customer base when they are using a new package, in terms of talking about what footprint to put in a design. Because most of them are smart enough not to use the footprint that the manufacturer gives. They'll use that as a basis, but they'll always tweak it based on something. But it's not enough. I

wish it was 100% of the time we or somebody else could get involved. I would say 25–30% of the time we just get what we get, and we try to make it work."

There is a difference depending on if it is a commercial or military/medical application. "On the commercial side, it is more transactional. You may never meet the designer unless they have a problem and they may already be on Rev B or C. Unfortunately, the manufacturer is now coming in after the fact and trying to make changes, which is more difficult and wasteful," says Nargi-Toth. "But for sure, in some of the new programs in mil/aero, or in medical, we find often that the OEM already knows they need assistance, and they want to reach across the table and engage early. They have a history of positive experiences with collaborative efforts that have produced successful projects that were on-time and met the commercial targets and they want to build on this positive experience."

Conclusion

When it comes to making decisions on investing in new equipment for the factory, manufacturers should have some sort of an evaluation procedure, according to Nargi-Toth.

I think most companies do have a procedure when they evaluate new materials and new equipment. Obviously, they need to know what the end goal is for the equipment.

"I think most companies do have a procedure when they evaluate new materials and new equipment. Obviously, they need to know what the end goal is for the equipment," says Nargi-Toth. "If it's a bottleneck fix, the leadership should come from operations and engineering. The decision is based on what is needed to improve productivity for one process or another. If it is technical development, advancing the process based on a current need that has already been identified then engineering and product development are tasked with developing the evaluation criteria. And if it is something that is needed for a next generation product following a roadmap such as what Matt talked about, the company needs to do some research to better understand what's out there today and what is being worked on and may be available in 12-24 months."

First, manufacturers must define what type of equipment they need and what they are trying to accomplish. Once that's done, it's time for a project plan to evaluate what's available.

"Even if we're talking about some of the simplest equipment in fabrication, we're talking $250,000. If I want to go out and buy a new automatic plater, we're talking about $5 million. It's a lot of money to invest, and you're not going to do it by just by running a few samples," says Nargi-Toth. "It all needs to begin with a project plan and a solid understanding of what the goals are for the new equipment. Once that has been established you can determine how you're going to evaluate the available technologies to make sure that you're making the correct decision and purchasing the right piece of equipment for your particular needs."

Turpin agrees. "Everything that Kathy said would apply to not just the EMS business, but, I would say, to any problem that anybody is trying to solve. Don't buy a piece of capital equipment unless you know what problem you're trying to solve, whether it's a technology problem, whether it's a process problem. Maybe it is an efficiency problem. Know what you're trying to solve, and then, whether it's your evaluation requirements with the capex supplier, share those goals with them and how you're going to evaluate it," says Turpin. "Certainly, for a project plan, make sure that you're checking for that, and in your turn-up of the process, that the problems you're trying to solve are the processes you're developing, and documenting, and rolling out during the

roll out of the new piece of capex. But, that said, from a high level, start with a problem in mind. Don't just start with, 'Hey, I need to buy a piece of equipment X, Y, Z.' Start with, 'I've got a problem, A, B, C. How am I going to solve it?'"

Finally, Turpin noted that, inasmuch as they want to be tightly integrated with their customers, he hopes that component manufacturers were as integrated with the automation suppliers. "To make sure that the things they're doing are integrated with the way of properly placing components, cleaning components, inspecting components, things like that."

Nargi-Toth says having an open dialogue with customers and sharing roadmapping activities is beneficial to both parties. "Because in doing that, we can use the information we gather from them to help direct our research efforts and it benefits the customers because we are better able to meet their future requirements," she explains. "So, if we do know that sub-1 mil lines and spaces will be a reality in implantable medical devices in the coming years, that's the direction we have to move in. And how we get there becomes an actual research effort on our part before we can even begin to go out and evaluate equipment. First, we must understand how we're going to get there. What's going to be the best way to get there? Can it be done subtractively or do we need to move into additive processing? That's the kind of thinking that keeps us always forward looking."

Every company has a roadmap Perhaps, a five- or 10-year plan. This underscores the need for communication in the industry, throughout the supply chain. Working closely with both customers and suppliers can provide vision and help determine when and what new equipment will be needed for a company's long-term success. **SMT007**

Researchers Demo Quality Optical Microstructures Using Lithium Niobate

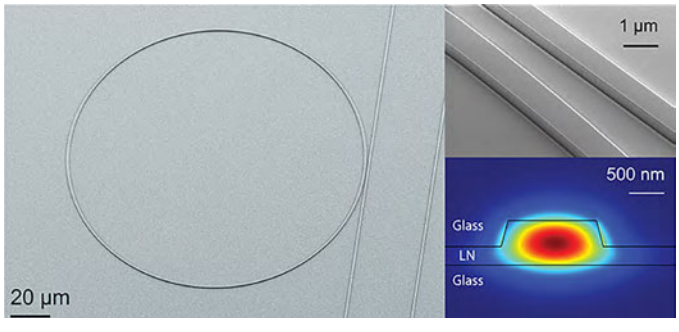
Researchers at the Harvard John A. Paulson School of Engineering and Applied Sciences (SEAS) have developed a technique to fabricate high-performance optical microstructures using lithium niobate, opening the door to ultra-efficient integrated photonic circuits, quantum photonics, microwave-to-optical conversion and more. The research is published in Optica.

"This research challenges the status quo," said Marko Loncar, the Tiantsai Lin Professor of Electrical Engineering at SEAS and senior author of the paper. "We demonstrated that you can fabricate high-quality lithium niobate devices–with ultralow loss and high optical confinement–using the conventional microfabrication processes."

Most conventional optical microstructures are made using processes of chemical or mechanical etching. But lithium niobate is chemically inert, meaning that chemical etching is off the table. But the Loncar lab–which is known for their diamond work–has experience with tough materials. Drawing on that expertise with diamonds, the team used standard plasma etching to physically sculpt microresonators in thin lithium niobate films provided by the company NANOLN.

The researchers demonstrated that the nanowaveguides could propagate light across a meter-length path while losing only about half their optical power. In comparison, light propagating in the previous lithium niobate devices would lose at least 99 percent of light over the same distance.

The researchers aim to build on these results and develop lithium niobate platform for a wide range of applications including optical communication, quantum computation and communication and microwave photonics.



The research opens the door to manufacturing ultra-efficient integrated photonic circuits, quantum photonics, and more.

MilAero Highlights

Lenthor Engineering Releases Q3 2017 Results ▶

Lenthor Engineering has reported total revenue of $6.806 million for the third quarter of 2017 (Q3 2017), up by 2% from the $6.722 million in Q3 2016.

Libra Industries Enhances Inspection Capabilities with Viscom X-ray System ▶

Libra Industries has purchased and installed Viscom's new X8011-II PCB X-ray inspection system at its Dallas, Texas facility.

Sypris Electronics Posts 19% Growth in Q3 Revenue ▶

Sypris Electronics, the EMS arm of Sypris Solutions Inc., has reported revenue of $7.8 million in the third quarter ended October 1, 2017, up by 18.8% compared to the same period last year.

C-MAC Recognized for Operations Quality ▶

C-MAC Microcircuits ULC has received the "Grande Mention" award for Manufacturing Quality in the province of Quebec, Canada.

Plexus Receives UTC Supplier Gold Status ▶

UTC Aerospace Systems has recognized Plexus Corp.'s Riverside facility in Penang, Malaysia with UTC Supplier Gold status.

IEC Announces Fiscal 2017 Fourth Quarter and Year End Results ▶

IEC reported revenues of $27.6 million and net income of $0.8 million for the fourth quarter of fiscal 2017.

Jabil Opens Newest Innovation Center in Marcianise, Italy ▶

Jabil Inc. announced today the launch of its newest Blue Sky Innovation Center located at its manufacturing plant in Marcianise, Italy.

CAMtek Earns ISO 9001:2015 Certification ▶

CAMtek Inc. has recently completed and achieved ISO 9001:2015 certification, which includes risk management.

Plexus Investment in Europe Continues to Grow to Meet Customer Demand ▶

Plexus is increasing investment in Europe with further expansion of its Oradea Design Center, located in Romania. This expansion enables Plexus to accommodate the continued growth in demand for its design and engineering services from customers in Europe.

Sparton Completes CFIUS Process ▶

The transaction remains subject to other governmental approvals, including clearance of the transaction under the Hart-Scott-Rodino Antitrust Improvements Act of 1976, as amended, as well as other customary closing conditions.

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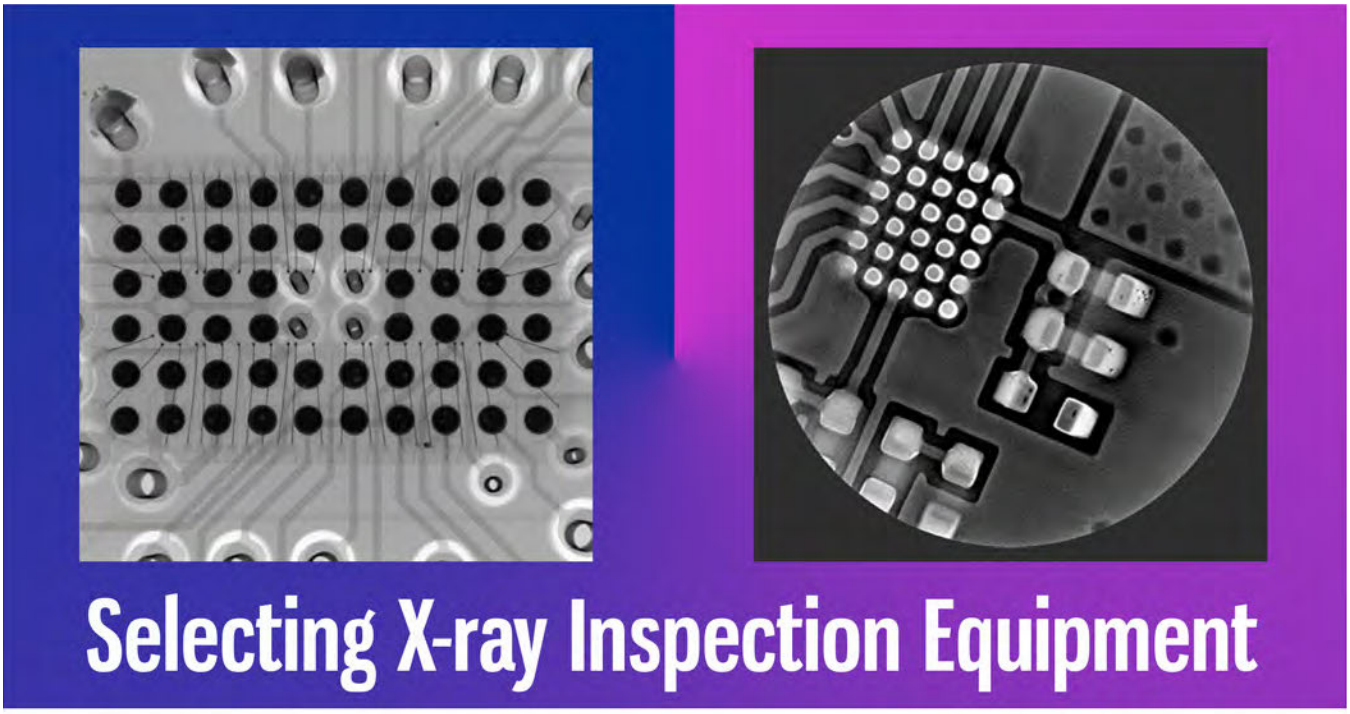

Selecting X-ray Inspection Equipment

Feature Article by Russell Poppe
JJS MANUFACTURING

There is a continuing trend towards smaller, more densely-populated printed circuit board (PCB) assemblies in electronics manufacturing. This is not necessarily because the PCB assembly needs to be smaller, but new designs are using significantly more ball grid array (BGA) and other types of devices with hidden solder connections, such as quad flat no-leads (QFN) and land grid arrays (LGAs). Such devices often have performance and cost advantages over larger packages with leads, so the trend is likely to continue.

Automated optical inspection (AOI) is an established, key process control in the SMT industry that greatly increases confidence in the quality of the finished product. But what do you do about devices where you cannot optically see the solder connections? X-ray inspection provides the answer.

Using X-ray as an in-process control can help remove the risk of producing assemblies that are impossible or uneconomical to repair due to misplaced 'hidden connection' devices. Reworking a misplaced device can be time consuming and may cause other issues on the assembly, for example with surrounding components on the PCB due to local heating. Rework might also exceed the maximum number of solder reflow cycles allowed for double-sided assemblies. Finding a failure later in the process, for example at JTAG or functional test, incurs additional lost time and cost in diagnosis and re-test.

So, when should you use X-ray? It should certainly be part of the 'first-off' inspection process, helping to ensure the oven profile is optimal for the leadless devices. It might then be sensible to check a sample of assemblies as they go through production; a few from the start, middle and end of the batch is typical. Alternatively, an 'in line' process might be used, though it is worth noting that X-ray inspection—even if automated—is relatively slow. In practice, placing leadless devices, especially BGAs, is quite straightforward and normally causes few issues, so X-ray should be employed thoughtfully.

X-ray inspection can also help reduce end-of-line manual inspection, for example on fine-pitch devices that cannot be fully covered by AOI (depending on what type of system you have), or where other BGA inspection methods such as an Ersascope might have been used.

Another great benefit of X-ray inspection is in resolving quality issues. X-ray allows inspec-

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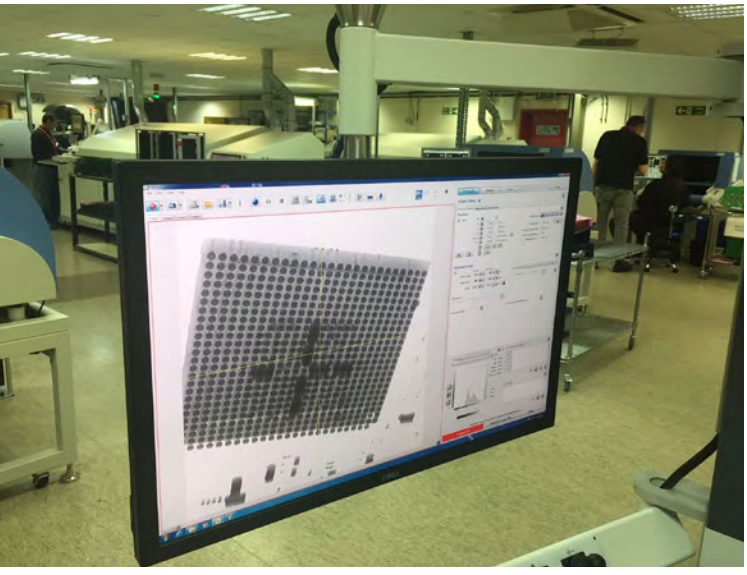

Figure 1: X-ray allows inspection without resorting to potentially destructive re-work or micro-sectioning.

tion without resorting to potentially destructive re-work or micro sectioning, which adds cost and, of course, leads to a scrapped assembly. Micro-sectioning also requires a bit of aneducated guess as to where the problem might be.

How often have your heard someone say, "It fails test, it doesn't work, and I can't see where the problem is, so it must be the BGA"? Enhancing X-ray to provide laminography, or indeed, full 3D capability that enables the inspector to walk through an assembly, helps find faults such as broken tracks or barrels in a PCB, for example, as well as any issues with leadless components.

Away from PCBAs, X-ray can provide non-destructive inspection of other manufactured components such as cable assemblies or machined parts where there is a need to see interior detail. It can also provide a degree of measurement capability.

So, a capable X-ray inspection facility is now considered a must-have for modern electronics assembly lines. But now that you have decided you need one yourself, or that your electronics manufacturing services (EMS) partner should be investing on your behalf, how do you go about choosing the right system?

Key Considerations

There are a lot of vendors and systems out there, so as with all capital equipment evaluations it is best to start looking with a must-have list already in mind. We will assume that price (and payback) will be part of the equation, and of course, the system must be large enough to accommodate the items that you want to inspect.

The following are four more areas to consider:

1. Image quality

If you were looking to buy a camera, then one with a higher pixel count, say, 24MP, is better quality than one with 16MP, right? If you know a bit about photography, you will know this is a great over-simplification (if not just plain nonsense), and if anything, X-ray can seem even more complicated.

There are physics and very clever software involved. Things that can affect image quality include the power, voltage, spot size, detector resolution, proximity of the X-ray source to the item and the field of view. Take voltage, for example. A 160kV system will have greater X-ray penetration capability than say a 130kV system, but the higher voltage can adversely affect the image contrast and hence, quality. How do you decide? The most practical solution is to take some typical sample assemblies and try the X-ray system out. Image quality can be a subjective opinion.

The great news is that you will probably find that systems aimed at PCB assemblies provide image quality that ranges from very good to excellent. This can perhaps be more to do with how the inspection is set up than the technical capability of its components.

2. How many 'Ds'?

The D, of course, stands for dimensions. There are three kinds of systems:

- 2D, which provides a straight top-down view
- 2.5D, which allows top down and tilted or angled views
- 3D, which is a three-dimensional re-construction of the assembly. This might use such techniques as tomography, laminography or (for the full 3D effect) computed tomography, or CT

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Of course, the more you get to see, the slower the inspection is. Complex CT scans for example can take hours to make. If the aim is to look at missing solder balls under a BGA for example, or shorts between them, then 2D can be fine. However, tilting can help get a better view if there are components obscuring the area of interest. 3D might be used for detailed quality investigations.

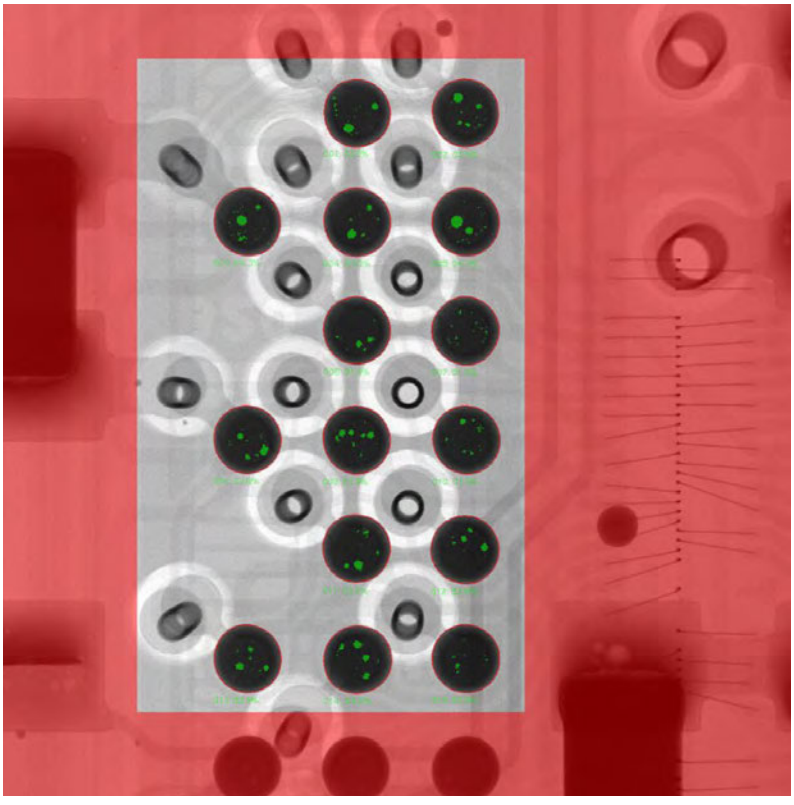

Figure 2: In this example, voids in the solder are highlighted in green.

3. Ease of use

Some systems allow a degree of automated inspection, for example by programming sequences of inspections with pass/fail criteria. This of course makes repeatable inspection and operation very easy, and allows an in-line process if required. Setting it up though, or performing ad-hoc inspections, does require some skill.

While modern X-ray systems are easy to use, the inspector does need to understand what all the settings do (e.g., the voltage and contrast settings we mentioned before) and be able to interpret what they are seeing, which does require a reasonable knowledge of PCB assembly. There can be features that make image interpretation a bit easier, for example, by applying color.

4. Maintenance

It is worth remembering that the Health & Safety Executive (HSE) must be notified before using X-ray equipment. Obligations may also exist around creating rules or procedures for use, and engaging radiation protection supervisors and advisors. The equipment supplier should be able to provide advice, and it is a good idea to have them perform an (at least) annual health check on the system.

It is also worth mentioning that there are different types of X-ray tube. 'Open tube' types are relatively quick and inexpensive to replace—perhaps a few pounds and a couple of hours—but need doing so after every 200-300 hours or so of use. 'Closed tube' types can last for many years but are much more expensive, maybe thousands of pounds. So perhaps the best choice depends on how much you will use the system.

The X-ray detectors tend to be standard or high-definition flat panels. The X-rays will cause these to degrade over time, typically around 20% after 10 years. While still usable, replacement after eight to 12 years could be advisable.

It is also worth finding out the common failure modes on systems, as while the component parts are similar, they can be assembled in different ways. For example, power supplies, connectors or cables can need replacing in time.

Hopefully, this article has helped you understand some of the areas to focus on when looking to invest in X-ray inspection equipment. **SMT007**

Russell Poppe is the director of technology at JJS Manufacturing.

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Supply Lines Highlights

TRI to Showcase PCBA Inspection Solutions at NEPCON Japan 2018 ▶

Test Research Inc. (TRI) will join NEPCON Japan 2018, which will be held at the Tokyo Big Sight, to showcase its Industry 4.0 Inspection solution, YMS 4.0, along with its complete PCBA manufacturing inspection solutions.

Video from productronica 2017: Nordson ASYMTEK Highlights Bulk Dispensing Technology ▶

Nordson ASYMTEK highlights its the new Helios SD960 bulk and two-component dispensing system. Almar Thewissen, program manager for Industrial Applications, EMEA, at Nordson, discusses its applications with I-Connect007 Technical Editor Pete Starkey.

Video from productronica 2017: Mycronic Discusses Precision Jetting Systems ▶

Clemens Jargon, VP of Global Dispensing at Mycronic, discusses with I-Connect007 Technical Editor Pete Starkey the company's portfolio of precision jetting equipment, with particular reference to the speed and versatility of the MYSmart series.

Video from productronica 2017: Heraeus Highlights Need for Highly Reliable and Compatible Assembly Materials ▶

Stefan Merlau, global product manager of assembly materials for Heraeus Electronics, discusses with I-Connect007 Managing Editor Andy Shaughnessy the biggest pain points of their customers, and how his company's latest technologies are helping them address these issues. He also speaks about their outlook for the industry going into the new year.

Cogiscan and MIRTEC Announce Partnership for Industry 4.0 ▶

Cogiscan Inc. has partnered with MIRTEC to offer a fully integrated Industry 4.0 solution for its suite of vision inspection machines and software.

Saki Joins the ASYS PULSE Community for PCB Assembly Line Productivity ▶

Saki Corporation has joined the ASYS PULSE Community to network its automated inspection and measurement systems with electronic production equipment from other PULSE member companies.

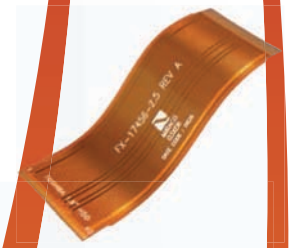
Anda Automation Partners with InterElectronic to Expand into Hungary ▶

Anda Automation has partnered with InterElectronic Hungary Ltd as its distributor in Eastern Europe.

Indium's Donna Vareha-Walsh Presents on State of Indium Metal Supply Chain ▶

Indium Corporation's Donna Vareha-Walsh, director, Metals Business Unit, shared insights into the global supply and demand for indium at the 2017 Global Minor Metals Forum on November 29 in Chengdu Qinhuang, China.

