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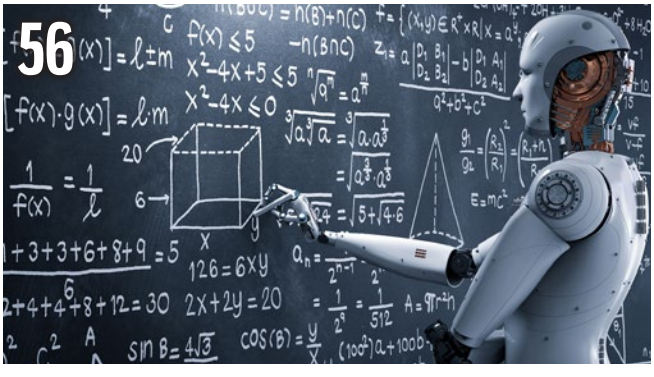
What You Need to Know

No matter your age or experience level, we all need to be continuous learners. In this issue we bring you some of the newest and highest impact topics. Read about insightful industry perspectives and the latest announcements from productronica 2019 to help further your expertise.



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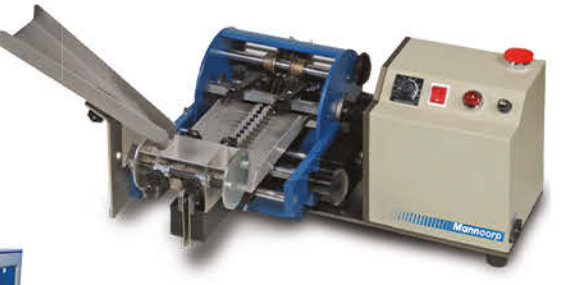

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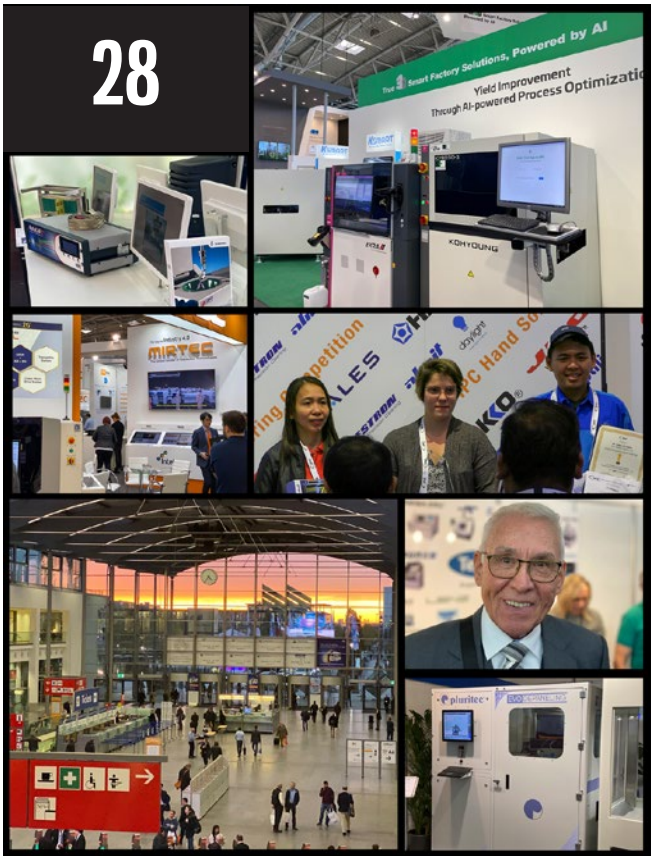

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What You Need to Know

Nolan's Notes

by Nolan Johnson, I-CONNECT007

Last month, the I-Connect007 team attended productronica in Munich. We spent the week touring the exhibition floor, talking to industry leaders, and bringing back news and interviews. You've undoubtedly already seen our photo gallery coverage in the I-Connect007 Daily Newsletter (if not, I encourage you to subscribe). And believe me, productronica gave us a lot of news to cover. In response, this month we're going to get right to the good stuff: what you need to know, and the news from productronica.

This issue includes an article on risk mitigation from APCT Global's Kimberly Johnson and Tony Torres. Next, we have interviews with Oren Manor from Mentor, A Siemens Business, on digital factories; Karthik Vijay from Indium Corporation on "The Convergence of 5G and Automotive;" Altium's Ben Jordan, sharing his vision on how using cloud storage technology in PCB design and manufacturing will change our industry; KYZEN's Tom Forsythe on clean vs. no-clean; Arch Systems' Ridhi Kantelal on upgrading a line to digital; and Curtis Smith from Huntron Inc., who covers thoughtful best practices for PCB repair. We also have columns from Eric Camden, Ray Prasad, Michael Ford, and Alfred Macha, which all deliver information you need to know.

Further, we have exclusive coverage of the IPC World Hand Soldering Competition held during productronica, including the award ceremony. This event brings together some of the most skilled handwork talent on the planet, competing for top honors, reputation, and prizes. And congratulations to Indra Setiawan from PT.SIIX EMS, Indonesia, West Java—the 2019 champion!

But wait, there's more! We also conducted productronica interviews aplenty, both in video and print; some of both appear in this magazine, and you can also find them online in our RealTime with… series. Read and watch the interviews to get a snapshot of the action at productronica for yourself. Enjoy! SMT007

Nolan Johnson is managing editor of *SMT007 Magazine*. Nolan brings 30 years of career experience focused almost entirely on electronics design and manufacturing. To contact Johnson, click here.

IPC World Hand Soldering Competition Award Ceremony

I-Connect007 brings you coverage of the award ceremony for the IPC World Hand Soldering Competition from productronica 2019. Congratulations to Indra Setiawan from PT.SIIX EMS, Indonesia, West Java–the 2019 champion!

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