Engineering And Providing Balanced Interconnect Solutions



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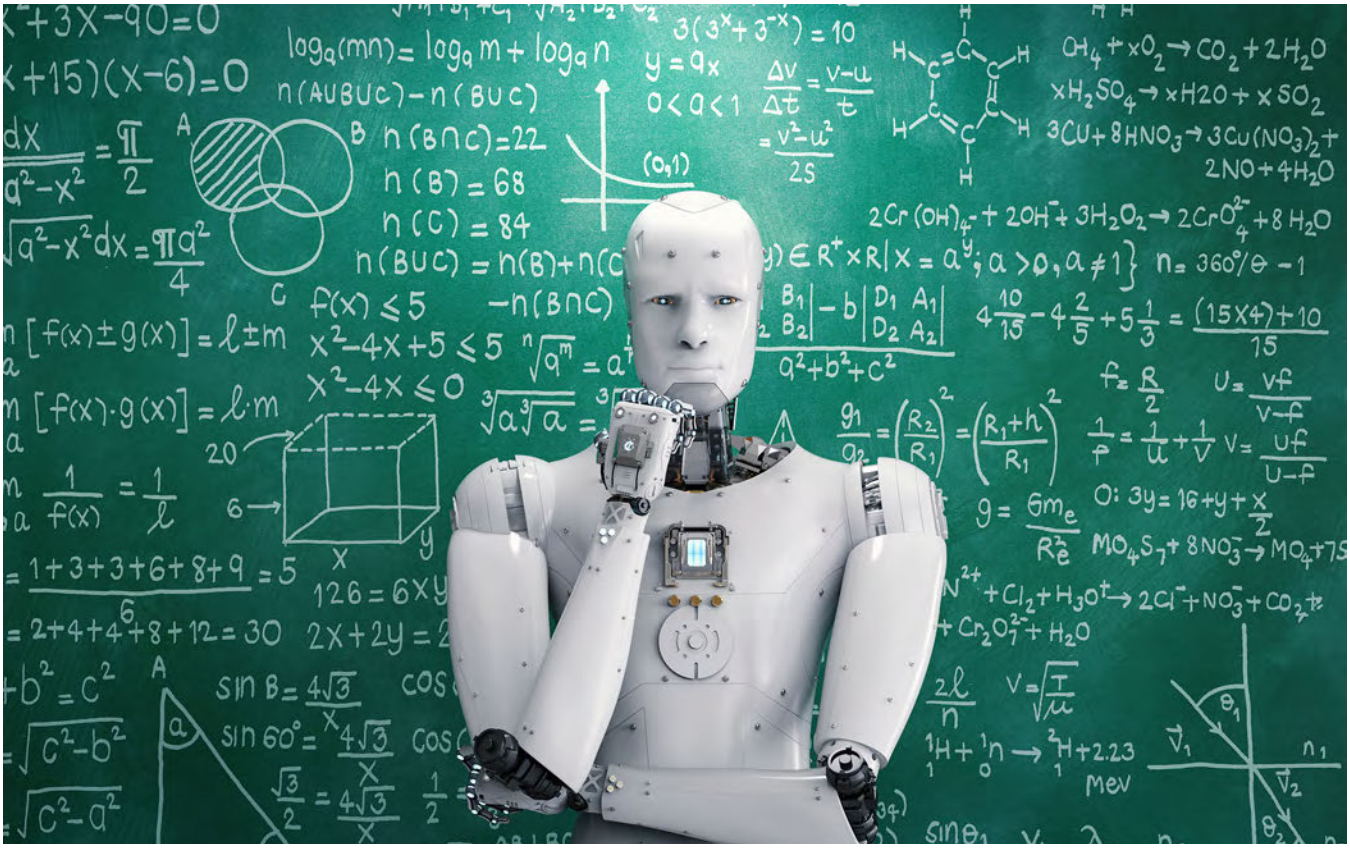
Configure to Order: Different by Design

Accelerating Tech–Insights from the Smart Factory
Column by Michael Ford
AEGIS SOFTWARE

Perhaps in the future, sentient robots looking back at humans today will consider that we were a somewhat random bunch of people as no two of us are the same. Human actions and choices cannot be predicted reliably, worse even than the weather. As with any team however, our ability to rationalize in many different ways in parallel is, in fact, our strength, creating a kind of biological "fuzzy logic." Robots will have to cope with mankind's wishes for differentiation, no matter how illogical that may be. Rather than repetitive automation, the Industry 4.0 computerization concept has been created to find efficiency in automated randomness. The crux of such a process is the ability to be prepared for, and to be able to manage, the increasing mix of products and their variants effectively, just as smoothly as if factories were producing in high volume. When considering Industry 4.0 therefore, being able to digitally configure to order (CTO), rather than having to be responsible for hundreds or thousands of individual bill of materials (BOMs), in a simple and effective way is an essential, critical business need.

Automation has been a key element since the start of the third industrial revolution, where electrical systems and controllers have been



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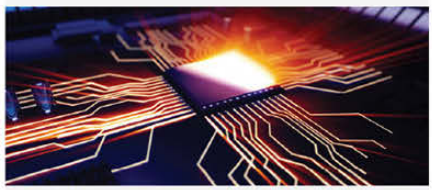

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running machinery designed to replace human manual dexterity. Until quite recently, automation has been rather dumb. Simple automation was dominant where machines simply followed a set of sequential instructions, or, in the case of assembly robots, copied a series of movements. More evolved automation can apply alterations and corrections based on, for example, the processing of visual checks on SMT machines, which correct the position and orientation of materials picked up or positioned for placement. The challenge for the creation of the vast majority of automated processes was made very much easier by the notion of mass production, where once set up, the automation would simply repeat what it was doing in a very efficient way, with very high equipment utilization. Unfortunately, the heyday of repetitive high-volume manufacturing for most of us has passed.

It seems ironic that automation has played the initial part in the downfall of mass-production itself.

It seems ironic that automation has played the initial part in the downfall of mass-production itself. Adopting automation meant that the quantity of products made could be increased drastically over manual production lines. This meant that the market for such products expanded. Requirements in expanded markets meant that there needed to be different versions made, for example with different electricity or communication standards, including of course human language. The concept of variants was born. Once established, marketing teams got involved, using variants to find ways of targeting against competitor's products, making lower cost versions, higher featured versions. Any company could then target increasingly well-defined niches of customer need with exactly the right cost-effective product. After marketing, came fashion. Technology has become fashionable, creating the need, for example, in personal devices such as cellphones, to be available in many different sizes, colors and styles. Perhaps as an extreme example, but genuine nonetheless, a specific original design of mobile phone is now manufactured with thousands of individual variants, depending on feature level, resource level, wireless options, software options, language, service provider, colors, etc. Keeping track of which phone is which during manufacturing is an absolute nightmare. Most of the variants look the same throughout most of the processes, but have different assembly combinations, including subtle differences in electronic component placement positioning. The worst aspect of this is yet to come. Since there are so many variants, the cost of storage of semi-complete and completed products has increased in line with the number of variants being produced. In most cases, the business demand has been to avoid stock of products as far as possible. The number of days of stock throughout the distribution chain has typically shrunk from being many months, to a few days at most. For manufacturing operations that are remote from their markets, such as China, the reduction can only be achieved by air-freight rather than sea-freight, increasing distribution costs and environmental impact. Companies that manufacture close to their markets, typically those remaining in the West, are pushed to be almost "make to order" so as to keep needless investment of stock to an absolute minimum. In-factory warehousing is included. The opportunity for manufacturing to smooth the effect of high product mix on the lines by creating stockpiles in the warehouse is rapidly running out. The reality now must be faced. Manufacturing must be capable of producing multiple configurations with complete control and without any loss of productivity. Those companies that can achieve this are surely the companies that will succeed, having reduced the extortionate operational overhead of mixed and low-volume production to an absolute minimum. This is the condition that Industry

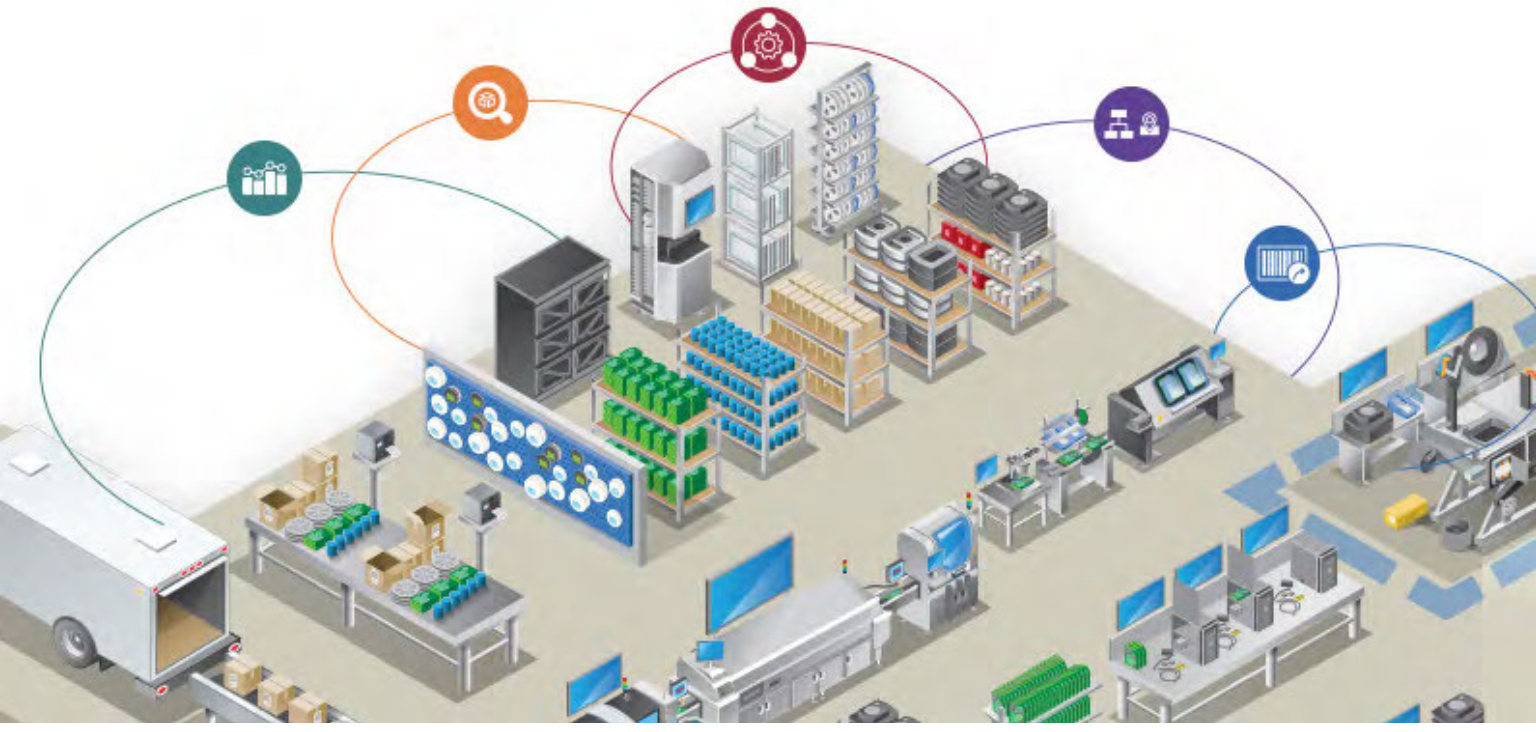

Figure 1: Knowing what is currently executing and the status of each process in the factory provides critical information for Industry 4.0 computerized management systems.

4.0 achieves through the use of computerization.

When considering implementation of Industry 4.0 solutions, following the hype in the market, attention typically is focused on the need for communication between machines on the shop-floor. Knowing what is currently executing and the status of each process in the factory, as well as all the related resources and support operations, provides critical information for Industry 4.0 computerized management systems. This includes work-order creation and assignment, as well as the control and planning of related resources and support operations. What is often neglected however until much later in the process, is the management and control of the engineering definitions of products and related variants that are to be made in this ultra-flexible factory. Engineering control is quite a challenge considering the many tens, hundreds or indeed thousands of products and variants that can potentially be live in production in a single factory at any time. The management of the precise engineering data, which includes visual aids and documentation, to be supplied to all processes exactly when needed can quickly become an extreme drain on engineering resource. Add to this the need for conformance, where every set of engineering data, whether comprising a set of machine instructions, or an ISO controlled operation standard for a manual process, needs to be issued and confirmed into place prior to specific execution of a work-order.

Apart from the number of different products and their variants, managing the many sets of BOMs on an individual variant basis is made more difficult where the differences between each variant can be quite small, but critical. Many of the differences will be at the end of the production process, for example the casing, manual, or packaging which is different. Of course, making a mistake here carries the same level of importance as anywhere else, as no-one wants to get a product with the wrong manual or power adaptor, or worse, with the wrong version of software. Small differences earlier in the manufacturing process, such as those in SMT production may make no discernable visual difference, but can affect many of the tests and processes that come later, as measurements and inspections

may show up different results. Any level of confusion about what is supposed to be there and what is not, is simply not an option in manufacturing. The management of individual variant BOMs therefore requires a very thorough team of engineers.

The concept of configure to order reduces the number of individual BOMs that need to be managed, eliminating the confusion and risk associated with individual variant BOMs. The classic perception of configure to order is on a final assembly line, where products are being made according to individual customer specifications, or, where there are defined sets of features that makes up a set of standard variants.

An example of this is common in the automotive industry, where on the final assembly line, for each base model of car, there are defined model variants, each adding a set of upgraded components such as engine, multimedia, lights, navigation system, etc., as well as individual choices that the customer has made, such as the color of the car. Production of the Ford Model T is a famous example of a non-flexible, automated mass-production line that achieved success by reducing costs and increasing productivity.

Today's final assembly lines boast that they can produce flexibly on a non-stop fixed tact final assembly line capable of making any combination of models, variants and individual customer choices.

Today's final assembly lines boast that they can produce flexibly on a non-stop, fixed-tact, final assembly line capable of making any combination of models, variants and individual customer choices. While this implies 100% efficient production, it hides a great deal of associated waste, which is constantly having to be optimized behind the scenes. Without knowing what is to be made each day would require material availability to satisfy any quantity of any combination of any specification each day, representing a huge amount of material investment.

Many of the optional components, especially the more expensive components, are likely to be rarely needed as compared to options lower in the range. It is a waste of investment to have unnecessary stock at the line, so some logic and planning needs to be done to ensure that the materials are there only when needed. The suppliers of such optional materials, which today mostly feature complex electronics sub-assemblies, would bear the brunt of the randomness of customer demand, and so face the very high volatility of demand on individual product variants that they supply. This can make their business very inefficient. Some grouping therefore, especially for high-cost, rarely-used materials would reduce investment cost overheads, but only if the "random" production could also be grouped. The compromise of the flexible final assembly line then creates follow-on issues. The waiting list for a car to be manufactured after placing an order with options, is quite significant. It can now take between 12 and 20 weeks for a specified car model to be scheduled, made and delivered from placement of a customer order. Many customers will not wait that long, and could go to competitors. The time is required by the car maker to optimize the supply-chain to minimize the risk of shortage of key components without incurring the need for material storage.

By focusing on an efficient final assembly, the costs of variant manufacturing has not necessarily been avoided, but is more likely to have been shifted up the supply-chain. The challenge to produce on demand at a competitive price is spread amongst all the suppliers. The cost to the business for flexibility is still there, but accounted for in a different way. Though this example is related to a flexi-

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ble final assembly production line, the concept and challenge applies equally to any factory where the factory output is controlled by the customer and needs to be flexible, including by the way, all the suppliers of sub-assemblies that support the automotive line.

The better the communication between manufacturing and the supply-chain, the "Leaner" the whole process of assembly with a high degree of variants, and high mix, will be. At the core, in engineering, is the product definition as described in the BOM. A configure to order BOM looks much the same as a regular BOM, except that certain part numbers refer to a choice of actual materials, representing options. These can be individual material choices or the choice of a set of material dependent features, or a combination of the two. Rather than having to create and select a unique BOM from literally thousands of potential variations, a single configure to order BOM will represent all feature and option combinations.

The configure to order BOM has all the various options defined through the use of the part number key-word, which is set up just once.

The configure to order BOM has all the various options defined through the use of the part number key-word, which is set up just once. It can then be simply used when planning and creating any and all of the different specific product configurations that are required, whether for a set group of products or even a single unit. As the configure to order BOM is processed during, for example, the creation of a work-order, the choices are offered to select the material, set of materials or sub-assemblies to reflect the specific variant need. This selection is stored as part of the work-order, ensuring that the correct engineering information is available at all work-stations and processes throughout manufacturing, and as a look-ahead for material preparation and supply-chain. All aspects of the MES software that works with configure to order BOMs will automatically follow the designated selected options without further manual overhead. The whole process of MES with the configure to order BOM is therefore several orders of magnitude simpler and more secure than handling multiple unique BOMs.

Systems supporting the configure to order BOM as an integral part of a singular MES solution provide the most efficient way to plan and execute in the high mix and volatile environments associated with the extreme flexibility that Industry 4.0 requires. No matter how the operation is planned, how work-orders are created, or how flexible production has to be moving products between configurations, the ability of the engineering team to remain in control of the product data across all of the variants is critical. The management of visual aids and documentation throughout the process is imperative. For those operations that are yet to see significant numbers of variants, it should be remembered that as the number of product options and variants increases, the number of unique BOM combinations increases exponentially. With the configure to order BOM this is not the case, each additional variant is simple to introduce. Any assembly factory that is aiming to become an Industry 4.0 operation, with flexibility to make products according to the real demand, without the use of expensive stock in the distribution chain should seriously consider the adoption of an MES solution hat includes built-in configure to order capabilities. **SMT007**

Michael Ford is the European marketing director for Aegis Software.

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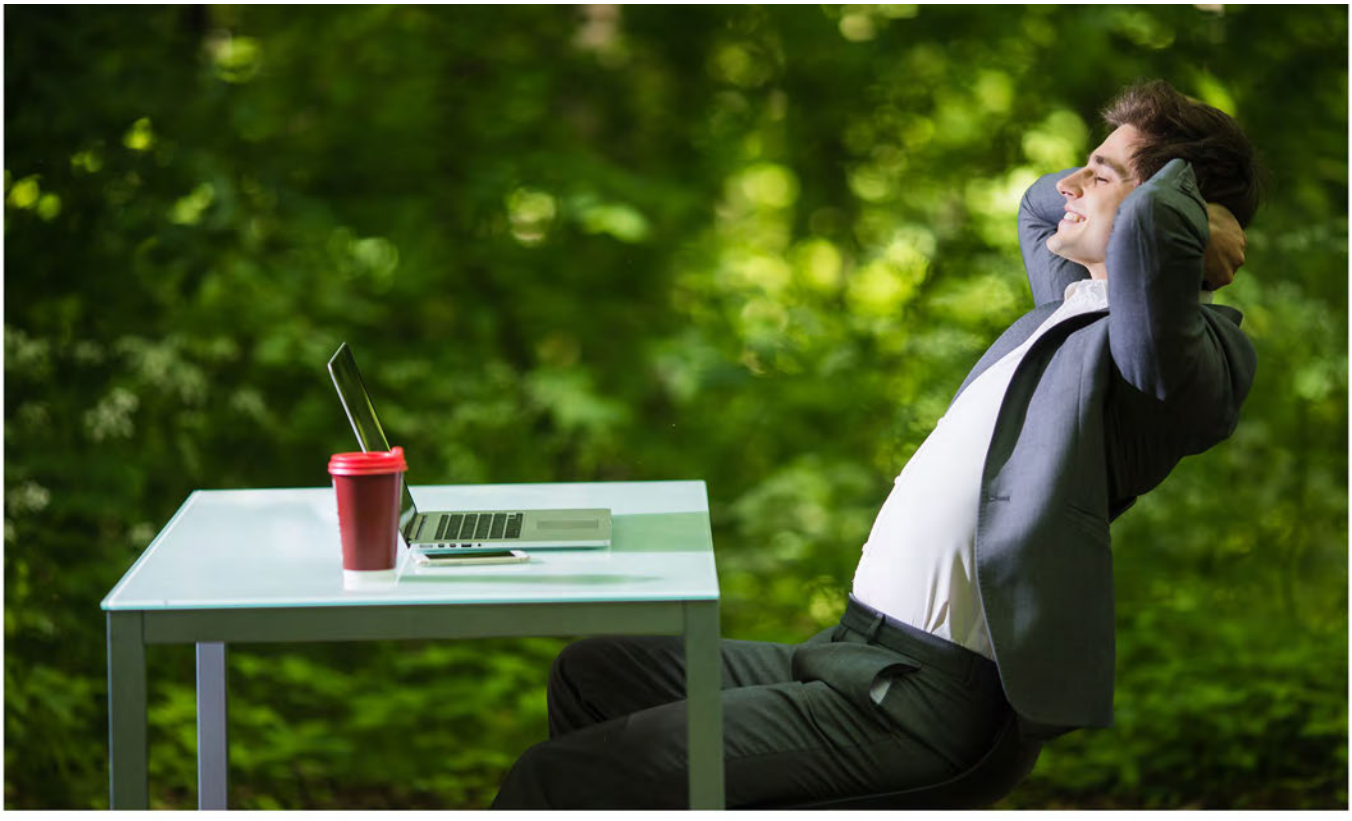

Creating a Healthy Work Environment

A Conversation with ULT's Wolfgang Koehler

Feature Interview by Stephen Las Marias
I-CONNECT007

German-based ULT AG has been engineering and manufacturing top-notch fume extraction and air filtration devices for industrial applications since 1994. What started out as a one-man-band now employs more than 120 people. The company is focused on removing airborne dry dust and fumes from manufacturing processes, by dedicated, local devices. The goal is to contribute to a healthy work environment and to prevent parts and machinery from contamination.

Wolfgang Koehler is the CEO of the North America branch of ULT. In an interview with *SMT007 Magazine,* he discusses how their business has been over the past year, their challenges and opportunities, and how they are helping their customers. Another topic of discussion is investing in new equipment—the key parameters to consider, and what's driving customers to buy their systems.

Stephen Las Marias: How has your business been last year, and what have been the major drivers for growth?

Wolfgang Koehler: We have done great over the past year. For our German HQ, 2017 has been another year of constant growth and development, showing that the course we plugged in is all about right. As the actual economy is strong in Germany and in many other parts of the world, we have been, among others, participating in the growing demand for sophisticated air filtration from laser manufacturing processes. In January 2017, we started our U.S. entity in Milwaukee, Wisconsin, following our global customer base to the Americas. This strategic move offers a huge potential for further growth.

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Figure 1: ULT offers a versatile extraction and filtration system for the efficient removal of soldering fume.

Las Marias: From your perspective, what sort of challenges are your customers facing?

Koehler: Our customers are facing multiple challenges from global competition to swiftly changing demands of their customers. This is not limited to a few, but involving all kinds of industries, from electronics, automotive and aerospace, to defense, energy, medical, and many others. It is the daily challenge to keep up with the market and stay a little bit ahead of your competitors.

Las Marias: How are you helping your customers with their problems?

Koehler: It is all about creating awareness of appropriately dealing with hazardous, sometimes highly cancer-causing particulates. We are supporting our customers to protect their labor, their parts, and their manufacturing equipment from harm and contamination.

Las Marias: What forces do you see driving the industry as a whole?

Koehler: We see that new technologies are rapidly developing, especially in laser-based processes. Those, along with metal 3D printing, will be driving the industry for the next decade.

Las Marias: What challenges and opportunities do you see for your company in the upcoming years?

Koehler: We do see a huge potential especially in laser applications. For example, 3D printing from metal powder is a rapidly growing industry, with materials and processes that require proper air filtration and professional disposal. We have learned from experience that almost any metal powders used in laser 3D printing are bearing a certain risk to health and manufacturing processes. We are offering off-the-shelf and customized solutions for dealing with highly reactive nanoscale particulates from metal 3D printing processes. This makes us unique in the market. We are very well prepared to support any customer in any industry when air filtration from metal 3D printing is required. The major challenge for us is to create awareness and convince decision makers to invest in proper, local and dedicated air filtration.

Another opportunity for further growth is air purification in electronics manufacturing. Whether it is about soldering fume or laser fume removal, extraction and filtration of dust, odors, vapors or gases, there are various airborne pollutants that may have hazardous impacts on employees, manufacturing systems and products. Here we see enormous potential and opportunities to install our air handling solutions. It is any company's target to protect their values in form of humans, machinery and product quality, which we are able to support by our fume extraction technology.

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Las Marias: You've been in the industry for decades. What are some of the biggest changes you've seen?

Koehler: We have seen a thing or two throughout the last decades, that much is true. We have seen laser having a huge impact on manufacturing long before anyone else was thinking about laser fume extraction. For us, it is essential to foresee future trends in manufacturing and what kind of airborne particulates might be occurring in processes to come. That is why we are spending a fair amount of money every year on R&D and projects with well-known research institutes. It is all about understanding manufacturing processes to come up with air filtration solutions that perform at top level.

Las Marias: From your perspective, what are the top reasons when investing in new equipment?

Koehler: Higher output, less scrap, lower costs per piece, more stable processes, and keeping up with new technologies. There are multiple reasons for investing in new equipment.

Figure 2: Fume extraction setup for hand soldering processes.

Las Marias: In your line of business, what market drivers would move customers to buying your equipment?

Koehler: Frankly, we would need to have a stricter law enforcement when it comes to personal exposure limits (PEL) and environmental protection. We are looking at materials and processes resulting in sometimes extremely hazardous particulates. Those might harm labor as well as being highly combustible when, for example, exposed to oxygen. Not to mention the negative long-term effect when being ventilated outside without proper filtration.

Las Marias: What advice can you give customers who are looking to acquire extraction/filtration solutions?

Koehler: Give us a call.

Las Marias: Is there anything else you'd like to add?

Koehler: We are very experienced in what we are doing. We are a one-stop-shop for local fume extraction and air filtration needs. Automation companies, system integrators, OEMs and end users in any industry worldwide have been relying on our engineering and quality.

Las Marias: How do you see the electronics manufacturing industry developing this year?

Koehler: From our perspective, we are looking at a growing market share as we are extending our global customer base. The close collaboration with well-known OEMs in the industry and ongoing R&D projects are contributing to our outstanding position in this market.

Las Marias: Thank you very much.

Koehler: Thank you. **SMT007**

I-Connect007

EXCLUSIVE IPC APEX EXPO 2018
PRE-SHOW COVERAGE

A Sneak-Peek at IPC APEX EXPO 2018

IPC President and CEO John Mitchell gave I-Connect007 a sneak-peek at the upcoming IPC APEX EXPO, happening in February in San Diego. Mitchell provides a description of this year's keynote, as well as a few new additions and areas of emphasis. It looks like it will be another packed house, with plenty to see, do, and learn about.


John Mitchell

Patty Goldman: John, what can you tell us about the upcoming show, and keynote speaker, which I understand is expected to be quite a draw?

John Mitchell: Jared Cohen is our Tuesday keynote. He is now the CEO of Jigsaw, which is a part of Google. He's the former advisor to two U.S. Secretaries of State and the author and member of the Council on Foreign Relations. The title of his speech is, "Game changers, Technology, and the Next Big Disruptions." He travels a lot, so he'll be drawing on his travel and first-hand accounts of some of the various important and emerging trends in technology, and then reveal how some of those will matter to the electronics industry.

Goldman: That should be very interesting and appropriate.

Mitchell: Yes, we're looking forward to Mr. Cohen's insights into the complex world of technology. In addition to this opening keynote on February 27, I will give a keynote on 'Educating a 21st Century Workforce," and cover how understanding the challenges and solutions in educating a 21st century workforce, is critical to businesses and leaders around the globe.

Goldman: Sounds good. What else will be going on at APEX?

Mitchell: Our theme this year is "Succeed at the Velocity of Technology." We are more than 95% sold out for the show floor, which is great, and we're anticipating more than 450 suppliers to showcase their products and services. In addition to the exhibition, we of course have our educational offerings, the professional development courses, which include subjects like PCB fabrication troubleshooting, printing, dispensing, jetting, manufacturing yield, reliability, and DFX. We really try to provide things that are driven by real-world application of what's happening right now, so the attendees can apply it later. We're trying to help them access new research on materials and processes and learn about trending materials or applications and processes, such as Industry 4.0 and wearables. We'll address real-world problems and teach the practical way that people can be

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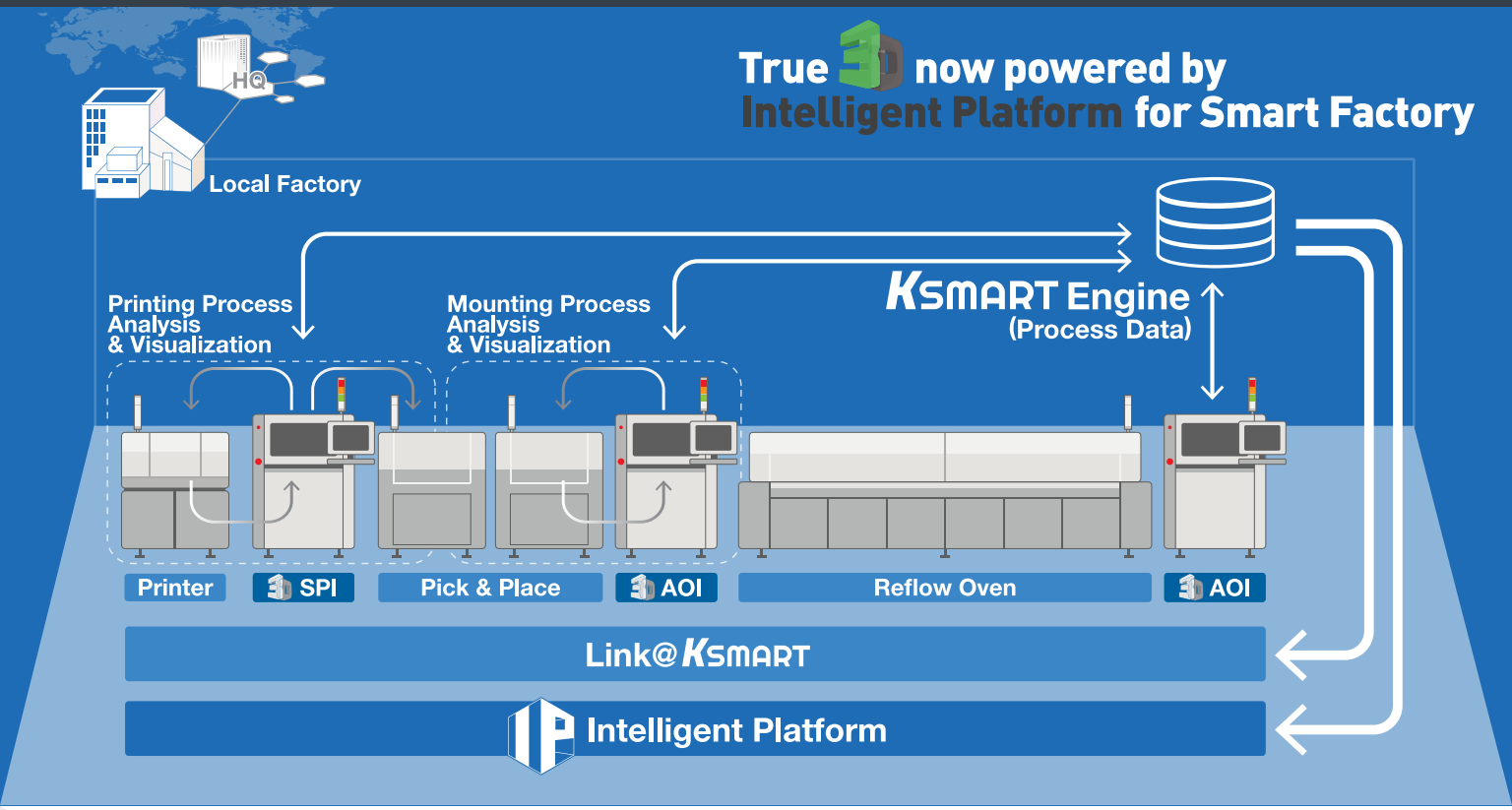

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successful at their jobs. So, flex circuit design, signal integrity issues, wearables, printed electronics, impedance and tools that merge electrical and physical design are just a few of the areas that the programming will cover.

Then, we have the technical conference, which offers the industry's most stringently-vetted program available. We have more than 80 papers this year, and they're measured against strict requirements by a panel of industry experts. We want to make sure we have the latest research and innovation available from the subject matter experts in the areas of board fabrication, design and electronics assembly.

The content that the attendees will be experiencing at this show is completely unique to IPC APEX EXPO. We've been careful to craft the conference so that similar topics don't overlap to help attendees maximize their time and effort. A few of the highlights include PCB fabrication reliability, assembly reliability, and then voiding and developments in the assembly of bottom termination components.

The Design Forum will be going on concurrently and will feature distinguished experts from the design community. They'll be delivering design-focused education on some topics, as well as sharing priceless and timeless lessons learned. They'll be presenting practices in Industry 4.0, including IPC-2581, emerging ECAD and MCAD, designing for flexible circuits, as well as circuit board design and mistakes you can avoid. Those are some of the topics that will be presented there. We will have buzz sessions again, with a market outlook buzz session, as well as IPC standards updates and environmental legislation updates.

We're trying to make sure that people in every stage of their career can be successful by coming to IPC APEX EXPO. There will be sessions for early career that we would recommend, things like PCB fabrication, voiding, bottom termination components, PCB surface finish reliability, things like that. Then, for those in mid or later career, some of the sessions they might benefit from would be the wearables, printed electronics, emerging technology, SIR corrosion, and some of the reliability issues with dispensing jetting, etc.

The whole show continues to grow every year, which I'm very pleased with. Frankly, the industry's been doing very well this past year. We're excited about that because typically the show follows the viability of the industry. We expect the show to grow right along with it this year. One of the two annual IPC board of directors' meetings will be held right before APEX EXPO, so you should see the majority of the IPC board members in attendance.

Goldman: Will there also be award ceremonies?

Mitchell: Yes. At the Tuesday luncheon we will have the official IPC annual meeting, and then for the Monday and Wednesday luncheons we will have the industry awards ceremonies. We just can't get them all done in one lunch. When you have thousands of volunteers, it's a good problem to have, right?

Goldman: Exactly. At the Tuesday annual meeting, will we be electing any board members?

Mitchell: A new member of the executive committee—a new secretary/treasurer—will be put forward at that time. Actually, all of the executive positions will be renewed because Joe O'Neill will just have finished his two-year term as chairman. He would move to immediate past chair and there would be subsequent shifts in the other positions, if tradition follows.

Those positions are being vetted by the board and we'll have that approved for general voting, as well, once the board approves. Also, there will be at least one board member renewal, and there may be one slot available, or not. We'll see. Right now, we're completely full at the maximum number of board members. If one of those people moves onto the executive committee, then there's a possibility that there may be another slot available, but it won't be a necessity to fill it. We have five on the executive committee, and then the elected board members range anywhere from seven to 14 members at any time. Right now, we're at 19, which is the max.

Goldman: Okay, what else? Anything more to add on the keynote speaker?

Mitchell: I think people will be very excited to hear from him. We've had really good fortune most of the years I've been here in having keynotes that people are pretty gung-ho about, so I expect this will be no exception.

And one other thing. In an effort to engage people earlier on understanding the industry and what IPC does for it, we're bringing in some high school groups that will be touring and will be privileged to hear some panels. I understand one of the schools, a San Diego school, has already accepted, and we've put the invitation out to a couple others.

Goldman: Any news on the standards front?

Mitchell: In addition to our standards, education, advocacy, and solutions areas, there are a few initiatives that we're going to focus on for the next two or three years. You'll see some of this coming out at the show. One of those initiatives is what we're calling the transportation initiative. As you've noticed, we've recently had a lot of standards in the automotive arena. We're going to be looking at the heavy trucking, rail, and shipping, etc. as well. Since electronics is proliferating into the transportation space, we want to make sure that we can leverage the industry's expertise to those verticals, as well. You'll see a lot of effort on the transportation initiative.

On the education initiative, we're looking to do a lot more and that will be discussed at APEX EXPO as well as workforce development. There are still a lot of jobs that aren't being filled and we're trying to work with the industry to understand exactly what the skill sets are that we could help develop in individuals so there can be more people available to be hired, as well as reaching out to schools and doing some academic work there.

We'll continue to improve our systems to be better and more consistent with our offerings to the industry, on a global basis.

Andy Shaughnessy: You mentioned the design forum. My focus is design, so I'll be covering that. Sounds like you have a pretty good program.

Mitchell: There's the standard information that everybody's used to, that will of course, always be there, but the team just continues to reach out to the industry to understand the latest, newest, hottest issues that we need to be covering. They're striving to make sure that it's out there so people can get that information.

Goldman: John, how much interchange is there between the people out on the show floor and the people in the conferences and committee

meetings? Sometimes I feel like for the people on the show floor, all they know is the show, and they never see that other half, which is the conference and the committee meetings. Do you get that feeling?

Mitchell: I'm sure that happens for some people, but I know there are other people that are experiencing all the show has to offer. It just depends. For instance, if you're a sales person and you're there, guess what? You're not going to leave the show floor, and that's where you ought to be because I know people there last year who said, "Hey, in the first day I met my entire annual quota." That person really ought to be on the show floor, doing the selling. That's what their role is. That's where they're going to be the most effective they can be.

For other people, they're going to spend time at committee meetings, standards meetings, and learning events, etc., and the show floor. That will be the guy that gets caught Wednesday afternoon and buys something on the show floor from somebody else because they were tied up all day Tuesday, and that's why people have three days to check out the exhibits.

Some instructors are going to be teaching the entire time and they may not even make it to the show floor. That's why we try to have the big food event one evening so people have a good motivation to go down to the show where we do the burgers, the dogs, and the brats and stuff. We pull everybody out on the show floor at 5 pm on Tuesday for the reception, then on Wednesday we're having the ice cream social from 2–4 pm on the show floor.

Goldman: One of the good parts about San Diego is the fact that the meeting rooms and the show floor are so close together, right?

Mitchell: Yes. Just down the escalator and you're right there. It's all a good thing.

Goldman: Yes, it is. Thank you so much, John. We'll see you soon.

Mitchell: Thank you, Patty. SMT007

Philip Carmichael IPC President, Asia on the Changes in PCB Value Chain

During the 2017 International Printed Circuit & APEX South China Fair (HKPCA & IPC Show 2017) in Shenzhen, China, IPC Asia President Philip S. Carmichael speaks with I-Connect007 Managing Editor Stephen Las Marias about the move in the value chain that's driving the electronics manufacturing industry forward. He discusses the new market trends that will further the growth of the PCB industry, and how new manufacturing technologies will help bring the industry toward the vision of a lights-out factory. Carmichael also explains the need for knowledge transfer, education, and standards, in the industry.

Watch the interview here ▶

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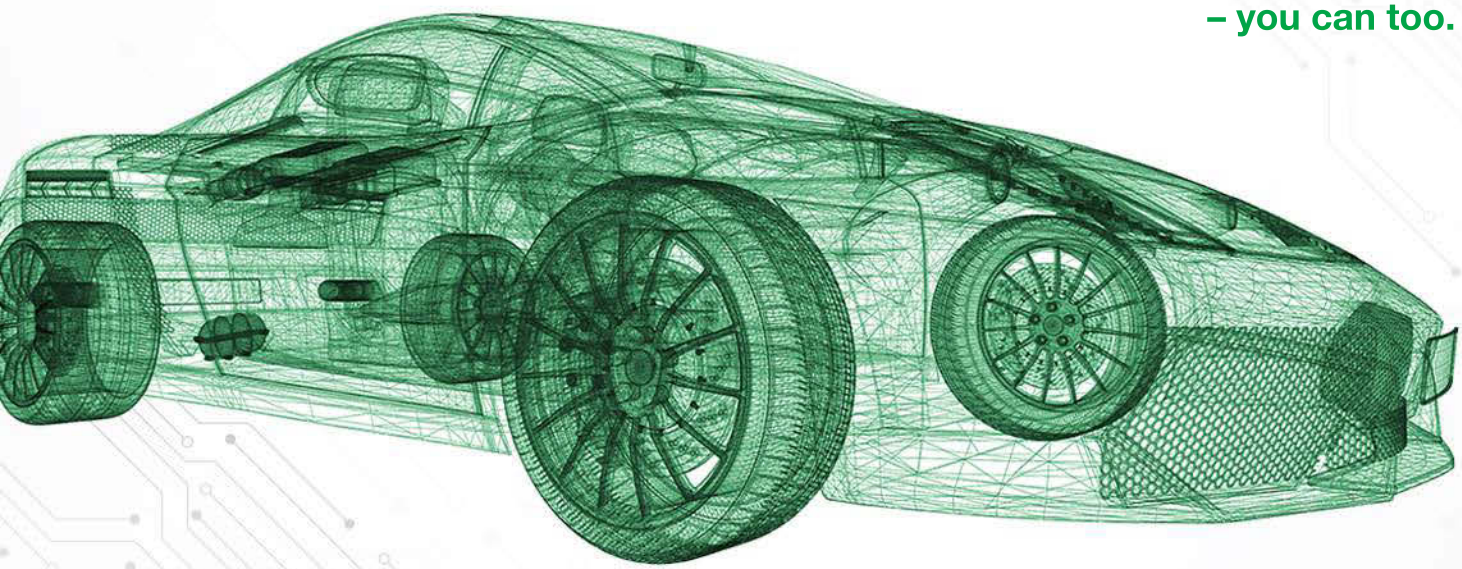

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Keeping it New, Current and Relevant: IPC Conference Director Jasbir Bath

Jasbir Bath, technical conference director for IPC APEX EXPO, has been coordinating IPC's technical program for several years now, but his interest and excitement for the event continues to expand. It's clear that Jasbir and his team take great pains to create a fresh, exciting menu of sessions, development courses and more, full of potential learning experiences, year after year. It looks like 2018 will be no exception.


Jasbir Bath

Patty Goldman: Hi Jasbir, please begin by telling me what your position at IPC entails.

Jasbir Bath: I'm the conference director for the IPC APEX EXPO conference. I've been doing it for the last four or five years. My responsibility is to help organize the conference, solicit papers, and then put together a technical program committee to solicit papers and review the abstracts coming in, and then select papers for the conference. We're at the stage now where we're putting papers into sessions. We're writing session descriptions and we're receiving papers and presentations for each of the sessions to review for the conference. That's the job that I'm responsible for. We may have some drops, we may have some additions, but we're in the middle of the review process for papers and presentations now.

Goldman: How many tracks should there be?

Bath: There should be 32 sessions. We're doing about five tracks in parallel from Tuesday afternoon, Wednesday all day, and then Thursday morning. We're trying to make sure that the tracks have assembly, PCB fabrication, and reliability tracks, as well as some others. We're trying to keep the fabrication and the reliability in one track, the assembly in one track, etc., so that two fabrication sessions aren't going at the same time. It's always tricky. We try not to clash with the standards committee meetings. That gets interesting, because some of the people who chair the paper sessions may also be involved in standards meetings. We want to make sure, for example, if there's a PCB assembly track that it doesn't overlap with a PCB assembly standards committee meeting.There has been feedback on that, so we're putting in a renewed effort to make sure we don't have any overlaps. At the same time, if there's a potential clash on Thursday morning with the professional development (PD) courses that are going on, we're also trying to make sure we don't have a PD course on one subject coinciding with a technical session in the same area.

Goldman: Do the professional development courses run on the weekend and during the week too?

Bath: They run on Sunday all day, Monday all day, and then Thursday morning. It's not a big overlap. There maybe last-minute changes that we can't account for, but generally we're in good shape.

Goldman: It's hard to make everyone happy.

Bath: Exactly. The chair of a standards committee session may also be chairing a technical

conference session we have, so we give priority in some ways to someone who's chairing a standards meetingand chairing a session. We'll give them the power to move things around.

Goldman: Continuing with the conference, are there any new tracksor hot topics this time around?

Bath: We have some that are generally considered hot topic sessions. There will be sessions on bottom termination components, which is a growing technology. We have the emerging technology session where we cover wearables, printed electronics, and emerging technologies like stretchable applications, wash-ability of materials for e-textiles, and an overview of XR virtual reality or augmented reality. That's a nice session. We have the traditional PCB fabrication and assembly sessions and component reliability. We have voiding sessions, which is a hot topic in terms of voiding areas for BGAs and components and how to minimize voids. We have a session on jetting, which is a newer technology where people are looking at non-contact dispensing for solder paste.

Then we have the traditional sessions, but some of those like surface insulation resistance (SIR) are still continuing issues. There are still challenges in terms of not just existing materials, but developing materials, masking materials, flux residue issues, etc. We'll have session(s) on reliability of plated through-hole materials, issues with reliability in terms of degradation and glass epoxy degradation. We're trying to cover things that are challenging, or issues that are coming up in the industry.

Goldman: Of course, all the papers are fresh and dealing with the latest technology.

Bath: Exactly. We also have a session on creep corrosion, where we have experts from IBM talking about the new developments in corrosion testing. Typically, you've got your alloy sessions, your high-speed/ high-frequency sessions, and where we're going on that. Then surface finish reliability, where we'll talk about recommendations for increasing shelf life with PCB finishes. A paper we have for the cleaning session is looking at cleaning challenges when we get to very fine powder sizes for solder paste.

Goldman: How clean is clean, right?

Bath: How clean is clean, and how clean can you get it? What are the challenges of removing flux residue? We have solder paste testing development on where we are in terms of the test technologies and J-standard 005, what test vehicles you can use for solder paste evaluations, and paste development for laser soldering applications. It's the kind of things that discuss new applications coming up, like miniaturization. We're getting smaller and smaller paste deposits. Some of the components to assemble are temperature-sensitive so reflow ovens can't be used so you may have to use laser or other non-contact applications to reflow those locations.

We've got rework application sessions. Rework is still interesting and still coming up. Session speakers will talk about the challenges for big board rework and optimizing bottom heat for manual rework applications. Then there are the typical copper foil issues, alloy reliability, and test/X-ray inspection issues. For instance, the impact of X-ray on preprogrammed managed NAND devices and understanding if the X-ray is causing any radiation damage to thedevices with best practices.

We have a design session looking at different redesigns and how to do it the right way, ECAD/MCAD tools, etc. We have a session on flex with areas covered including minimizing signal degradation for flex PCBs. We have sessions on conformal coatings covering issues on high temperature protective coatings, and nano coatings, etc. We are also looking at reliability modeling and reliability of adhesives. That pretty much covers the conference. We have some new sessions, some sessions on existing material developments, where we're going, and then test and papers to cover some of the challenges and development that we need for new technologies.

Goldman: How many papers total for the 32 sessions?

Bath: Approximately 75. The sessions are either two-or three-paper sessions running from Tuesday afternoon, Wednesday all day, and then Thursday morning.

Stephen Las Marias: Compared to last year, do you have more papers for 2018?

Bath: It's about the same. If the paper is being presented in another conference we don't accept it. Basically, we want what is new. We set a higher bar for our criteria for acceptance. Our philosophy is not quantity, but quality. If it doesn't add value we won't include it within the technical conference. Our review process is such that, when we're reviewing papers and presentations, we're reviewing for technical content, as well as grammatical issues, and making sure that the paper is a good read for the audience. We're reviewing papers to make sure they read well. That's something that I don't think other conferences do as well. Our process for review can take 2–6 weeks because of the back and forth with the authors. When we do reviews on the papers or presentations, we generally get good feedback. Some people don't like some aspects when we ask them to update them. But, in general, we get a lot of feedback that says, "Thank you for helping me to provide a better paper and presentation." Because, at the end of the day, we're trying to enhance the informationvalue to the audience.That's the idea.

Goldman: Do you also put together the buzz sessions?

Bath: The buzz sessions come in with industry challenges. Typically, we ask within IPC, "What sessions do you think would be of use to the industry?" The sessions typically are presented by IPC staff, but buzz sessions could be from somebody who comes to IPC and says, "We would like a session in this area." These are free sessions which are giving the status of some area of interest. For example, the first buzz session this year is a politics and policy roundtable. What's going on in government relations? What are the issues? Your typical technical conference session may not have this kind of discussion. These usually have two or three speakers, a panel, a short presentation, and then question and answer with the audience, and more interaction. The second buzz session will be a standards update. Three is on printed electronics. Where are we going? Where do we need to go to get to the next level? These are things that someone who is a chair of a standard committee, or an IPC staff standard commitee liaison, has been talking within their committees, and is saying, "Couldn't we have a buzz session on this area?" Maybe it's not fully developed, but it's developing, and they can give a status of where they are at and say, "Here's where we need to go to." It should be of interest to the audience.

Goldman: I see there's one also called student presentation, although there's nothing listed yet.

Bath: Yes. The suggestion came during the Technical Program

Committee discussions, "Should we just open up a buzz session to universities or students who have an area of interest?" Maybe they're doing a six-month project or MS project and could come to the buzz session and present on this area. We're asking around for students who do work in electronics manufacturing if they might be willing to come and present. We would look to get an IPC emerging engineer to chair that session because we're trying to encourage students to participate in these kinds of events. That's the idea. We haven't got it dialed in, in terms of speakers yet, but we're looking. And because it's a presentation, it doesn't need to have a paper with it. In terms of getting this session done, it wouldn't be that hard. We've asked around a little bit and we're just waiting. As of now, it's just a place holder we have for student presentations.

Goldman: I hope that works out, because that could be very interesting.

Bath: It would be nice to have but if doesn't happen in 2018, we'll revisit that session for 2019. We're trying to encourage the students who wouldn't get the opportunity to present in a technical session to use this session, and get them involved a little bit more. That would be good for them and for the industry.

For other buzz sessions, you've got the typical ones: the pulse of the industry, China/environmental issues, and new areas such as e-textiles. This is a developing standards group; this is what we're doing and some of the questions/areas around that. Where are we in terms of standards development? Buzz sessions can be kickoffs to discussions on where the industry should go.

Buzz session seven is on the the PCQR squared database. What are the updates? Then, the pulse of the electronics and the business outlook with roadmaps and things, and where we're going. Buzz session 11 is something that we got from Brooke Sandy-Smith at Indium Corp. on IPC J-STD 001 standard and the ROSE testing requirements in the standard being discontinued. What are we going to do? Let's have a panel discussion on this. This was from a user. Someone out there saying, "We would like to have this." Then we checked within IPC and there were people in the industry who were willing to be on the panel for this. We don't have to go out and pull people. They want to be involved. We just ask them and they say, "Yes, sign me up." This is an ongoing issue. This is something they've got to deal with, so you'll get feedback in the industry

on where we are and the status of the emerging methods to reach the level of industry standardization. What should we be doing? We're trying to get these types of discussions moving in the industry.

Goldman: Let's talk about the professional development courses, the PDs, of which I see there are 30 being offered. They're usually about half a day, right?

Bath: Yes, there are 30 half-day sessions, with classes on things like non-contact/jet dispensing and other focused technologies. They can encompass what we currently know about a subject, and things on the horizon. As we get into more and more miniaturization, we learn about new technologies and people need to know where the state-of-the-art is. This is going to cater to that, which we hope will be of use. We believe it will be.

There are the regular courses too, like the design analysis courses. I think quite a lot of them have been around before, but there are updates from each of the authors on those. We're trying to make sure we cover all the

bases. We cover the ESD program. It's not something that maybe has a massive audience, but it's something that we think could be of use. We've got design for testability and boundary scan.

There's something for everybody here. We've got the cleaning and coating. We have a couple of sessions on reliability from Dock Brown of DfR, discussing physics of failure. Let's give the audience something that they don't normally get when they come to the technical sessions with a more in-depth discussion on certain areas. We have Jean-Paul Clech at EPSI who is will be presenting on reliability as well. We also have new developments in selective soldering.

The rest of them cover areas including PCB fabrication, PCB assembly, and the issues in those areas. How do you troubleshoot? What are the defects? How do you do failure analysis? For engineers coming in, it covers people who maybe are developing engineers, trying to learn the ropes, and then some of the courses are more advanced for those who have been around in the industry and want to learn about developments in those areas. We're covering it in both ways as best we can. We're covering a wide range of topics from intermediate to advanced levels. We're saying, "Here's the booklet, pick and choose, however you want it." We think that these are the courses that would be of most interest to the audience.

Goldman: In the past, how well attended are the PD courses?

Bath: In recent years, we haven't had to cancel any PD course for lack of interest. I don't have the figures in front of me, but at minimum maybe 10-15 people, and at maximum maybe 100 attend a PD course. Typically, we're in the 20-40 range, but for some of these courses we're getting 60, 70, and more, which is a lot. We're not upset about the attendance whatsoever. These are the areas where there's a growing need, and we're happy to oblige.

Goldman: Any last thoughts from you, Jasbir?

Bath: If you look at the entire technical program, you'll see different pieces that cover different areas. I look at it in terms of new developments, but also new defects or failures that people are working on. It's a nice overlap between the technical conference sessions, which give you the details of where we're going, and the PD courses, which may give you more training, and cover those aspects in more detail. The technical conference session could be on printing, but the PD printing course will cover three hours where the conference would be a half an hour, or an hour and a half. It's more in-depth. The buzz sessions are where the pulse is, the biggest issues and the emerging trends. We've got a nice balance in terms of how we do this. We've got the PD courses on the front end and on the back end, with the conference and the buzz sessions in the middle. With the exhibits on top of this and the standard committee meetings, I think it's a nice balance. It gives everybody a chance to pick and choose.

Goldman: If somebody really wants to get immersed in it, they certainly can and come home with a boatload of knowledge.

Bath: Exactly. You come in, pick and choose what you want, and you come out and hopefully apply what you learned to your work. That's how we want people to come in on Saturday and Sunday all the way through to the end of week. You have every opportunity to learn something everywhere you turn.

Goldman: Thanks so much for your time, Jasbir. We appreciate it. See you in February.

Bath: No problem. Thank you. SMT007

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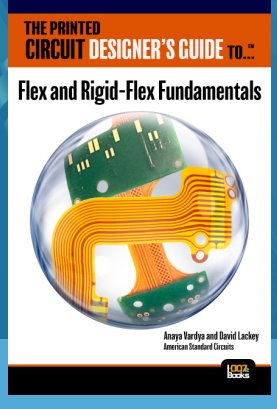

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CFX: Updates and Developments


Nancy Jaster

Nancy Jaster is the manager of design process at IPC—and she has every right to be. As part of the technical staff team, she works directly with many IPC standards committees to support the industry, particularly those related to DFM and DFX guidelines, as well as those involved in data transfer. With 28 years' experience in the industry—10 years in manufacturing and 18 years in design—she understands clearly what people need on the factory floor.

In an interview with I-Connect007, she discusses the latest developments in the Connected Factory Initiative (CFX), the machine data interface standard that would enable manufacturers, equipment, device and software suppliers to achieve Industry 4.0 benefits, and CFX demos at IPC APEX EXPO 2018.

Stephen Las Marias: Nancy, what's the rationale behind the Connected Factory Initiative?

Nancy Jaster: I'm one of the fortunate ones in that I've got the experience in both design and manufacture. I already have the IPC-2581, which is the standard to get design data to manufacturers. The wonderful thing about 2581 is that it is intelligent data. It's no longer just a flat file. It's a model-based dataset where we can share much more information with the manufacturing floor than we ever have before because it's all bundled up in this one package.

IPC used to have CAMX, a standard for transmitting data on the shop floor. But it was tied to a message broker, which limited its usability. After talking to some of the machine vendors, my original thought was how we could take CAMX to the next level, and how do we get CAMX working with 2581? I realized that we had an issue there, and that we really needed to look at the shop floor like we looked at getting design data into manufacturing as an intelligent data model.

Data is key not only to the design process but the manufacturing process. We really need this overall data backbone to support the industry, and we want this data backbone to be smart, intelligent data. We want it to be on a standards base, so that if we're calling, say a fiducial the same thing in every standard that we have, then we can easily pass that information back and forth. We standardize how we describe it, and what it makes up from a data perspective, and then you can reuse that piece of information anywhere within the product realization process. It's critical for us to get to the standard understanding, the standard way of using data. It's critical for the industry to be looking forward, thinking about it from an intelligent data perspective. When I started in this industry, we got flat files and we got drawings, and then we would have to take those and parse those out. I actually did some machine programming on the shop floor for a while. You'd have to take that unintelligent data and put all that intelligence in there. Now, we have the ability to do that within the data.

CFX is taking that shop floor data and taking it to the next level, coming up with standard terms and definitions, and has a standard transport definition so the information

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can flow from machine to machine, no matter whose machine it is. When they get that data, they can then apply their internal algorithms, their secret sauce, shall we call it, so we're not infringing upon what the manufacturers are doing or what may make their piece of equipment special. It's just using that common

framework so we can transmit the data from machine to machine. As we gather information, like if you have a part and you must alter the placement slightly, we can seed that back upstream. You want this to be bidirectional data going back and forth, so we can learn from the shop floor and continually improve the manufacturing process.

Las Marias: Is CFX a replacement for the IPC-2541, or the CAMX, as you were mentioning earlier?

Jaster: It's kind of a replacement, but it's twofold. One, the industry has moved ahead. When you think about how this industry started and how we used to do drawings on big drafting tables, and then photographing it down to the size we really wanted, to where we are today with data. The whole technology has changed and we're taking advantage of those advances. With the whole Internet of Things and Industry 4.0, people really want to start communicating more about the data. In the past, it's really been one way. You just keep it flowing through the factory. But we know there are so many things we can learn from the process, and we want to take that information and flow it back, not only in the manufacturing process but to design.

When I was in the development area, that was always a problem because we'd send it over to manufacturing and they may do something or tweak that data partially, not change the design, but they might adapt the data a little bit for their shop floor. Then that meant that information didn't necessarily get back into the design community. So, being able to have bi-directional data is going to move us forward. Not only can the shop floor understand what's going on in their machines and maybe tweak things a little here or there, or if they know this design in the past has had a problem, to change something to adapt to it. They can also feed information back to the design community as well because we've got this common set of terminology that we're using, so it'll be easy to transmit information back and forth.

Las Marias: How is CFX going to address all that?

Jaster: CFX is not related to any one tool. It is tool agnostic, so it is being done by the equipment manufacturers, the software vendors, and OEMs, all on the committee. We have a chair from each one of those areas to make sure that it's being looked at across the board, and that it's not one industry or one player trying to push their version of things. It is definitely a balanced committee with balanced leadership who are looking at this for the entire electronics industry.

We have already agreed to a transport mechanism, and it's the AMQP 1.0 message queuing protocol. The team looked at a number of transport mechanisms, and the team decided that was the one that really had the most versatility and would serve us in the long run for this committee. Now, the next thing we're working on is standardizing the bits of information we need to share back and forth.

But instead of doing it machine by machine, like if you're a surface mount machine or an oven, we're instead doing it by function. We know that with pretty much every machine,

they've got an eye on that machine to make sure that they're looking at the fiducial. So, this is from 00, and everything is determined from this point. We know everybody has a camera that's looking for that, right? So, why reinvent that multiple times for each piece of equipment? That's going to be a building block.

We're creating all these building blocks that we can say, 'Oh, this piece of equipment needs a barcode reader. It reads barcodes, and it's looking for 00.' It's pulling those together, and now we can create the standard so that this is how we pull that information across from machine to machine. It's consistent across the board. If what we're calling a fiducial, then every piece of equipment's got to use that same terminology and the same criteria to describe that block. It's that commonality at a low level, at the right level, so we're not forcing people to tell them how necessarily to do things. So, what information needs to be portrayed? When I worked at Lucent, we used to talk about the 'whats' and the 'hows', and the whats are what you need to have at a lower level, so that you can standardize.

Everybody can agree to that, everybody knows that a product has an ID. We want to standardize on that ID and say, 'this is the ID.' Every board has the point zero, the starting place where we zero out from, so all my dimensions are from this point forward. Everybody agrees to that, so we're going to make sure that definition is the same across the board. By doing that, you can then build upon it, but you're still not inhibiting innovation on the software provider or the machine vendor to do things differently, or even the OEM. There's still an opportunity for them to make improvements or adjustments, or they can decide what information they want to maybe feed upstream to keep track of quality, production, or for whatever reason. It still allows everybody to do things differently when you get down to the 'hows.' How they do it, it may all vary, but if we're communicating the same language across the board, it's going to make life so much easier for everybody.

Las Marias: CFX aims to provide or enable true plug and play interoperability of the equipment, device, and the software.

Jaster: That is our goal.

Las Marias: So far, what have been the challenges in that aspect? We're dealing with a lot of vendors here.

Jaster: Yes, and somehow, I got lucky. I don't know what I did, but my vendor support has been great from day one. I think part of it was that I went into the very first meeting and said, 'This is for you. We want to do what is right for the industry. We've got no preconceived ideas. We want it to be not non-tool specific. It's not like you're going to have to go off and buy vendor A's product, or use a particular product.'

I think it helped because I do have manufacturing and design experience, and that helped me a bit in communicating to folks. Because I've been there, and I've actually had to run Mylar tapes to run sequencings machines for through-hole components and figure out what's the best way to layout and insert those parts on the board. Been there, done that, and I understand the complexities of the shop floor.

It's only gotten more and more so as the industry has evolved. Part of it was being in the right place at the right time. I had help from my chairs in pulling the right people into that room, and I cannot say enough about my three chairs: Jason Spera from Aegis Software, Mark Peo from Heller Industries Inc., and Mahi Duggirala from flex. The three of them are wonderful. They're open and they're willing to listen to all ideas. They're not there pushing an agenda.

Sometimes, we've had a meeting or two where people were kind of pushing an agenda,

and we basically said, 'No, stop it. IPC doesn't allow commercialization.' We don't want people pushing their own agendas when it's product specific or vendor specific. Some of that came up, and the wonderful thing is that a good, strong, solid team of people pushed back at the right points in time. I'm not saying it happened a lot. It really has been a very good group to work with. They're very interested. At first, there may have been a little skepticism. Could we really keep it generic enough that everybody could use this? But when we came up with the building block approach, people thought that was unique and a great idea, so let's go for it. Probably the biggest problem we have in all of standards committees is that they're made up of volunteers. Our volunteers have been great, a lot of them have given it plenty of time, but there just never seems to be enough time. You always wish you had a little more time with folks where you could maybe get a little bit farther, a little bit faster. So, you're always limited by people's time that they can commit to a project. But let me reiterate, IPC has great volunteers.

We are making great strides. We had our first meeting over in Germany at productronica. We've never done that before, but my colleague over there who runs some of the standards meetings, Andreas Ojalil, ran that meeting for me. We have a lot of our committee members over there, so they're continuing to work it. People are excited because they see where this is going, and they see that this is going to be machine to machine, it's generic, and you don't have to use a particular message broker. You're not tied to any one competitor's tools. It's going to give you what we need without forcing you to do something you don't want to do. You're not giving away the secret sauce, which is critical.

Las Marias: I think one big factor is the increasing trend towards Industry 4.0. This is a version of that when it comes to the factory floor in the electronics in the industry.

Jaster: And that was part of it, too. When we started, we said we wanted it to address Industry 4.0, and everybody in that room said, 'Well, what's the definition of Industry 4.0? Because everybody's got a different definition.' That's one of the things that this team said, 'For this team's perspective, this is what we mean by Industry 4.0, this is our interpretation, and this how we're going to address it.' People agreed, so it may not fit some other models, but it's going to work for the folks who the standard is intended for.

Las Marias: What about the legacy systems that are being used by manufacturers or electronic assemblers? Do they have to install new systems or equipment?

Jaster: They won't have to install new equipment. This is intended to work with all existing equipment, and it will, because it's at a high enough level that it will work. When it really is going to come into play is for the equipment manufacturers and the OEMs, and even the software providers. They now know if they work to this standard that it's going to be easier on implementation. With any standard, you don't have people going, 'Okay, we're going to cut it in tomorrow.' It doesn't happen that way.

It's like with a software update in the CAD world. A CAD vendor comes along with an update for their program. A company will decide when they want to implement that. They may implement it on new designs, where you still have to have things around for old designs.

With factories and producing products, even in the design community, most of our customers or our members are not consumer products. Consumer products you can do a lot of things and change over in a year, because you can change a whole product.

In the defense industry, the automotive electronics industry, we have a long-term approach to products because we must have long-term support. In telecommunications, my background, we always had to support the old as you move to the new. I believe going to the CFX standard will be a phased approach., At some point in time people on the factory floor may want to start implementing CFX even with some of their older equipment, or older programs, etc. But because it's a standard, it should be easy and adaptable to do. Once we get the tool kit available, which Aegis has just graciously signed over to IPC, we're going to put it on a public website so that people can go in and start working with it. I haven't seen it yet, but I am told it's very easy to program in this new environment using the AMQP 1.0, and it's going to be very simple for folks to make modifications and update things. Obviously, every factory and every machine vendor will have to determine when they want to start implementing this. But again, that's the wonderful thing about it being at the 'what' level, and not at the 'how' level. It allows that flexibility.

Now, what happens to the old standards? They're still going to be around. It'll take us a while before we say that we're not going to support them. We won't necessarily do any updates to them, but we don't necessarily say that you can't get the standard, because if somebody's currently using a particular standard and they want to buy a copy of it again, we can do so. You can't necessarily just throw it out just because you got something new. You always have to look back and make sure you can deal with legacy products.

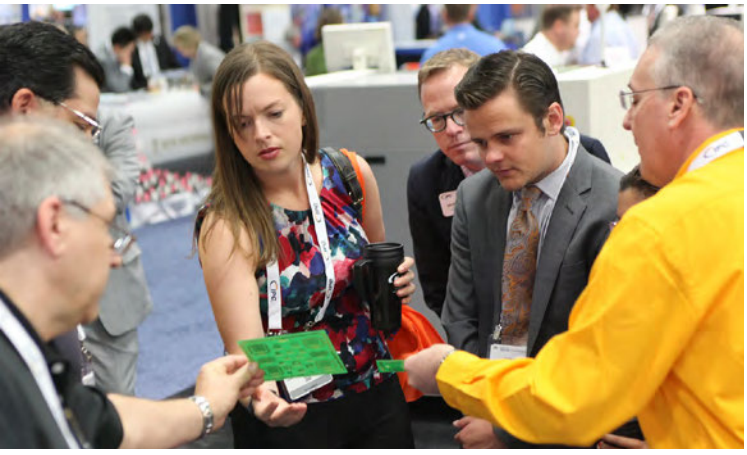
Las Marias: That's true, because a lot of manufacturers have already invested millions in them.

Jaster: Right. You always have repairs, you always have legacy issues, and you have old machines on the factory floor. My guess is, as people bring in new equipment, they'll start using the standard. They'll see how easy it is to develop and use, as well as transmit data back and forth. The bi-directional ability is going to be great. Then they may take on projects to update other programs on their floor, even for older equipment. It'll be easy enough to do moving forward, once they get used to using the new standard.

Las Marias: Right now, you have the software toolkit from Aegis, which is the CFX messaging library, and then the transport mechanism AMQP 1.0. Are there any other new developments with CFX?

Jaster: Right now, we're working on those building blocks and defining what those building blocks should be. The next step is getting those building blocks in place and getting the standard definitions there. Come APEX, we actually hope to be able to demonstrate on the show floor how simple and easy it is to use these building blocks to run the machines. I'm hoping we will have demonstrations there, but the key now is getting all those building blocks together and determining at what point we want to go ahead and actually publish the standard. It's just more work right now and getting those blocks built.

Las Marias: Apart from the demo, what should the industry expect at APEX regarding CFX?



Jaster: Well, hopefully the standard will be released next year. The standard will be released for the building blocks that we know of today, but as industry changes, we need to keep making sure that we are in tune with industry and continually look to make sure the standard stays up to date with where the industry is going.

I would love to see if we can integrate it into making sure that it's communicating well with the 2581 data. I really want to get this continuous backbone of data and expand it out. Right now, we're really focused on circuit assemblies. Can we expand this into printed wiring board assembly? I think we can, so is that the next phase we tackle? I don't know. We have a standard component traceability. We need to make sure that component traceability works well with the CFX standards so that we can make sure we're providing that information back. I'm also responsible for a number of standards related to material declarations for RoHS and REACH. I would like to get those standards connected in as well, so that they're all talking to one another. I want a set of standards to support a data backbone for the electronics industry.

As you know, when you're putting in data it is basic quality 101. Do it right the first time. If design inputs the data and it is correct, which it has to be, then it transfers automatically over to production. If they don't have to touch anything, not only do you speed up your process, you improve your quality, you have fewer errors, and you have less manual intervention. Now we don't have to worry about transmitting data from machine to machine because they can all talk to one another with CFX.

Then you worry about, how do you take this data, and move it even farther outward in through the thread? We really need this backbone of data to support manufacturing. Data has always been key, and we've gone from paper, to flat files, to somewhat intelligent files, to now extremely intelligent data, and we just need to take that and keep using the technology as it becomes available to us. The other part is making sure it's secure. You always have to make sure your data is secure.

Las Marias: The traceability, the standards, and then RoHS and REACH. They will be connected, but not really integrated into the CFX, right?

Jaster: Not yet. That's another phase. When the directives came out for RoHS, we needed things, and so standards were written. Now we're working on connecting the factory. My goal is someday to get them all talking to one another.

Las Marias: Do you think this will be able to somehow pave the way for something like the lights-out assembly factory?

Jaster: Not yet. Do I think robots are going to completely take over the factory? No, because people still add value. Will it get us to a point where you can engage your people to instead of doing busy work they are doing something of more value? Definitely. Instead of people having to manually do something over and over, or correct problems over and over, it's going to help improve the quality, improve the data, and then allow employees to spend time working on other activities and things that can help the overall manufacturing process. How can they improve the secret sauce, or what can they do differently within their factory, versus other factories, to make their product better

than somebody else's? It's going to take people away from doing that drudgery, like double checking and triple checking data all the time, into allowing for more innovation.

Las Marias: Moving forward, as new technology developments happen in the industry, how can others in the electronics assembly industry join in or contribute to the CFX?

Jaster: All they've got to do is call me, email me, talk to one of my chairs, or talk to another committee member. To participate on an IPC committee, you do not have to be an IPC member. Obviously, we would love everybody to be an IPC member, but you don't have to be. We take any and all volunteers. We are welcome to include people in the process. When this goes out for industry review, we want folks that maybe haven't been involved looking at the document and making sure that we haven't missed something. When I teach hardware methodology, I always have a section on why we need design reviews, or why you need to do a test plan review. People get so focused on what they're doing and think they've got everything covered, but you always want that fresh set of eyes to look at it to make sure that you didn't forget something.

Going out for industry review is going to be very critical on this document. I have nothing but the highest regard for this team. This team is doing an outstanding job. The comments we're going to get back are going to be for the little things we forgot, not the big things. I think the logic is strong. The way everybody on the team is approaching and looking at and agreeing to it, I know we're headed in the right direction. But you want to make sure that the little things aren't forgotten.

That's going to be where we're going to get some help, with the little tiny details. One screw used to screw up assemblies on the shop floor. Somebody forgot to add a screw to the drawing to put the faceplate on, and guess what? You can't ship product. It's the little things that can always trip you up. Again, I feel very strongly that we are totally in the right direction. This is going to be an outstanding standard that everybody's going to be able to use, but it's good to have reviews to make sure we're looking at all aspects of it.

Las Marias: Nancy, do you have anything that we haven't talked about that you would like to share?

Jaster: The one thing I just really want to stress is that it has been a pleasure working with this team. I think we will have a major impact on the industry when we finally get the work completed. The level of cooperation within the industry is just outstanding. I am extremely proud of this team and its leadership. It is a delight to go to the meetings, and they're just a great group of people that really want to do what's right for the industry.

I'm not saying that my other teams aren't great, because I love my teams, but to see the manufacturers, the equipment manufacturers, and the software guys all in the same room, and nobody's trying to protect turf, is just amazing. You have competitors in this room and yet they're all working together to do what is right for the industry. They're doing what they believe is right for the industry. When we get the standard completed it will make a significant impact on the industry, in a positive way.

Las Marias: That's true. That's also what we at I-Connect007 strive towards—to be good for the industry. Nancy, thank you very much for your time.

Jaster: Thank you. **SMT007**

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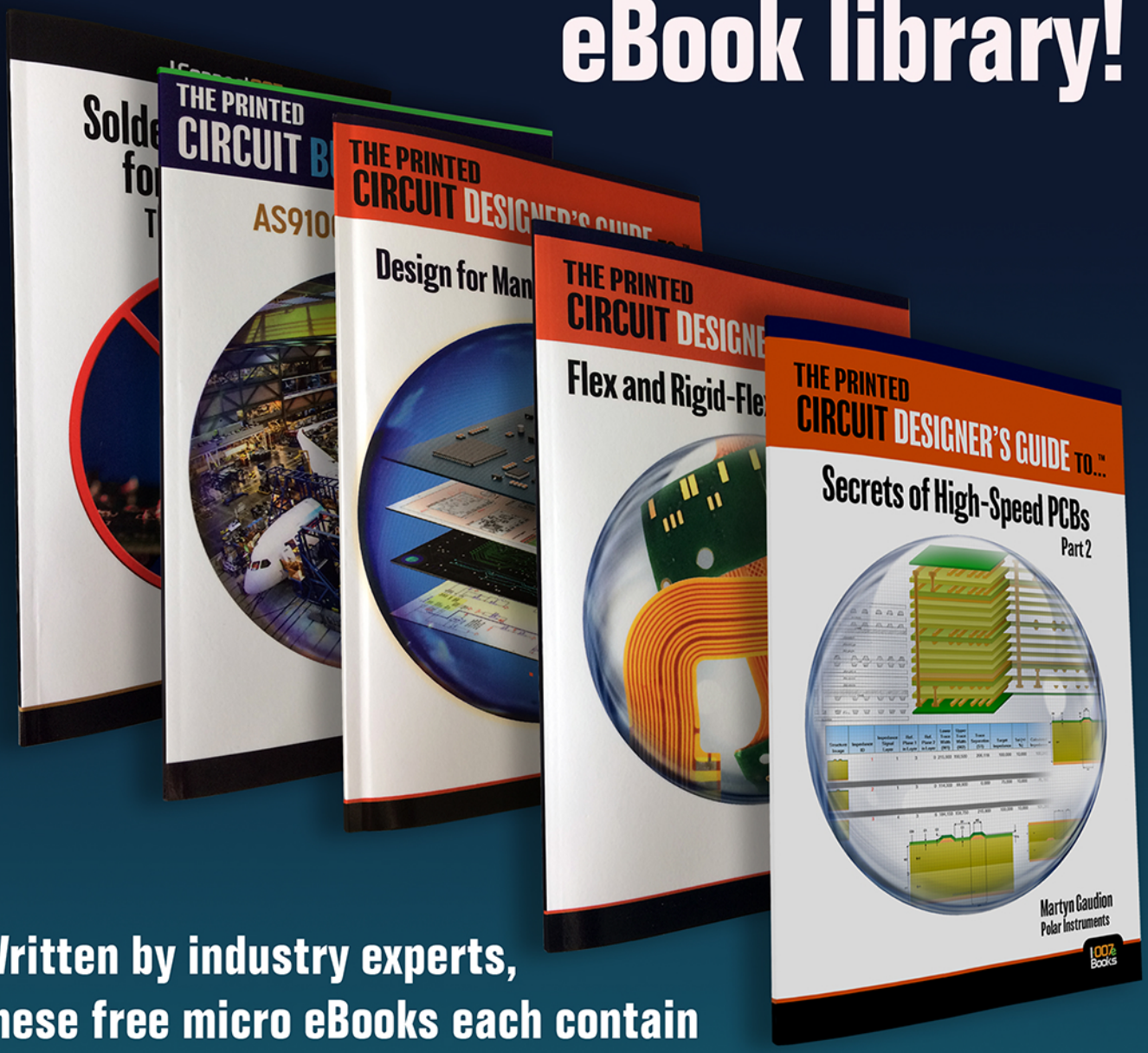

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All the Details on IPC's Emerging Engineer Program

Teresa Rowe and Nancy Jaster, in charge of IPC's Emerging Engineer Program, explain to I-Connect007's Patty Goldman and Jonathan Zinski how this novel approach to attracting and supporting young people works.


Teresa Rowe

Patty Goldman: Teresa and Nancy, let's start by having you tell us a little about what each of you does at IPC.

Teresa Rowe: I am a senior director of assembly and standards technology. I work with a technical team, as a staff liaison to the industry preparing IPC standards. My focus is in the assembly area. I'm also one of the leads for the emerging engineer program that we're going to be discussing today.

Nancy Jaster: I am also in the technical department as a staff liaison. My focus is more on IPC's design standards, and I assist Teresa with the emerging engineers program.

Goldman: Teresa, can you please describe the emerging engineers program and fill us in on this IPC program?

Rowe: The emerging engineer program started about three years ago. At IPC APEX EXPO 2018, it will have reached its third year. It was developed out of a conversation we had about attracting the younger generation to join our standards activities and to be more interested in our efforts as a global association for the electronics industry. We are attempting to pair emerging engineers, or individuals, who are in the early part of their career in electronics with someone who has been part of a task group or subcommittee, and part of our standards development processes, for a longer period of time. We like to think of it as a way to bring the two generations together to introduce our older generation to the newer technologies and newer thoughts, but also for our emerging engineers to gain the knowledge and exposure that they need to develop their careers.

We started very small and we have grown the program; we have tried to tailor it each year to not only have our engineers grow in the program, but also to introduce them to more detailed projects as the years develop. Nancy came on board at the tail end of the first year.

Jaster: The program is to help these young people develop leadership skills as well, because it gives them an opportunity to explore other areas, and to understand everything about the association. We've had real success in having some of our mentors take our emerging engineers and make them co-chairs of teams, so they can start learning the leadership skills that they need. It's an excellent program for people who are new in the industry or who haven't been there very long to get some leadership ability, as well as learn more about IPC and the standards development process. It really helps IPC out because it gives us some fresher views…not that we don't love our members who have been with us for a long time, but it gets us some newer people involved and starts expanding things, so we can be ready for the future as well.

Goldman: How many engineers, or how many sets of mentors and engineers are there right now?

Rowe: We have two that will be in their third year with us, and we have three in their second year. We are now looking at our applicants for our first-year group starting in 2018. The interesting part of this is that for our second-year group we actually have a university student who is one of our emerging engineers. We were excited in our second year to bring an individual on board who is a student, as opposed to actually working in the industry at the current time. He has developed a real interest in IPC and he's taking on a larger role, too, with some activities that Nancy has been working on.

Goldman: You said you have applicants. How does that part work? Who applies and how do you determine who you accept?

Rowe: There is an application process. We ask applicants to complete a benefits and commitments paper or page, which is on our website for the emerging engineer program[1]. That explains the commitment for three years; as we both said, it is a three-year commitment for this program. We ask the individual to acknowledge that and for their supervisor, or the person they report to, to acknowledge that this is a three-year commitment on their part. We have had requests for additional information such as 'What do I do beyond the events?' for example. We've been able to work with each individual to understand their concerns as they're worried about that three-year time commitment. It does take that paper and it also takes a copy of their resumé. When that information comes to Nancy and me, we sit down together and review it to determine if that person meets the qualifications and requirements, and then we fill our slots accordingly.

We do have situations where organizations have asked for the person's mentor to be from their company, as well. We've been able to match those individuals up, where the mentor is someone who may be mentoring that individual at their company now. In other cases, it's someone from their organization, but maybe from a different site or a different location around the world. We've also had companies come to us and say, 'I have an emerging engineer candidate, and I would truly like to have someone mentor them who is not part of our organization to give them a broader knowledge base of other organizations and the way to rest of the world works.'

Jonathan Zinski: When you go through the application process, how many slots do you have to fill?

Rowe: We have been talking about five for our current year, plus a university student.

Goldman: I guess you need to have mentors, which I presume are mostly committee chairmen? Would that be accurate?

Jaster: We do have chairs that have been mentors, but the key is really that they're an active member on a committee. We want somebody who can work with the emerging engineer and direct them to the right standards committees that they may be interested and want to participate in. They don't necessarily have to be a chair, but it does have to be somebody who has been involved in the standards activities.

Rowe: Patty, we've seen TAEC lifetime members come forward and ask to be mentors.

Goldman: The mentors must have to make a three-year commitment too. What all is involved in that commitment?

Rowe: We certainly expect before the first meeting for our mentor and our emerging engineer to discuss the emerging engineer's interests. We encourage them to do that by teleconference, although email is fine. The emerging engineers discuss what their interests are, as far as professional development. In the first year, as they attend APEX EXPO, we require them to attend professional development courses and they have to attend standards committee meetings. They have to attend a series of other receptions and events. They have to acknowledge that they've attended all of these things. We ask them to keep notes. They do a report at the end of the event that shows us what they've done. The fun part is we ask them to take selfies when they meet individuals. We may send them off to meet someone, or a person that meets a certain set of criteria. We ask them to take a selfie and show us they've met the person and started to network and have a conversation. Then it's up to the mentor to follow up on activities for the remainder of that year.

Jaster: One of the things we have them do is go to the show floor. They have to meet with a number of exhibitors, because we want them to get down on the show floor and see all that equipment and talk to some of the vendors on the show floor. It's really an opportunity for them to start networking and understanding the benefit of being at IPC APEX EXPO and getting the most out of it, because we really encourage them to do all the activities that are available to them. They basically get a one-of-a-kind opportunity for three years and we encourage them to take as many of the classes as they can, and to go to as many of the activities as possible, so that they can not only learn, but network and really get a full feeling of what the show and conference is all about.

IPC's emerging engineers and their mentors.

Goldman: The commitment on the part of their company, presuming they're from a company, or university, is they have to get themselves to the meetings, to the show, and then IPC sponsors them for meetings and workshops. Is that correct?

Rowe: This is true for companies, yes. The commitment from the company is they have to get the emerging engineer to the show and sponsor their travel.

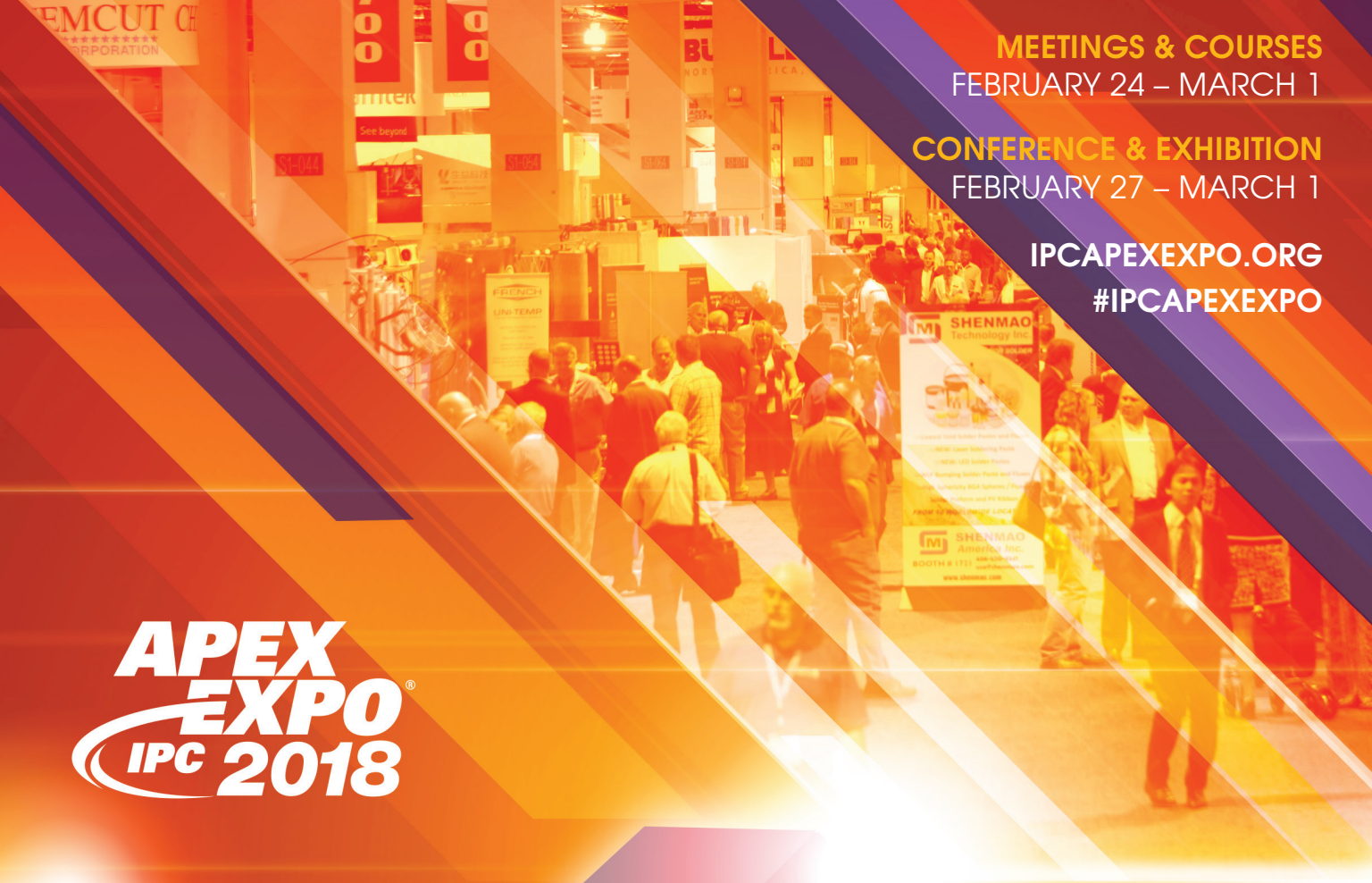
Goldman: I know there are a lot of workshops offered. Is there a requirement as to how many they should take each time, or is that open?

Jaster: The first year we said they have to take two classes.

Rowe: Then the second year we required one. We're now preparing our third-year activities. We'll be working on that. This will be our first group to reach three years.

Goldman: After this you'll see how well the first two participants, or emerging engineers, pick up on their own for next year.

Rowe: This is true. What we have noticed, to Nancy's point, is that one of our two emerging engineers has taken on a general vice chair position.



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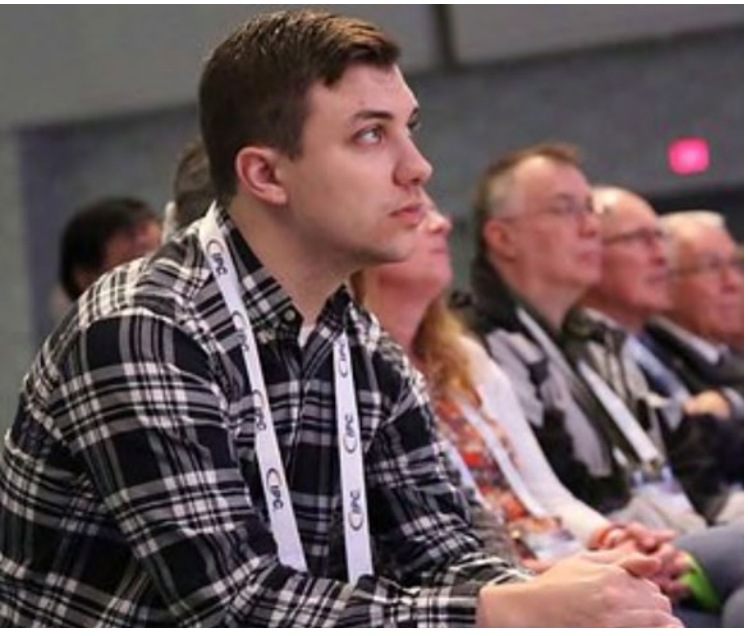

Jaster: Actually, two emerging engineers have become vice chairs.

Goldman: Fantastic. So they are delving into it. We all know how you can get really interested in this industry. Many of us kind of fell into it by chance, so it's nice that now we're making a concerted effort to bring people into the industry and not letting it happen just by chance.

Jaster: The nice thing is, because they do have the mentors, it's not like we're just saying, 'Here you go,' and they get overwhelmed by the size of APEX EXPO. They are getting some encouragement; they're getting direction from their mentors. I recall the first time I went to APEX EXPO—and I already had several years under my belt—it was almost overwhelming with the amount of choices of classes, technical sessions, and the show floor. Having somebody to help mentor them and help get them through that process and find the most benefit for them is very helpful. We owe a big thanks to our mentors for stepping up and doing that, as well.

Rowe: I second that. We have seen our mentors and our emerging engineers interacting off in a corner, or looking at the directory trying to determine where they were going. It is real-time event. It's not a mentor saying, 'I'm here to help you and you come find me.' The mentors are reaching out to the emerging engineers and really guiding them through those activities.

Goldman: They volunteered to be a mentor and so they've got a real interest, and that's good to hear.

Rowe: They've taken it to heart.

Jaster: What was really interesting last year, our second year, was watching the emerging engineers bond as well. The second-year ones kind of took the first-year engineers under their wings and tried to help them along. To me it's just been an overwhelming success at how well the folks that are involved in the program are enjoying it and taking advantage of all the opportunities that they have.

Goldman: I take it you expect to continue to expand the program?

Jaster: We do.

Rowe: As we mentioned, we have slots open for this year and we have a number of applicants. The deadline was December 15, for the 2018 class. I know that we have some individuals who've expressed interest and we're just waiting at this point in time for their paperwork to come in. We do have four that have already sent their applications in.

If someone applies, we don't automatically accept them into the program. We review the applications. We also have had individuals apply and asked to be waitlisted, just like you have a university situation with delayed admission. We've had a situation already where we were able to accommodate the individual because he couldn't attend the first year. He said, 'I'm interested in this program, I just can't come to APEX EXPO,' so we delayed his start until the following year. We do try to accom-

modate when we can, because we understand that this is a volunteer effort that their companies are allowing them to do.

Goldman: What feeling do the companies have regarding this?

Rowe: From my perspective, I don't think we'd have companies coming back and offering the second individual for the three-year program. We do have a company who has said, 'We have someone in their third year, and we'd like to have another person start this year.' We've had interest from companies that have taken the program to heart. Nancy and I talked about this just recently. They have embraced the idea of introducing these individuals to this activity. I've had feedback in another conversation from one of our mentors saying that the program has really helped the emerging engineer in that company to take on a bigger role. It's recognizing within the company that this is something that they've been selected to do and it was a choice, not only by their company, but by IPC. This is an opportunity to embrace for their career. This is my perspective from an assembly point of view. Nancy, I know you've had similar conversations with your design groups, correct?

Jaster: Yes. Again, the companies are really enthused to have people in this program. Our current emerging engineer, I don't think he's going to have any trouble whatsoever getting a job, because some of our mentor companies have already expressed an interest in him. It's giving him an opportunity to do things that he wouldn't have had the opportunity to do had this program not been there. He's already getting involved in industry and working on projects because he is an emerging engineer.

Goldman: Now, you've almost got a full slate for next year. How do people find out about this?

Rowe: Our marketing group has put out flyers on the program at various IPC events. We have posters that we post at our major events. We've also used tabletop tents in our standards committee meetings. We've done some visual information for them. We also have a webpage[1] on the IPC website.

Jaster: There's also usually a full page in our show directory as well.

Goldman: So if somebody doesn't go to the show or a standards committee meeting they might not find out about it? How does that work for university students? Just curious.

Rowe: We have spoken about the emerging engineer program at IPC Day and at some of the events on university campuses that we have attended in the past couple years.

Jaster: If you see me at any trade show, you know that I'm pretty blunt and ask young-looking people how long they have been in the industry. Then, I explain what the emerging engineer program is. I think some people wish I'd go away, but I'm out there talking all the time. I was at an event at PCB Carolina, at

North Carolina State, and there were a lot of students there. I definitely brought it up to all the students there. We're trying our best to get to the student community as well.

Goldman: Is there some place where you list the emerging engineers and their mentors, so that when people see them at the meetings and so forth the rest of us can speak to them?

Jaster: We do make them show up at the breakfast for the keynote speaker. Certain lunches we make sure we have them stand up and they get introduced along with their mentors. Wednesday evening, we have a meet-and-greet with the emerging engineers at APEX. That is one of the activities they are going to be highly encouraged to attend, so they can meet other committee members, or other IPC members. Again, they really bonded as a group, so there's no problem getting them together for opportunities like that. They like each other, which is a good thing.

Rowe: We've also put their photos on our Emerging Engineer program web page[1]. We don't have their names, but we do have their pictures that were taken at APEX EXPO 2017. We have special badge ribbons for them when they attend a meeting. Each emerging engineer gets a very unique, large pin. Patty, as you're aware, the TAEC members have pins, the Hall of Famers have pins, President's Award winners get pins, and they're a certain size. The emerging engineer pin is much larger and the mentor pin is unique as well. They are a pewter color, rather than gold. Each person is presented with one when they join the program, which they wear when participating in their events so that they can be identified.

Zinski: Are there any more specific requirements for people who are considering applying, other than being in the industry?

Rowe: We'd like for them to be interested in standards development, although we understand and we accept that at this stage in their career they may not understand what that means. This is a program for them to learn what IPC offers and an opportunity for them to be paired with someone who has been in the industry. Beyond being early in their career and having an interest in the electronics association or electronics in general, there aren't a whole lot of criteria that say they have to study this or that or whatever. Nothing like that.

Jaster: What's really been nice is we have folks that are more on the design side. We have other folks more on the manufacturing side and those who are interested more in the process-related type of standards rather than assembly standards. We've been lucky that we've gotten a nice array of people interested, not just all from one area.

Goldman: That's another good thing. Okay, I think we have covered just about everything here. Thanks so much for your time.

Rowe: Thank you very much. SMT007

Reference

1. IPC Emerging Engineer Program.

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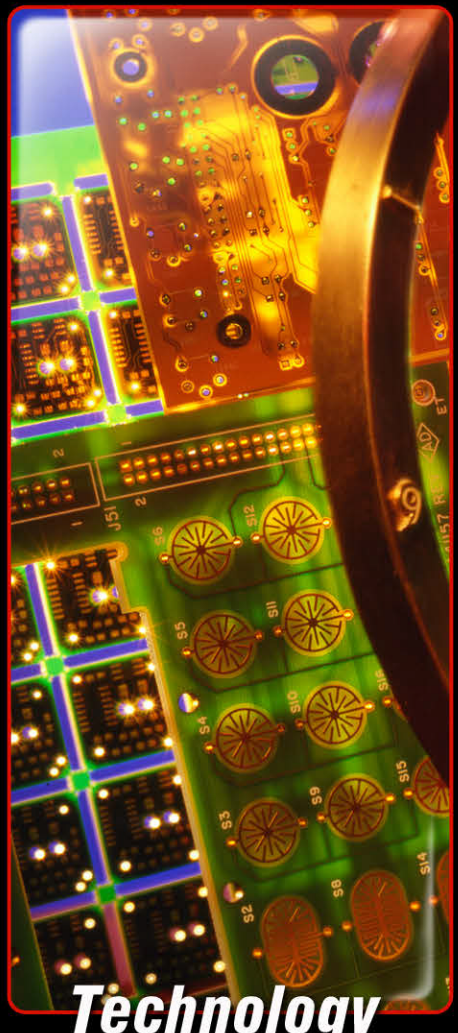

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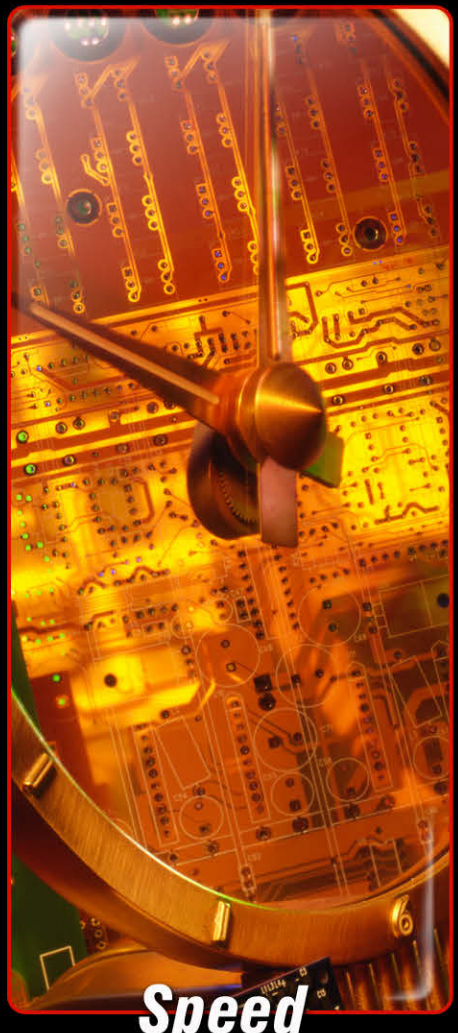

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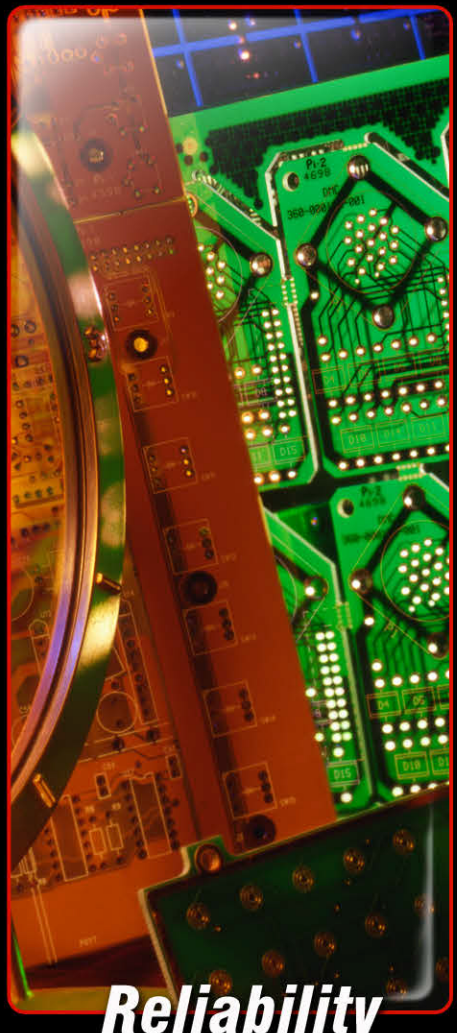

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What to Expect at IPC APEX EXPO 2018: EXPO Veteran Alicia Balonek Shares

Alicia Balonek has seen it all. IPC's senior director of trade shows and events joined IPC during the dotcom bubble, and helped launch the first IPC APEX EXPO. Editors Andy Shaughnessy and Patty Goldman spoke with Alicia about IPC APEX EXPO 2018, what attendees can expect, and the organization's continuing efforts to attract talented young people to this industry.


Alicia Balonek

Andy Shaughnessy: Alicia, I didn't realize you've been doing this with IPC for 18 years. I'm sure you've seen a lot through the years—including substantial changes.

Alicia Balonek: Well, that's true. I started with IPC in 1999 and I was part of the launch of APEX in 2000, so this show is very dear to me and it was a great opportunity to be involved with a launch show. There's such a connection to the show, we've certainly experienced our fair share of ups and downs but for the most part it's been an extremely enjoyable experience through the years. There have been a lot of changes in the industry, especially on the board side, particularly in 2004 when IPC Printed Circuits Expo, a show produced by IPC since 1994, was co-located with APEX and IPC APEX EXPO was formed.

Every show is a new experience and we just seem to keep learning from that, and we do it for the industry. This is the largest event in North America for electronics manufacturing and it has been since its inception. Everything is under one roof, from one end of the manufacturing process to the very end of the process, and we're proud to be able to bring the industry together for this important event.

Shaughnessy: We're glad it's not in Anaheim anymore (laughing).

Balonek: Well, for a show this size, especially with the extensive electrical and plumbing requirements, there aren't many facilities throughout the country that can handle this event, especially with the long move-in time. We have almost two million pounds of freight on the show floor. It's a heavy equipment show, so not only does it take time to get that freight onto the show floor, we also must make sure that we're giving the exhibitors ample time to calibrate the machinery and their assembly lines so they're ready before the show begins.

Shaughnessy: I think everyone really likes San Diego. It's hard to have a bad time here.

Balonek: Especially when you're coming from the Midwest or the East Coast in February. Everybody enjoys that warm weather and it is a great facility. I've been in this industry for a long time and I've worked in many different convention centers, and we have great staff from the San Diego Convention Center working with us. I couldn't ask for a better team. They look forward to our show every year.

Patty Goldman: So what will be happening this year?

Balonek: Well, it's not necessarily new, but a favorite of the event, is the show floor reception on Tuesday evening which is a great gathering place for attendees to network with the exhibitors. We're introducing "Passport to Prizes" this year and we'll be giving away an iPad mini,

Beats headphones, Google Home, and lots of other useful and high-tech prizes. When attendees register they'll be given a little passport card which will have the exhibitor sponsor's booth number and name on it. They have to go to those specific booths throughout the show to get stickers from them; on Thursday, they must drop off the card at the IPC booth, where we'll announce the winners that afternoon.

Goldman: That's something new that should be fun.

Balonek: Especially with the younger audience that we're trying to attract to APEX EPXO. Of course, they come for the education, but there should be a fun aspect of it too. They've asked for more networking opportunities and just fun things to do on the show floor.

Shaughnessy: People like it when they can get a beer together at the show.

Balonek: Exactly. Our keynote speaker this year is Jared Cohen, the founder of Google Ideas and now he's with Jigsaw, the Alphabet arm. We're excited to bring him to the show, and he's equally excited to speak to this audience. I think his quote was, "Wow. This is perfect for me," when the invitation came across his desk.

Goldman: A nice technical audience.

Balonek: Yeah, and that's the one thing with the keynote speakers that we do try to recruit for this event—they love speaking to this audience because they can speak at the same level as them. For lack of a better term, they don't have to "dumb it down" for us. We get it. Mr, Cohen will present, "Game Changers: Technology and the Next Big Disruptions."

Shaughnessy: Yeah, it was great having Mayim Bialik last year. She was great discussing engineers versus scientists. That was funny.

Balonek: It was interesting the questions they were asking her. I always find that fascinating to see what kind of questions there are. I think my absolute favorite keynote speaker, though, was William Shatner.

Shaughnessy: Hard to beat that.

Balonek: I'm still trying.

Goldman: You've had some pretty good ones.

Balonek: Thank you. It's a hard industry to tap into. It's a very niche industry, so it's a long process of trying to figure out who would be the best fit. So, if you have any ideas, I'm always open to them.

Shaughnessy: I think it's good how you rotate. Instead of having all futurists or something, you kind of rotate and you even had a super famous guy like Shatner, but then the next year was Michio Kaku.

Balonek: That's an important thing when planning an event. You've got to keep it fresh every year so people keep coming back. One new initiative that we are doing this year is a STEM program for high school students, and that will take place on Thursday. We invited two high schools from Southern California that are involved in STEM programs. There's been a lot of talk in this industry about how to attract the younger employees for the industry. It's great to recruit at the college level, but

there's such an initiative for STEM now that we really need to start reaching out to people at the high school level before they even enter college so they can consider this industry as a career choice.

David Bergman, our vice president of standards and training is doing a cool presentation, "How to Make a Circuit Board out of Peanut Butter," for the students and then we'll take them on the show floor. Hopefully, after they see the peanut butter presentation, they'll see the equipment and the technology that makes the circuit boards and it will all come together for a better understanding of the industry. Then we have a lunch scheduled with a panel discussion with some industry leaders so they can ask questions about our industry. We hope that it will be well-received by the students and that we'll be able to recruit the next generation for this industry.

Shaughnessy: That's one of the things we constantly see: People are retiring. For some reason, especially in PCB design, there was a big flood of designers joining the industry in the '70s and '80s. We're seeing a few young people coming in, though.

Balonek: And that's good but we need to do more and that's where STEM comes in. STEM education is so important and it's nice to see schools offering these types of programs. My daughter is in middle school now and they refer to her program as STEAM in her school, she's involved in the program and goes to classes three times a week. They have afterschool workshops too, so it's a really good to start at even a younger level to start tapping into where our future engineers are coming from.

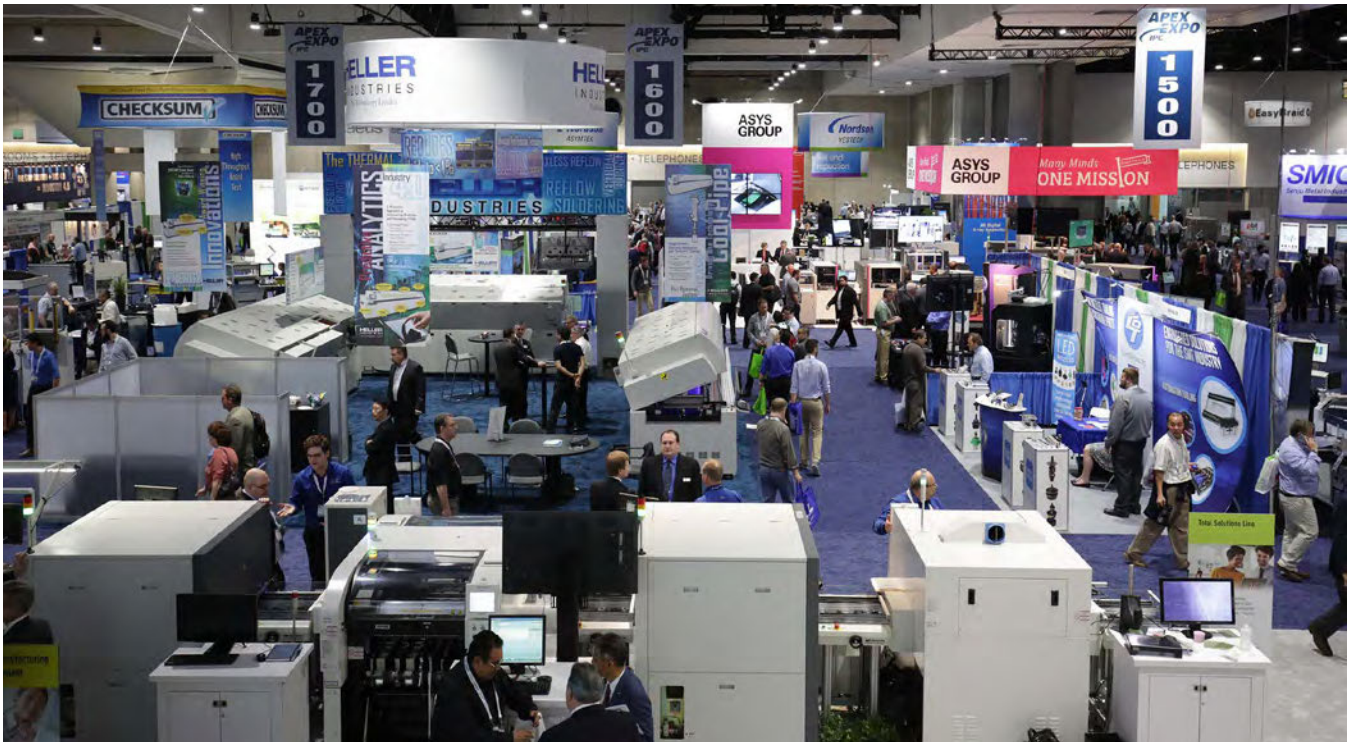
Goldman: Is your daughter finding the program interesting and intriguing?

Balonek: Oh, she absolutely loves it, and especially the part that includes making slime. I don't know if you guys have young kids, but they're making it all the time. I cannot tell you how many gallons of Elmer's Glue I have in my house right now. But even with these small experiments, they're exposing themselves to science which is beneficial for kids. But back to the STEM program at APEX EXPO, we're able to provide this program through sponsorships and I'd like to take a minute to recognize, ASM Assembly Systems, Mycronic Inc., Nordson and Panasonic Factory Solutions Company of America for sponsorships. In exchange, they'll be invited to the panel discussion and the students will be visiting their booths during a special tour of the show floor. We'll also be making a donation in their names to the STEM program for the participating schools.

Goldman: That sounds like a fantastic program. I guess the important thing is to make sure it's not a one-time thing, right?

Balonek: Right. It's a pilot program this year and we hope to be able to offer it again next year and maybe even doing things in different cities. I know a lot of our members have production plants within their facilities so we could do something in their cities if they don't have the time to coordinate a program themselves.

Goldman: We recently had our newest team members visit a PCB facility—they are editors, not really PCB people. They were absolutely astounded at what was involved in making the circuit boards, and of course they related it to



their cellphones: "Oh my gosh. Who knew all this stuff had to happen to make one?"

Balonek: Exactly. I had no idea before I joined IPC.

Shaughnessy: Where were you before you came to IPC, Alicia?

Balonek: I worked at a financial association in the banking industry, which was cool, though, because that was in the '90s, so you saw a lot of changes in banking with the ATM machines coming out, retail banking, gas stations and grocery stores. It was an exciting time there. It was right around the dotcom era too.

Shaughnessy: That was the good time.

Goldman: Not as exciting as circuit boards, though, right?

Balonek: You know what? The longer I'm at IPC, the more exciting it gets. I finally get it. It took me a long time to grasp this industry. It's exciting to see how engaged our members are too. That's what I like most about working at IPC.

Shaughnessy: Everybody you talk to in the industry will tell you about their job. They'll tell you how they love it, how they got into it. Everybody has some crazy path that led them to this industry.

Balonek: It's funny. Engineers are typically introverts until you start asking them about their work in this industry.

Goldman: Alicia, what else should our readers know about this year's show?

Balonek: I'd like to just share a few facts with you. Just the sheer buying power of our attendees that come to the show—many of them wait until they visit IPC APEX EXPO before they make their purchasing decisions for the year. In fact, through our attendee surveys, we know that 37% of our attendees indicate that they will be making a purchase within six months of the show. Then about 28% of our attendees actually make the final buying decisions for their companies, and 55% recommend or influence those buying decisions. We have the key decision-makers coming to this event.

Goldman: That's good. How about the size this year? How's that shaping up comparatively?

Balonek: We're expecting about 450 exhibitors in about 150,000 net square feet of space, and right now, the needle is pointing into the direction of selling out the show. We still have a lot to do, but that is our goal. As far as attendance-wise, we'll have total visitors of about 9,000, which encompasses about 4,600 attendees and about 4,400 booth personnel.

Shaughnessy: That's a lot of people. You do a good job just herding the cats and putting it all together.

Balonek: It's fun. We work so hard planning all year long, and, when I see it come together, I cry at every ribbon-cutting. I'm just so happy that all our plans went off without a hitch, although there are sometimes little bumps in the road. It's very fulfilling to me.

Goldman: I bet. Your baby gets born.

Balonek: Exactly.

Shaughnessy: I liked having the guitar players during the ribbon-cutting in Vegas. That was nice.

Balonek: Yeah, they were fun. My husband and I were on a trip in Vegas and we were at the Irish bar in Mandalay Bay, and that's how I found them. They were a lot of fun.

Goldman: Is that how you come up with your ideas, hmm?

Balonek: It's just amazing where you come up with ideas and what you're doing when you come up with those ideas. I also want to mention the First-Timers' Welcome Reception. We normally have a breakfast on Tuesday morning for them, but this year we're having a reception on Monday evening for the first-timers.

Goldman: You expect that to be a better time slot?

Balonek: I think it's a better time. Nobody really wants to get up for a 7:00 am breakfast meeting. And we will be holding the Women in Electronics reception on Wednesday evening.

Goldman: You have something every evening. Are those considered part of the show? Or are those separate?

Balonek: Yes. Those are free networking events and included in the exhibit hall only registration option.

Goldman: Well, we are looking forward to it. Especially after winter, we're always looking forward to San Diego. Thanks for talking with us today, Alicia.

Balonek: Thank you. SMT007

IPC APEX EXPO
App is Where It's At

In an interview with I-Connect007, IPC Exhibits Manager Kim DiCianni discusses the IPC APEX EXPO 2018 app and how this powerful tool will keep attendees on track. She also highlights its usefulness for exhibitors.


Kim DiCianni

Stephen Las Marias: Kim, can you please tell us more about yourself and your role at IPC?

Kim DiCianni: I am the exhibits manager at IPC. I handle all logistics, sales, operations, overall exhibitor tasks for the event as well as managing registration, the agenda planner, the app, and most things that have to do with exhibitors and attendees for IPC APEX EXPO. I've been with IPC for 12 years, and I've always worked on the show, so I've been growing with the event as IPC APEX EXPO evolves.

Las Marias: Please tell us about the app. When was it first created for the APEX show?

DiCianni: I started managing the APEX EXPO app in 2015. We created the app two years prior to that, but I don't know that it was as extensive or had the capabilities that it does now. It has come a long way from that first year.

Las Marias: How is the app helping the attendees?

DiCianni: The app provides everything that attendees could possibly want or need for the event, including being able to look up exhibitors by specific categories. If they're looking to focus on a specific category, not only can they see what exhibitors are tied to that, they can see related tech conference and PD sessions, and any event related to something they're interested in. App users could filter for "adhesives," and it will tell them what exhibitors are related to it, and what sessions might be of interest to them.

Basically, what happens is when an attendee registers, they select their demographics. Their demographics then go into our online agenda planner, which feeds the app. It gives them suggestions of any exhibitor that would be of interest to them, any session we have, and attendees can add those things to their planner. If they add it to their schedule, they're able see what time something takes place or what exhibitor they might want to see. They can browse exhibitors by name and product categories that the exhibitor selected.

We have "What's on Now?" which shows anything that's going on at that moment or coming up soon. They can look at any speaker's profile. They can see a list of attendees, or someone that might be of interest for them to connect with, and they can request a connection to that person. We have the maps of the show floor and the meeting rooms area. Users can see virtually anything that we offer at the event right in the palm of their hand, and it's always the most up-to-date information.

We have the show directory on site as well, but, as you know, once something goes to print, if something changes, it's no longer up to date. The app is always up to date. If something gets canceled at the last minute, we can do push notifications letting people know, or if

it was replaced by something or if the speaker changes. For the Tuesday morning keynote at 9:00 a.m., we can send a push notification at 8:00 a.m. as a reminder.

Jonathan Zinski: I was looking at your app from last year, and it was very extensive. I liked how you had links to check out the local area and find restaurants.

DiCianni: Many people aren't familiar with San Diego, so it helps. The app has social media links so they can look at Facebook, LinkedIn, or anything IPC is putting out during and after the show. The app we have now is called the multi-year. We use Core-apps and have since 2015, so if you already have the app on your phone from a previous year, it'll automatically add the new show, but it keeps the apps from the previous show also. So, if you made notes last year on something, you can go back, look at your notes from last year, and see if it is going on again. You're able to go back and compare the app. It never goes away.

Las Marias: How popular was the app last year and the years before, in terms of downloads, and did the attendees find it useful? Do you have some sort of feedback mechanism that will gauge that?

DiCianni: Last year, about 20% of our attendees downloaded the app. It has increased each year since 2015, in terms of downloads and usage. Comparing 2016 to 2017, the number of people using speaker profiles, sessions, and exhibitors is growing as well as the overall use. I think every year we're seeing an increase in usage.

Zinski: Do you use analytics to see what features are being used the most and which aren't being explored as much?

DiCianni: I would say probably our largest hits are on the session views, exhibitor views and speaker views—they're all very high.

Zinski: What means are you using to advertise it? If I had seen it last year, I would have used it.

DiCianni: On the printed show directory that's given to all registrants the QR code is right on the front page of the directory. We had 8-1/2 x 11 signs across the registration counter with the QR code. It had a picture of a tablet, a phone with the logo and then the QR code to download it right there. On most of our directional signage throughout the hall upstairs in the meeting area we also had the QR code. I know we promoted it to exhibitors in newsletters, and it was promoted within the conference brochure last year that was sent to attendees in December.

Zinski: Is there a way in the app for users to leave feedback about features they'd like to see improved or that they'd like to see added?

DiCianni: Currently not in the app itself, we do not. We do send exhibitor and attendee surveys at the end of each show. I know on both the exhibitor and attendee surveys we do touch on usefulness of not only the app itself but the agenda planner and ask survey respondents to provide their ideas for suggested improvements.

Las Marias: Does the data on usage or functions and features being used by attendees help you decide what other features to include in the show next year?

DiCianni: Absolutely. For example, the app is confirming that people like to look at new products. We know speakers at a session might be important or the session itself or

certain products or new products. It helps when we see trends, what's important to attendees, what they're looking for, etc.

Zinski: You said the app is continually updating for each year, so if someone has last year's, and is interested, they could download it right now and it would update for the show?

DiCianni: The 2018 app is still being created and it has to go through the approval process from Apple, so that's where we're at right now is putting in the new graphics and getting it prepared for 2018. Before we can actually push it live, it has to go through an approval process. If you were to download it right now, you would be able to see '17, '16 and '15, and then as soon as '18 becomes available, it would come into the app as an update. It would tell you that you have an update for the app, and then '18 would become available.

Once a person registers, their information comes from our registration company, and it populates into the agenda planner. Then when the app goes live, basically everything in that agenda planner, all our sessions, everything comes into the app. We're in the process right now of actually finalizing the agenda planner itself. It should be done in the next week.

Zinski: I'm on Android, and I was looking on Google app store, and I saw two of your apps. One of them looked pretty old, and the other one was the recent one.

DiCianni: Yeah, prior to 2015, we used another company for the app, so that's probably the other one you're seeing, because I don't think they ever go away. We have requested for it to be removed, so I'll have to check that out. Another thing I wanted to mention is the operating platforms, because I know people worry about Apple having so many operating, the app is always up to date and will work with the operating systems as they update. So, there's never going to be an issue with that.

Zinski: That's good to know. It's frustrating when a phone pushes an update. Android was pushing out their latest operating system, and half my apps are just crashing because they're not ready.

DiCianni: Exactly, and that's something that is very important to us, and I have confirmed repeatedly that, no matter what updates these carriers are doing or what platform they're using, it will work with it.

Las Marias: Kim, is there a benefit to the exhibitors for using the app?

DiCianni: Yes, we offer a sponsorship opportunity for them. On last year's, we just had an IPC banner, but this year, we are offering that to exhibitors, and it would lead to their page. It could be a great promotional tool to get themselves out there.

Las Marias: Right, good exposure. Hopefully doing this preview will inform a lot of people way before the event, and come the actual event, they will know that they can download the app. Thank you very much for your time.

DiCianni: Thank you so much. **SMT007**

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Tips & Tricks

ASSEMBLY PANELIZATION

Article by Ken Horky
PETERSON MANUFACTURING

Thoughtful PCB array and panel design can reduce line stoppage, improve changeover time and reduce material scrap. For the purpose of this discussion, a panel is an array of PCBs which may or may not include scrap material.

Fiducial location and design are good aids to prevent mistakes, but may still result in line stoppage. In this figure, the round features with square mask perimeter are fiducials. The square feature with round mask is a PCB bad mark. If you have fiducial recognition issues, making the shape of the mask opening different than the fiducial feature may help the vision system discern the target feature easier. Locating the bad mark at the PCB center consistently helps the line operator identify the bad mark without supporting drawings and reduces camera movement. Locating fiducials off center of the PCB will help prevent a print and/or place error but it will still stop the line upon the error.

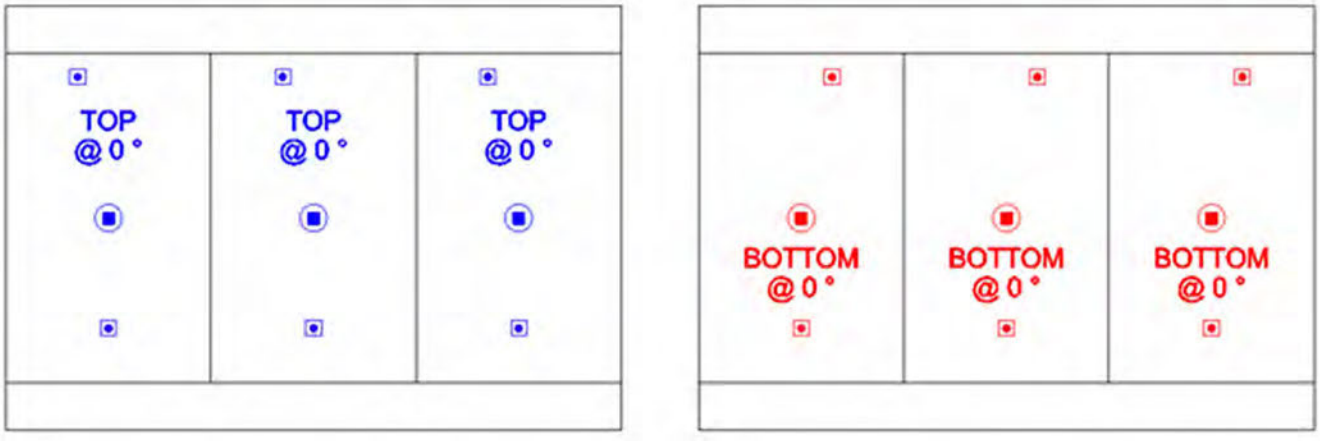
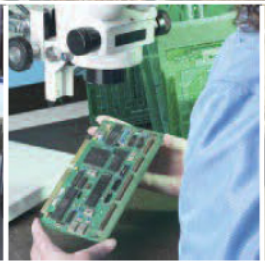


Figure 1: A simple panel array of the top side and the mirrored horizontal view of bottom side components if applicable.



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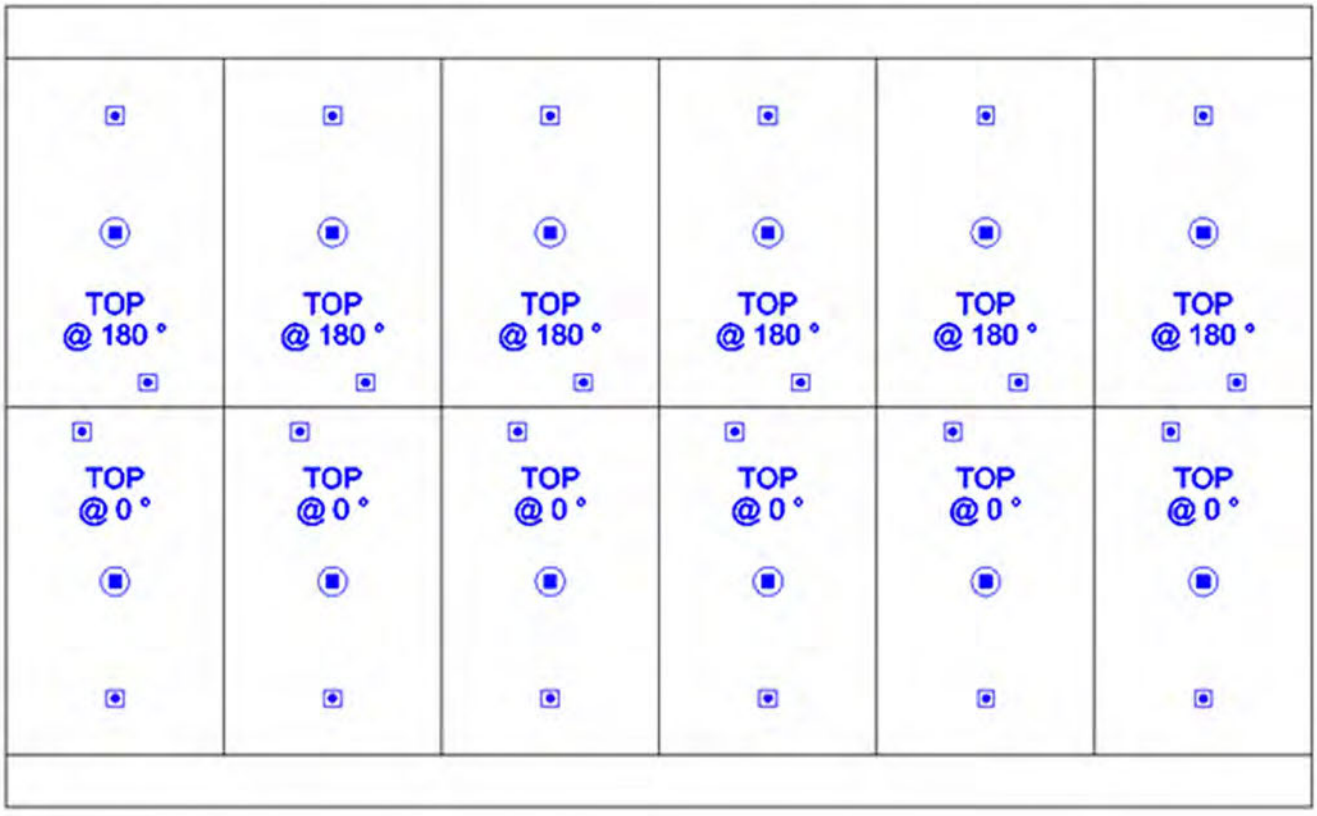

Figure 2: The scored PCB array with the top row rotated 180°.

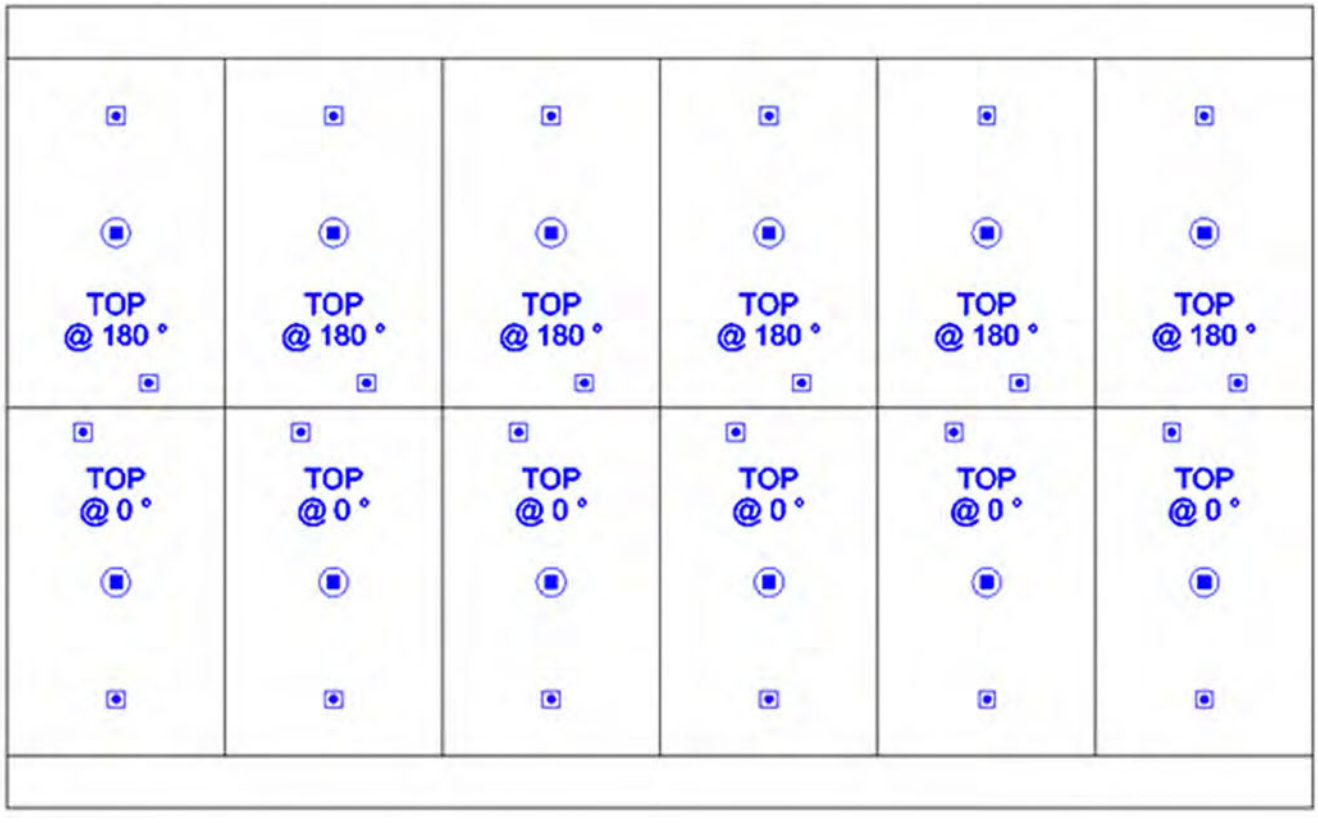

Figure 3: One row with top-side up and the second row mirrored vertically.

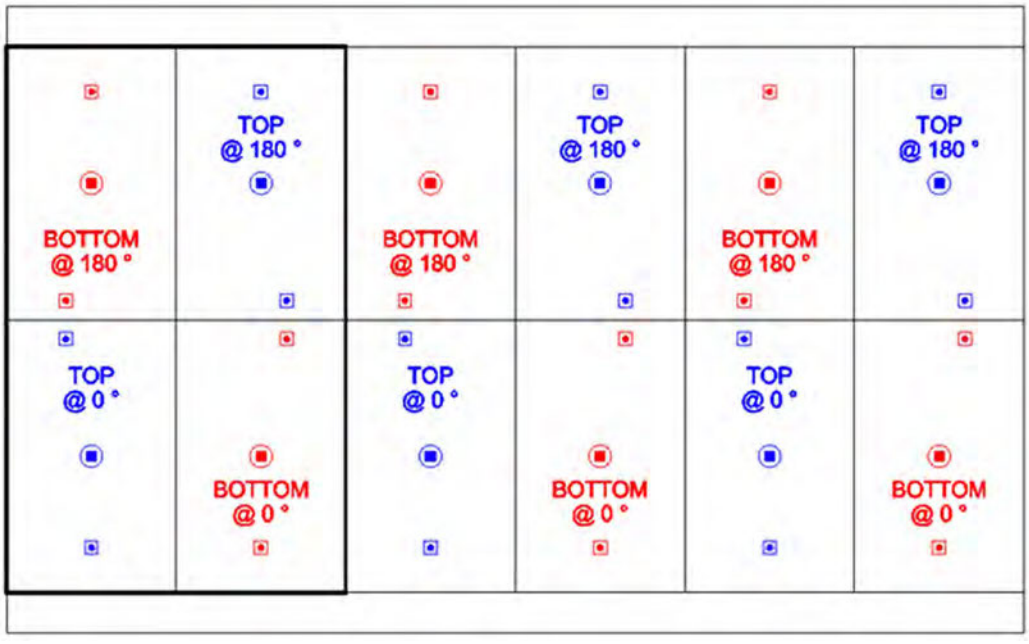

Figure 4: An array with a combination of mirroring and rotations. Within the four PCB orientations are the top side mirrored horizontally and vertically.

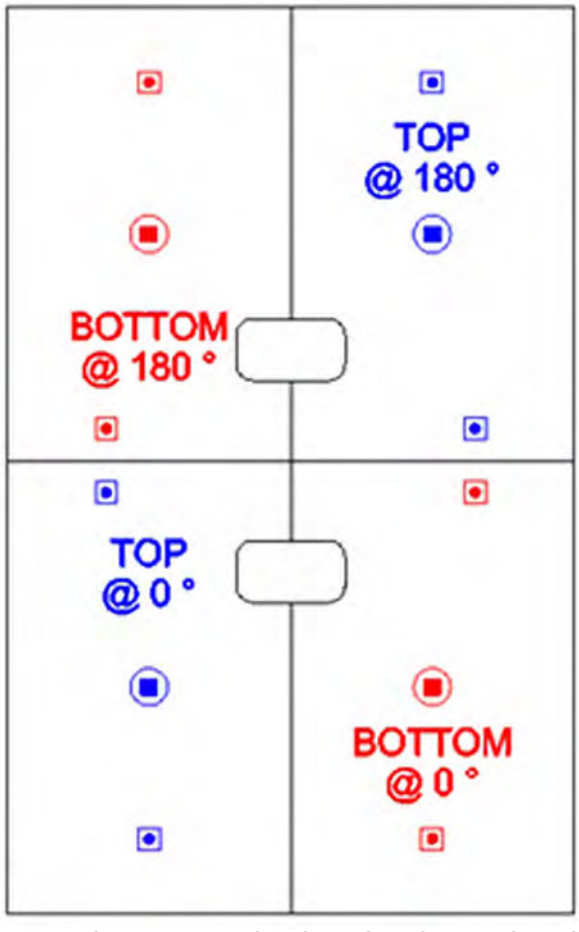

Figure 5: The cutout can be aligned so the panel can be scored rather than tab routed, saving scrap material.

The benefit to this panelization is that the line operator cannot send the panel downline with the wrong rotation. The line will not stop unless the panel is put in upside down. The line setup changes if there are bottom-side components.

This may be feasible if all the components can survive a second reflow on the bottom side in your process. This array can be rotated incorrectly by the operator in process. This panelization will eliminate changeover setup, so you would build one side, return it to the beginning of the line, flip it over and build the other side without changing your printer or placement setup. This panelization also only requires you to purchase one stencil.

This array can be rotated and mirrored any way as long as the unpopulated side of the panel is up. Eliminating line stoppage due to operator orientating the panel incorrectly, there is no changeover setup between top and bottom sides. An additional benefit to this array is for PCB borders with a cutout.

Your bare board fabricator has their own set of constraints and material sizes unique to their process. Work with them and consider it during your panelization design to keep material cost down. **SMT007**

Ken Horky is a process engineer at Peterson Manufacturing. To contact Horky, click here.

PCB Pad Repair Techniques

Knocking Down the Bone Pile
Column by Bob Wettermann
BEST INC.

There are a variety of reasons behind pads getting "lifted" completely or partially from the laminate of a PCB. Per the just revised IPC-A-610 Revision G, a defect for all three classes occurs when the land is lifted up one or more pad thicknesses. Lifted pads can occur when a device has been improperly removed or there is a manufacturing defect in the board construction. The propensity for this to occur when pads are very small, like in the case of an 0201 or when there is an unconnected BGA pad.

In any case, as with any repair, the ultimate decision on the ability to repair the pad lies with the customer. In some cases, only a limited number of repairs are allowed by the customer and if allowed the same repairs can only be attempted with customer-approved materials and methods. Like all repairs defined by the IPC 7711/21 Rework of Electronic Assemblies/ Repair and Modification of Printed Boards and Electronic Assemblies, the repairs can only be done with customer approval.

There are two different industry-accepted repair techniques for lifted pads when the objective is to replace the pad. One involves the use of dry film heat and pressure curable adhesive that is stuck to the replacement pad. The second involves the use of a two-part epoxy and "gluing" the replacement pad to the laminate. While the better method usually involves personal preferences, pull test data and better observed results of the replacement pad staying in position post soldering makes the epoxy method the one of choice.

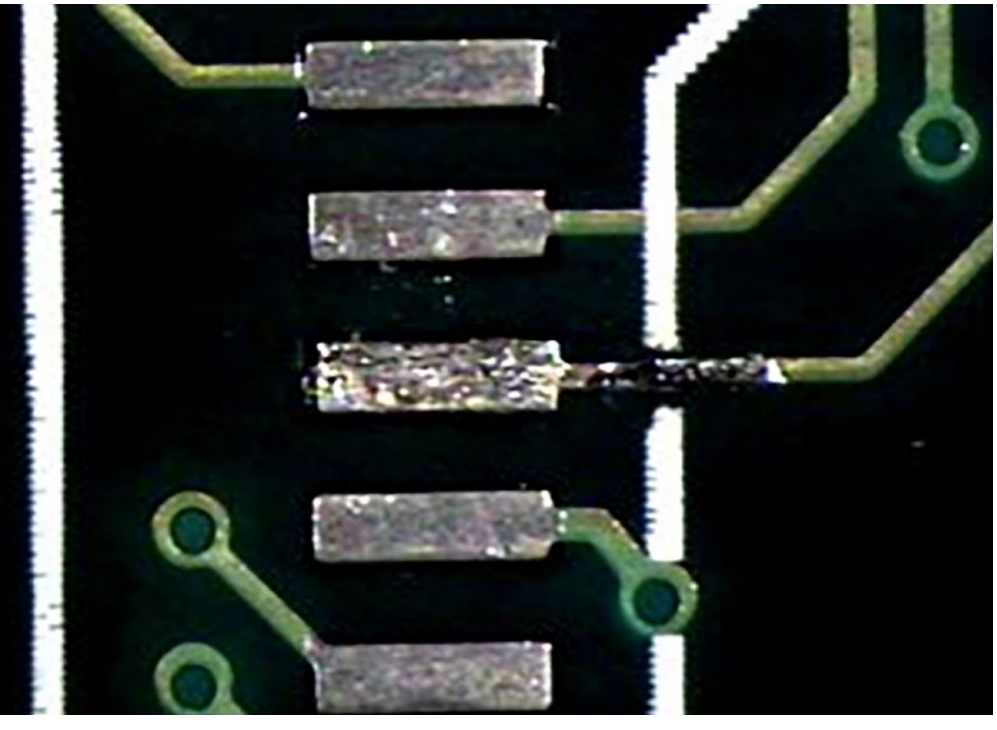

Figure 1: Initial damaged pad requiring replacement.

The epoxy repair technique outlined in IPC-7721 Rev C Procedure 4.7.1, describes a method for the repair of pads by using a replacement plated pad (attached via a skeleton of other patterns) and a two-part epoxy adhesive system. Each of the steps in the process require cleaning for best possible adherence of the repair materials as well as well as for inspection to make sure that the procedure is done properly. To start, remove the pad with a sharp knife and carefully cut a small piece of the connecting circuit. Using the proper solder and flux,

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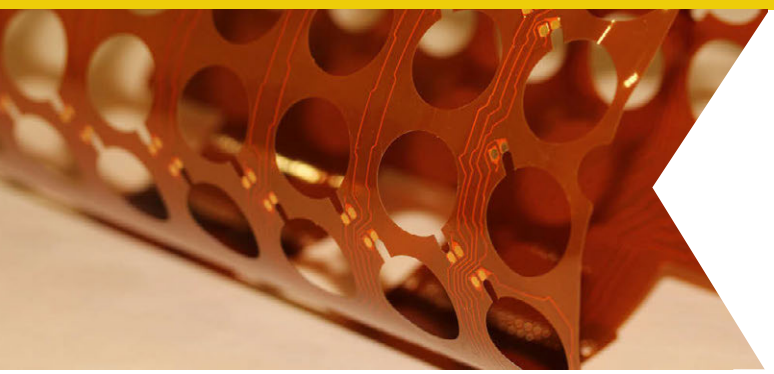

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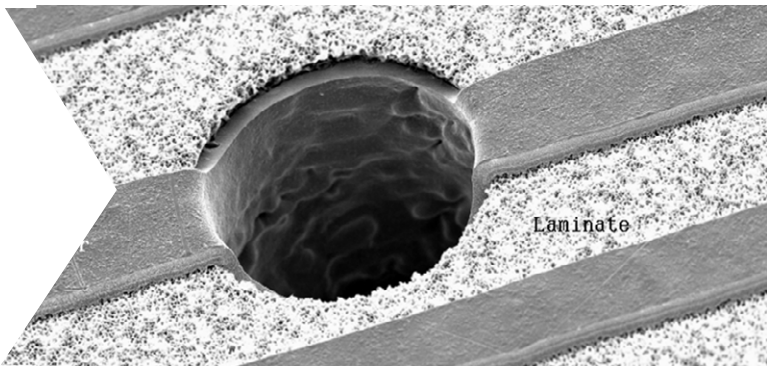

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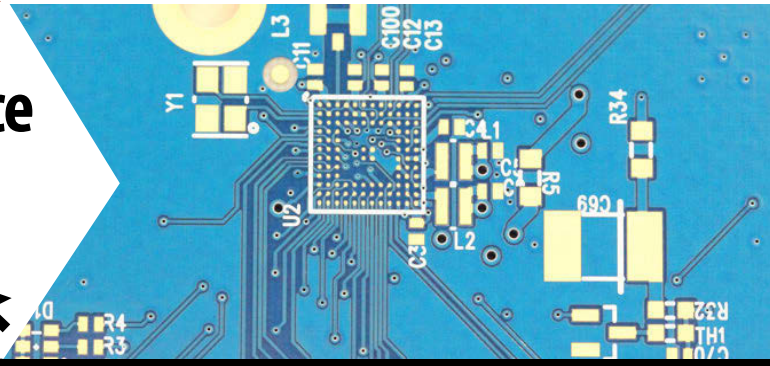

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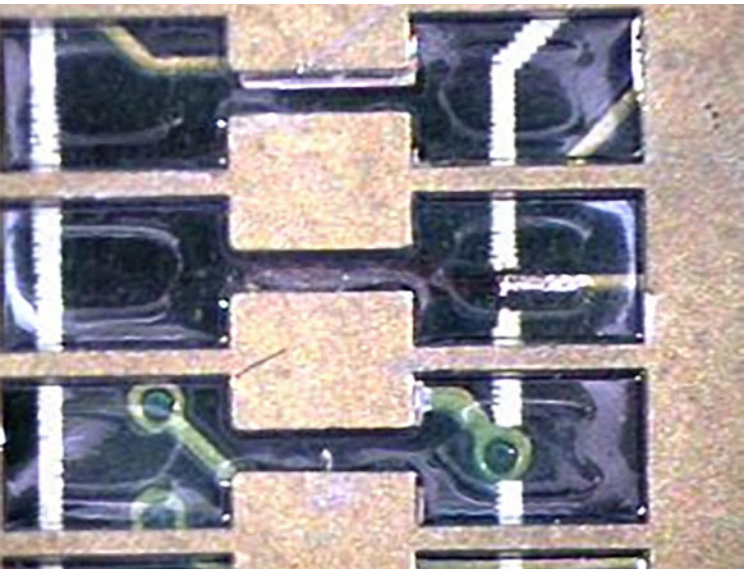

Figure 2: Replacement pads of commercial circuit frame.

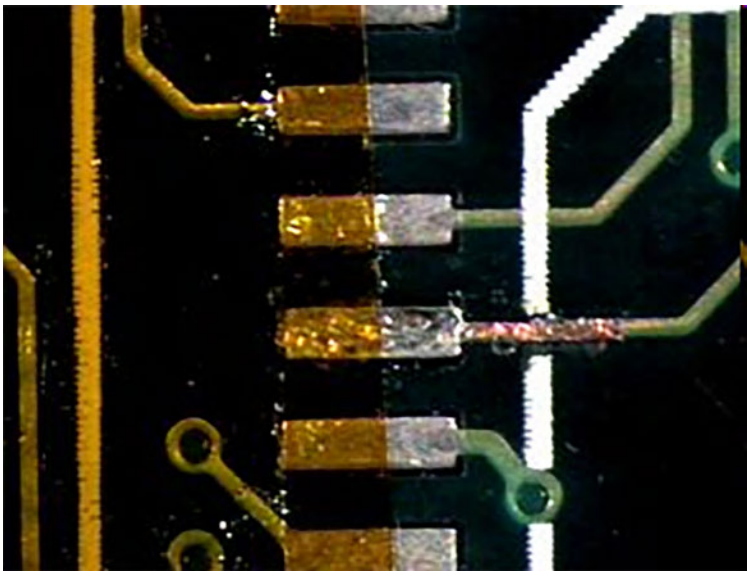

Figure 3: Replacement pad held down with Kapton tape for epoxy/resin curing process.

attach the replacement pad with the connecting circuit by lap soldering the two together. Mix the two-part epoxy per the manufacturer's suggestions, direct the mixture and apply pressure to the replacement pad and laminate and cure per the manufacturer's instructions. (This technique also works for still attached but lifted only pads.) Make sure to inspect for anomalies and perform an electrical continuity test as a post repair check.

In a second repair method (IPC 7721 Procedure 4.7.2), a dry film-backed plated replacement pad is adhered to the PCB laminate by a heat and pressure-activated dry film. All the process steps in the above epoxy method apply until you get to the sequence where a repair material is chosen. Once the replacement pad in the circuit frame is identified, it is cut out from the frame using a sharp blade. Only in this case the technician has to make sure that they cut through both the replacement pad as well as the adhesive backing. Now the pad is soldered to the trace if required. A special tip and handheld heating tool similar to a soldering iron is placed into a fixture which controls the downward pressure. Through this heated tip temperature and tip pressure the adhesive cures. The other steps are similar in nature to the epoxy repair method.

One of the most challenging types of pad repair are those with embedded vias. These vias, connected to other board layers, will still need to maintain their connectivity to the connected layer post repair. There are numerous approaches to maintaining these very difficult repairs including but not limited to small jumper wires of small copper trace interconnections.

There are two methods for repairing damaged pads. Both the two-part epoxy/resin and the dry film techniques will do the job. In either event, a highly-skilled and trained technician can make most of these types of repairs when financially viable and where the risks of reliability have been mitigated based on the end use operating environment. **SMT007**

Reference

1. IPC 7711/21 Rework of Electronic Assemblies/Repair and Modification of Printed Boards and Electronic Assemblies.

Bob Wettermann is the principal of BEST Inc., a contract rework and repair facility in Chicago.

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ASSIGNING IDs WITHIN the INTERNET of THINGS

Article by Hubertus Grobbel
SWISSBIT AG

Networking devices and machinery is in full swing. However, despite all the Industry 4.0 enthusiasm, there are voices of caution: Secure your communication. For this, identification of the participants is one requirement and special SD cards offer a surprisingly simple and flexible solution—ready for post-quantum cryptography.

For IT security experts, the three steps that open a "secure channel" are obvious: identification, authentication and authorization. A two-step authentication process can significantly improve security. The token used for authentication can also be used for encrypting the communication content.

Today, these processes are generally accepted by the human user of IT networks. But this is different for the Internet of Things (IoT). So far, sensors, actuators, devices, machines, IT systems, and, of course, critical infrastructures rarely need to "identify" themselves when they connect to networks—and anybody who requests data from them or stores data on them also remains anonymous.

In well-guarded manufacturing plants that are not connected to the internet, these risks might be tolerated. In the smart, networked factories of the future, such security gaps are no longer acceptable. The risk is too great for unauthorized individuals to gain control over the smart factory using remote internet access. There are reports and videos about cars that could suddenly be remotely controlled by unauthorized parties. They emphasize that the possibility of remotely controlling factories and power stations, or of third-party controlled manufacturing robots, should not simply be brushed aside.

Therefore, things also must be assigned an ID. If only identified devices can communicate with each other, life becomes significantly more challenging for hackers.

ID Inside the Memory Card

Thus far, fitting a device with a secure element either meant soldering identifiable hardware components (trusted platform

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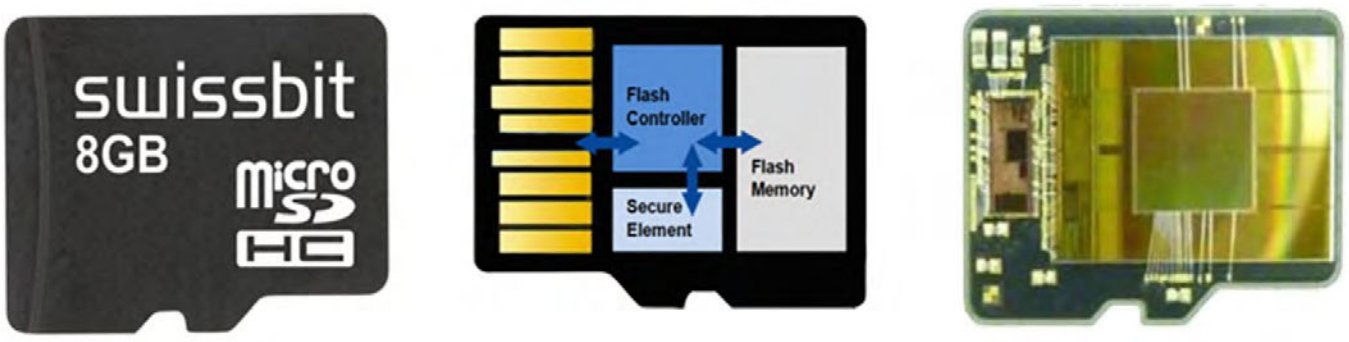

Figure 1: Swissbit offers industry-standard SD and microSD cards with secure elements and specialist firmware that can be used as TPM.

module or TPM) onto the relevant components or using processors that can be unambiguously identified via integrated security functions (trusted execution environment or TEE). There is a significantly more flexible option to retrofit infrastructures with an equivalent to ID cards simply by using a SD, microSD or USB interface and secure memory cards.

Secure memory cards, such as those from Swissbit, consist of a flash memory chip, a smart card and a flash controller. Because a crypto element is used as the secure element, not only can communication be secured, but data can also be securely encrypted. This allows for trusted boot concepts to be implemented and for licenses to be secured. Flash memory with integrated AES encryptor can also be used to encrypt additional data memory (for example, conventional hard drives) within the system. The flash memory cards proposed for the authentication and encryption within the Industrial Internet of Things (IIoT) are already employed on a large scale in tap-proof mobile phones, police body-cams, and for the protection of patient data in medical technology.

Trusted Platform Module as Retrofit

Combining the identifier with a standard data memory holds much appeal, mainly because most of the components and embedded systems in the IIoT require memory anyway for operating systems and data. Implementation is comparatively simple because memory interfaces are standardized and even middleware for the integration of TPM-requests can be supplied if required.

One of the biggest challenges when creating secure IIoTs is retrofitting older systems and existing components. If they have USB or SD interfaces, these legacy systems can simply be equipped with an SD card as TPM with tamper-proof identities and integrated retrospectively into the security concept.

Future-Proof

An even greater challenge: During a product life cycle, security becomes more vulnerable, as attack methods become increasingly sophisticated. The quantum computer, which is expected to become available within the next few years, is a threat to the encryption process. Consequently, it will be easy to hack asymmetrical cryptography. It will be necessary to develop post-quantum cryptography (PQC), demanding algorithms that are resistant to attacks from quantum computers. Thus, product managers must consider the upgradeability of security solutions, not least because of the German IT Security Law, which requires the use of the most modern technology. As easily exchangeable modules, secure memory cards thus provide a solution for the PQC challenge as well. **SMT007**

Hubertus Grobbel is the head of the security products department at Swissbit AG.

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Accurate Circuit Engineering (ACE)

Santa Ana, California, U.S.A.

ACE ACCURATE CIRCUIT ENGINEERING

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In the competitive world of electronic components, the speed at which a product gets to market determines its viable life and profitability. Our ongoing involvement in the prototype market helps us keep you on the cutting edge of technology and provide you with keen insights into future innovations. When you absolutely must have reliable, quick-turn prototype service for PCBs or low-volume production, trust your project to the ACE, Accurate Circuit Engineering.

Markets:	Automotive, Communication, Computers, Consumer, Industrial, Military/Aerospace
Board Types:	Single-sided, Double-sided, Multilayer
Mfg Volumes:	Prototype, Small, Medium
Other Services:	Assembly, Quick turn-around, R&D, Turn-key
Specialities:	3D Features, Blind/buried vias, Controlled depth drilling, Controlled depth milling, Impedance, Edge plating, Filled/, Heavy copper, HDI, Laser ablation, through-hole, Thermal clad PCBs, T, anagement
	9001, ISO 14000, ISO/TS 16949, UL

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Recent Highlights from SMT007.com

1 Ten Things EMS Providers Must Do to be Great ▶

With EMS companies, its becomes more important than ever to stand out from the rest of the crowd. So many EMS companies are vying for business that if a company wants to be truly successful, it has to come up with ways to distinguish itself. The question becomes how to do this. With that in mind here are 10 things that EMS companies must do to be truly outstanding.

2 Is Your EMS Provider the One for You? ▶

No matter where you are in your outsourcing journey, ensuring that your EMS provider is right for you is one of the most important success factors. The right partner should bring you years of pain-free manufacturing that has the ability to evolve and adapt to your needs as your business grows.

3 Insights from productronica ▶

The recently held productronica was a busy exhibition. There were booths that were so crowded that people were standing in the aisle to talk with company representatives. But some booths were nearly empty. Read to find Dieter G. Weiss' comments on this biennial show.

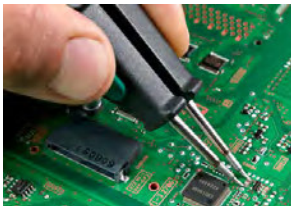
4 Valuetronics Q2 FY2018 Results Hit Record High ▶

Valuetronics Holdings Ltd has announced a net profit of HK$50.8 million for the three months ended 30 September 2017 (Q2 FY2018), up by 33.5% compared to the same period in the previous fiscal year.

5 Libra Industries' Robert Brandt Elevated to IEEE Senior Member

Libra Industries' Robert Brandt, production maintenance specialist, has been elevated to the grade of IEEE (Institute of Electricaal and Electronics Engineers) Senior Member.

6 IPC Crowns New Hand Soldering Competition World Champion



In cooperation with productronica 2017, IPC presented its very popular Hand Soldering Competition with a regional competition from November 14–16 and the World Championship on November 17. Taking the title of hand soldering champion was Zhang Yi, China, Chengdu #10 institute with a functional board and score of 473 out of a possible 500.

7 Hana Microelectronics Reports 13% Growth in Q3 2017 Revenue

Thailand-based EMS firm Hana Microelectronics Group has reported revenue of $172 million in the third quarter of 2017, up by 13% compared to the same period last year.

8 GPV Expands Production Capacity in Mexico

GPV has doubled the production capacity at its plant in Mexico with a new state-of-the-art manufacturing line.

9 IPC APEX EXPO 2018 Attendees Can Succeed at the Velocity of Technology at Free Networking Events

IPC APEX EXPO 2018 attendees can meet with electronics industry innovators and connect with peers all in one place at the San Diego Convention Center, February 27–March 1.

10 SMTA Announces Call for Abstracts for 2018 Events

SMTA announced that abstracts are now accepted for several events taking place in 2018. All submissions must be strictly technical with focus on technology research and minimize marketing content.

SMT007.com has the latest news and information. Subscribe to our SMT Week newsletter when you register at: my I-Connect007.

Career Opportunities

Pssst! Are You Looking for Someone?

Place your notice in our Help Wanted section.

For just $500, your 200 word, full-column—or, for $250, your 100 word, half-column—ad will appear in the Help Wanted section of all three of our monthly magazines, reaching circuit board designers, fabricators, assemblers, OEMs and suppliers.

Potential candidates can click on your ad and submit a résumé directly to the email address you've provided. If you wish to continue beyond the first month, the price is the same per month. No contract required. We even include your logo in the ad, which is great branding!

To get your ad into the next issue, contact:
Barb Hockaday at barb@iconnect007.com or +1.916.608.0660 (-7 GMT)

I-Connect007
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SALESPERSON WANTED · MAINLAND SOUTH CHINA

Work where you live!

The I-Connect007 China team is seeking an experienced salesperson to generate and manage a revenue stream for our Chinese publications.

Key Responsibilities include:

- Sell advertising contracts for monthly magazine
- Develop and cultivate new business
- Keep timely and accurate records
- Generate and follow up on all leads
- Manage contract renewals
- Account management: work with local and international team to provide customer support
- Phone and email communications with prospects
- Occasional travel

Qualifications

Successful candidates should possess a university degree or equivalent, experience with managing and cultivating leads, projecting, tracking and reporting revenue. We are looking for positive, high-energy candidates who work well in a self-managed, team-based, virtual environment.

Compensation

This is a base salary-plus-commission position. Compensation commensurate with experience.

Requirements

- Must be located in China Mainland, South China area preferred
- Good command of Chinese language, proficient with English speaking and writing
- Able to follow established systems and learn quickly
- Able to maintain professional external and internal relationships reflecting the company's core values
- 2-5 years' sales experience
- Experience with Microsoft Office products
- Must be highly motivated and target-driven with a proven track record for meeting quotas
- Good prioritizing, time management and organizational skills
- Create and deliver proposals tailored to each prospect's needs
- Experience in the electronics industry desirable

QUALIFIED CANDIDATES: CLICK HERE TO APPLY

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GOOD FOR THE INDUSTRY

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Career Opportunities

saki
The Future in Focus

Position: Field Application Engineer

Saki America Inc., headquartered in Fremont, CA, a leader in automated inspection equipment, seeks two full-time Field Application Engineers (FAE), one in the Fremont headquarters and the other for the Eastern and Southern United States.

The FAE will support the VP of Sales and Service for North America in equipment installation, training, maintenance, and other services at field locations. The FAE will provide technical/customer support and maintain positive relationships with existing and future customers.

Strong analytic abilities and problem-solving skills are a must in order to understand customer applications and troubleshoot issues. The FAE will perform demos and presentations for customers and agents as well as assisting in trade show activities. Candidate must have a minimum of a two-year technical degree, experience in AOI, SPI, and X-ray inspection, and strong verbal and written communication skills. The position requires the ability to travel about three weeks per month. Must be a US citizen and be able to lift up to 40 lbs.

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eptac
TRAIN. WORK SMARTER. SUCCEED.

Become a Certified IPC Master Instructor at EPTAC

Job Summary:
We are growing! EPTAC, a leading provider in the electronics training industry is looking for some great people to join our team. If you love teaching people, choosing the classes and times you want to work, and basically being your own boss, this may be the career for you. We are looking for instructors that have a passion for working with people to develop their skills and knowledge. If you have a background in electronics manufacturing and an enthusiasm for education, drop us a line or send us your resume. We would love to chat with you. Opportunities available across U.S. and Canada, especially in our growing markets of California, Chicago, Minnesota and New England. Some travel involved. IPC-7711/7721 or IPC-A-620 CIT certification a big plus.

Qualifications and Skills:
- A love of teaching and an enthusiasm to help others learn new concepts and skills
- Background in electronics manufacturing
- Previous soldering and/or electronics/cable assembly experience
- Previous IPC Certification a plus, but will certify the right candidate

Benefits:
- Ability to operate from home: no required in-office schedule
- Flexible schedule: control your own time, work as often as you like
- IRA retirement matching contributions after one year of service
- Training and certifications provided and maintained by EPTAC

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Career Opportunities

ACE ACCURATE CIRCUIT ENGINEERING

PCB Assembly Supervisor—full time
Accurate Circuit Engineering—Santa Ana, CA

Position Summary: Responsible for all assembly processes to ensure continued growth as directed by management.

Essential Job Functions:
- Create, implement, and supervise in-house manufacturing facility
- Recruit, hire, train, and supervise assembly floor personnel
- Extensive hands on experience with all aspects of PCB assembly
- Understanding of IPC-A-610 standards
- Research and acquire additional assembly resources
- Gather data on product shortages, lead times, price changes, etc.
- Coordinate the assembly activities with sales to ensure 100% on-time delivery
- Create, implement, and supervise daily quality processes to ensure 100% accuracy
- Document, monitor and review progress of the business unit
- Respond to internal and external customers in a timely manner
- Coordinate walk-through, site audits, etc.

Qualifications:
- Minimum 3 years as operations supervisor of electronics assembly house
- 5+ years' experience in the electronics industry
- Previous experience as a quality or operations supervisor preferred
- Ability to solve practical problems using pre-established guidelines
- Strong facility in Microsoft Office applications
- Excellent verbal and written communication skills
- Ability to work with people of diverse backgrounds
- Highly organized/excellent time management skills
- Ability to perform at the highest level in a fast-paced environment
- Valid California driver's license.

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ACE ACCURATE CIRCUIT ENGINEERING

PCB Process Planner

Accurate Circuit Engineering (ACE) is an ISO 9001:2000 certified manufacturer of high-quality PCB prototypes and low-volume production for companies who demand the highest quality in the shortest time possible. ACE is seeking a skilled individual to join our team as a PCB process planner.

Responsibilities will include:
- Planning job travelers based on job release, customer purchasing order, drawings and data files and file upon completion
- Contacting customer for any discrepancies found in data during planning and CAM stage
- Consulting with director of engineering regarding technical difficulties raised by particular jobs
- Informing production manager of special material requirements and quick-turn scheduling
- Generating job material requirement slip and verify with shear clerk materials availability
- Maintaining and updating customer revisions of specifications, drawings, etc.
- Acting as point of contact for customer technical inquiries

Candidate should have knowledge of PCB specifications and fabrication techniques. They should also possess good communication and interpersonal skills for interfacing with customers. Math and technical skills are a must as well as the ability to use office equipment including computers, printers, scanners, etc.

This position requires 3 years of experience in PCB planning and a high school level or higher education.

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Career Opportunities

CHEMCUT
BOUNDLESS INNOVATION | UNBEATABLE PRECISION

Chemical Process Engineer

Chemcut, a leading manufacturer of wet-processing equipment for the manufacture of printed circuit boards for more than 60 years, is seeking a Chemical Process Engineer. This position is located at Chemcut's main facility in State College, Pennsylvania. Applicants should have an associate degree or trade school degree, or 4 years equivalent in chemical process engineering.

Job Responsibilities Include:

- Developing new industrial processes
- Providing process criteria for both new equipment and modifying existing equipment
- Testing new processes and equipment
- Collecting data required to make improvements and modifications
- Assisting in investigating and trouble-shooting customer process problems
- Ensuring that equipment works to its specification and to appropriate capacities
- Assessing safety and environmental issues
- Coordinating with installation/project engineers
- Ensuring safe working conditions and compliance with health and safety legislation

Key Skills:

- Aptitude for, and interest in chemistry, IT and numeracy
- Analytical thinking
- Commercial awareness
- Ability to perform under pressure
- Communication and teamwork
- Problem-solving

Experience with circuit board processes is a plus.

Contact Arlene at 814-272-2800 or by clicking below.

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CHEMCUT
BOUNDLESS INNOVATION | UNBEATABLE PRECISION

Field Service Technician

Chemcut, a leading manufacturer of wet-processing equipment for the manufacture of printed circuit boards for more than 60 years, is seeking a high-quality field service technician. This position will require extensive travel, including overseas.

Job responsibilities include:

- Installing and testing Chemcut equipment at the customer's location
- Training customers for proper operation and maintenance
- Providing technical support for problems by diagnosing and repairing mechanical and electrical malfunctions
- Filling out and submitting service call paperwork completely, accurately and in a timely fashion
- Preparing quotes to modify, rebuild, and/or repair Chemcut equipment

Requirements:

- Associates degree or trade school degree, or four years equivalent HVAC/industrial equipment technical experience
- Strong mechanical aptitude and electrical knowledge, along with the ability to troubleshoot PLC control
- Experience with single and three-phase power, low-voltage control circuits and knowledge of AC and DC drives are desirable extra skills

To apply for this position, please apply to Mike Burke, or call 814-272-2800.

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Career Opportunities

Electronics Expert Engineer

Orbotech is looking for an Electronics Expert Engineer to handle various hardware activities, including communication, data path processing, device interfaces and motion, as well as system supporting functions in a multi-disciplinary environment.

What Will Your Job Look Like?

- Providing cutting edge hardware solutions for challenging product line needs
- Developing board design and Logic in VHDL
- Defining and managing interfaces (software, algorithm, mechanics and electricity)
- Successfully integrating hardware with other product disciplines
- Supporting the product needs during and following release

What Do You Need to Succeed?

- BSc in electronics engineering
- At least 5 years of R&D experience in complex board design, mainly FPGA (communication interfaces, DDR controller, algorithm implementation)
- Experience in an Altera/Xilinx development environment
- Experience in ECAD design tools (DxDsigner, ModelSim) is an advantage
- Knowledge in laser interfaces, RF and analog is an advantage

Who We Are

Virtually every electronic device in the world is produced using Orbotech systems. For over 30 years, Orbotech has been a market leader in developing cutting edge inspection, test, repair, and production solutions for the manufacture of the world's most sophisticated consumer and industrial electronics.

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Electronics Team Leader

Orbotech is seeking an Electronics Team Leader to join our electronics team, which develops multi-disciplinary systems, including vision/laser, image processing, and control and automation missions.

What Will Your Job Look Like?

- Lead a team of electronics engineers in a multi-disciplinary environment
- Lead electronic activities from requirement phase to development, integration and transfer, to production
- Be the focal point for other disciplines and projects managers
- Maintain and improve existing electronics platforms

What Do You Need to Succeed?

- BSc/MSc in electronic engineering/ computer science from a well-recognized university
- 5+ years' experience in digital board design, high-speed links, computing embedded systems, and HW/SW integration
- 2-3 years' experience in leading a team of engineers
- Solid skills in complex FPGA design with multi-modules
- Solid skills in high-speed board design, DDR3/4, PCIE, USB, IO, and optic links
- Ability to design and execute end-to-end solutions

Who We Are

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Career Opportunities

Technical Content Specialist

Indium Corporation is seeking a technical content specialist to guide the development of data-rich, high-level content for the company's semiconductor and advanced assembly materials (SAAM) sales and technical literature. The technical content specialist will work with multiple departments to ensure that all externally-facing technical and sales collateral and internal training materials are consistent in format and of superior quality.

The technical content specialist will:

- Assist in the development of key content and ensure consistency of message and format across platforms
- Develop a technically-detailed understanding of Indium Corporation materials and offerings to the SAAM industry
- Curate a library of technical conference papers and associated materials, including content related to Indium Corporation materials and their performance
- Assist in the development of, and ensure consistency for SAAM promotional materials, such as product datasheets (PDS), images, brochures, whitepapers and presentations (technical and sales)
- Attend at least one technical conference and its paper session per year

Requirements:

- Technical undergraduate degree (BS in Chemistry/Physics/Metallurgy/Materials Science or Engineering discipline)
- 5 years of work experience in semiconductor assembly or advanced electronics assembly
- Excellent written and spoken English language skills; fluency in Chinese desirable
- Proven ability to work independently with verbal or written instructions

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Ventec Seeking U.S. Product Manager for tec-speed

Want to work for a globally successful and growing company and help drive that success? As a U.S.-based member of the product and sales team, your focus will be on Ventec's signal integrity materials, tec-speed, one of the most comprehensive range of products in high-speed/low-loss PCB material technology for high reliability and high-speed computing and storage applications. Combining your strong technical PCB manufacturing and design knowledge with commercial acumen, you will offer North American customers (OEMs, buyers, designers, reliability engineers and the people that liaise directly with the PCB manufacturers) advice and solutions for optimum performance, quality and cost.

Skills and abilities required:

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

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

Please forward your resume to jpattie@ventec-usa.com and mention "U.S. Sales Manager—tec-speed" in the subject line.

www.venteclaminates.com

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Career Opportunities

BLACKFOX
Premier Training & Certification

IPC Master Instructor

This position is responsible for IPC and skill-based instruction and certification at the training center as well as training events as assigned by company's sales/operations VP. This position may be part-time, full-time, and/or an independent contractor, depending upon the demand and the individual's situation. Must have the ability to work with little or no supervision and make appropriate and professional decisions. Candidate must have the ability to collaborate with the client managers to continually enhance the training program. Position is responsible for validating the program value and its overall success. Candidate will be trained/certified and recognized by IPC as a Master Instructor. Position requires the input and management of the training records. Will require some travel to client's facilities and other training centers.

For more information, click below.

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Altium

Business Development Representative at Altium

New Logo Business Development representatives are highly motivated and hardworking with an upbeat can-do attitude. They work with our New Logo Sales Team to displace our competition in accounts by offering Altium's unified PCB development tools within a defined region.

The New Logo Developer's (NLD) main responsibilities will be qualifying leads and prospecting into competitive lists, searching the web, and utilizing internal sales tools (Inside View, LinkedIn, Marketo, SalesForce) to uncover and work with opportunities for the New Logo Closer to close. They are expected to meet or exceed monthly, quarterly & annual quota.

Responsibilities:

- Develop lead opportunities by collecting information that includes business pains/needs, timelines, authority and project teams, budget, competitive information, etc.
- Aggressively drive daily prospecting calls to build pipeline of prospective clients and occasionally closing smaller deals
- Develop relationships with key partners in their territory to identify new business opportunities
- Plan and prioritize personal sales activities in conjunction with the New Logo Closer, with the goal of achieving sales targets
- Work alongside inside sales teams on specialized projects such as call-out campaigns, promo drives and webinar fulfillment
- Once trained, maintain an in-depth knowledge of Altium products and technologies, competitive products, and industry trends.

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Career Opportunities

orbotech

FPGA Design Expert

Orbotech is seeking a FPGA Design Expert to join our electronics team, which develops multi-disciplinary systems including vision/ laser, image processing and electro-optics.

What Will Your Job Look Like?
- Lead image acquisition and processing activities in the team
- Engage in all aspects of FPGA design activity: requirement phase, coding, synthesizing, verification support and LAB bring up
- Participate in system definitions for current and next generation products
- Collaborate with other teams: SW, algorithm and QA

What Do You Need to Succeed?
- BSc/MSc in Electrical Engineering from a well-recognized university
- Extensive knowledge of VHDL
- 5+ years of FPGA development experience (requirement, architecture, RTL coding, simulation, synthesis, timing analysis, P&R, board level integration and verification)
- Experience in designing and implementing low-latency, high-throughput FPGA designs utilizing PCIe Gen2/3, Gigabit Ethernet, SERDES, DDR3/4
- Experience in complex FPGA such as Altera Stratix-II and Arria 5&10 devices
- Authoring documentation experience such as FPGA specifications and FPGA verification plans

Who We Are

Virtually every electronic device in the world is produced using Orbotech systems. For over 30 years, Orbotech has been a market leader in developing cutting-edge inspection, test, repair, and production solutions for the manufacture of the world's most sophisticated consumer and industrial electronics.

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Altium

Application Engineer

The application engineer is the first contact for our customers who have technical questions or issues with our product. We value our customers and wish to provide them with highest quality of technical support.

Key Responsibilities:
- Support customer base through a variety of mediums
- Log, troubleshoot, and provide overall escalation management and technical solutions
- Create various types of topic based content, such as online help, online user guides, video tutorials, knowledge base articles, quick start guides and more
- Distill complex technical information into actionable knowledge that users can understand and apply
- Continually develop and maintain product knowledge

Requirements:
- Understanding of EDA electronic design software, schematic capture and PCB layout software
- Bachelor's degree in electronics engineering or equivalent experience
- Sales engineering and/or support engineering experience
- Circuit simulation and/or signal integrity experience
- Understanding of ECAD/ MCAD market segments
- Understanding of micro controllers, SoC architecture and embedded systems market
- Database experience preferred (i.e., MySQL, PostgreSQL, Microsoft Access, SQL, Server, FileMaker, Oracle, Sybase, dBASE, Clipper, FoxPro) etc.
- Experience with PLM/PDM/MRP/ERP software (Program Lifecycle Management) preferred
- Salesforce experience a plus

Salary based upon experience. Comprehensive benefits package and 401k plan. Openings in USA, UK, and Germany.

For more information, contact Altium.

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Career Opportunities

MacDermid
PERFORMANCE SOLUTIONS

Do you have what it takes?

MacDermid Performance Solutions, a Platform Specialty Products Company, and daughter companies manufacture a broad range of specialty chemicals and materials which are used in multi-step technological processes that enhance the products people use every day. Our innovative materials and processes are creating more opportunities and efficiencies for companies across key industries – including electronics, graphic arts, metal & plastic plating, and offshore oil production. Driving sustainable success for companies around the world, and at every step of the supply chain, takes talent. Strategic thinking. Collaboration. Execution.

The people of MacDermid Performance Solutions stand united by a guiding principle: If it doesn't add value, don't do it. This belief inspires a unique culture where each team member has opportunities to imagine, create, hone and optimize. Do you have what it takes? Join our growing team of over 4,000 professionals across more than 50 countries with openings in research, finance, customer service, production and more.

MacDermid Performance Solutions and its affiliates are Equal Opportunity/ Affirmative Action Employers.

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NCAB GROUP
Integrated PCB Production

Outside Sales/ Key Account Managers

NCAB Group USA is adding to our existing outside sales team in various U.S. locations:

- Ontario, California
- Itasca, Illinois
- Vancouver, Washington

This is a sales position that requires the ability to convert those cold calls into high-value customer meetings. What we are looking for:

- A "hunter" mentality
- The ability to create solid customer relationships
- A desire to excel and not settle for mediocrity
- 5+ years of experience in the PCB or semiconductor industry
- An excellent ability to present a product and do the "deep dive" during customer visits by asking open ended questions and identifying customer pain points
- The energy to move from prospecting to cold calls to getting the win
- Knowledge of "SPIN" selling
- A college degree
- Willingness to travel, domestically and globally
- U.S. citizens with a valid U.S. passport

Interested? Send your resume.

Visit us at www.NCABGroup.com

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Career Opportunities

ARLON

Arlon EMD, located in Rancho Cucamonga, California is currently interviewing candidates for **manufacturing** and **management positions.** All interested candidates should contact Arlon's HR department at 909-987-9533 or fax resumes to 866-812-5847.

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

Our facility employs state of the art production equipment engineered to provide cost-effective and flexible manufacturing capacity allowing us to respond quickly to customer requirements while meeting the most stringent quality and tolerance demands. Our manufacturing site is ISO 9001: 2008 registered, and through rigorous quality control practices and commitment to continual improvement, we are dedicated to meeting and exceeding our customer's requirements.

more details

YOUR JOB AD HERE

For information, please contact:
BARB HOCKADAY
barb@iconnect007.com
+1 916.365.1727 (PACFIC)

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- Get instant access to premium 'members-only' e-books, industry surveys and more

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Events Calendar

47th NEPCON JAPAN ▶
January 17–19, 2018
Tokyo Big Sight, Japan

DesignCon 2017 ▶
January 30–February 1, 2018
Santa Clara, California, USA

EIPC 2018 Winter Conference ▶
February 1–2, 2018
Lyon, France

SMTA Pan Pacific Microelectronics Symposium ▶
February 5–8, 2018
Big Island, Hawaii, USA

IPC APEX EXPO 2018 Conference and Exhibition ▶
February 27–March 1, 2018
San Diego, California, USA

China International PCB & Assembly Show (CPCA Show 2018) ▶
March 20 – 22, 2018
Shanghai, China

MicroTech 2018 ▶
April 9–10, 2018
Egham, UK

2018 SE Asia Technical Conference on Electronics Assembly ▶
May 8–10, 2018
Kuala Lumpur, Malaysia

PCB EXPO Thailand ▶
May 10–12, 2018
Bangkok, Thailand

Medical Electronics Symposium 2018 ▶
May 16 – 18, 2018
Dallas, Texas, USA

IPC Calendar of Events

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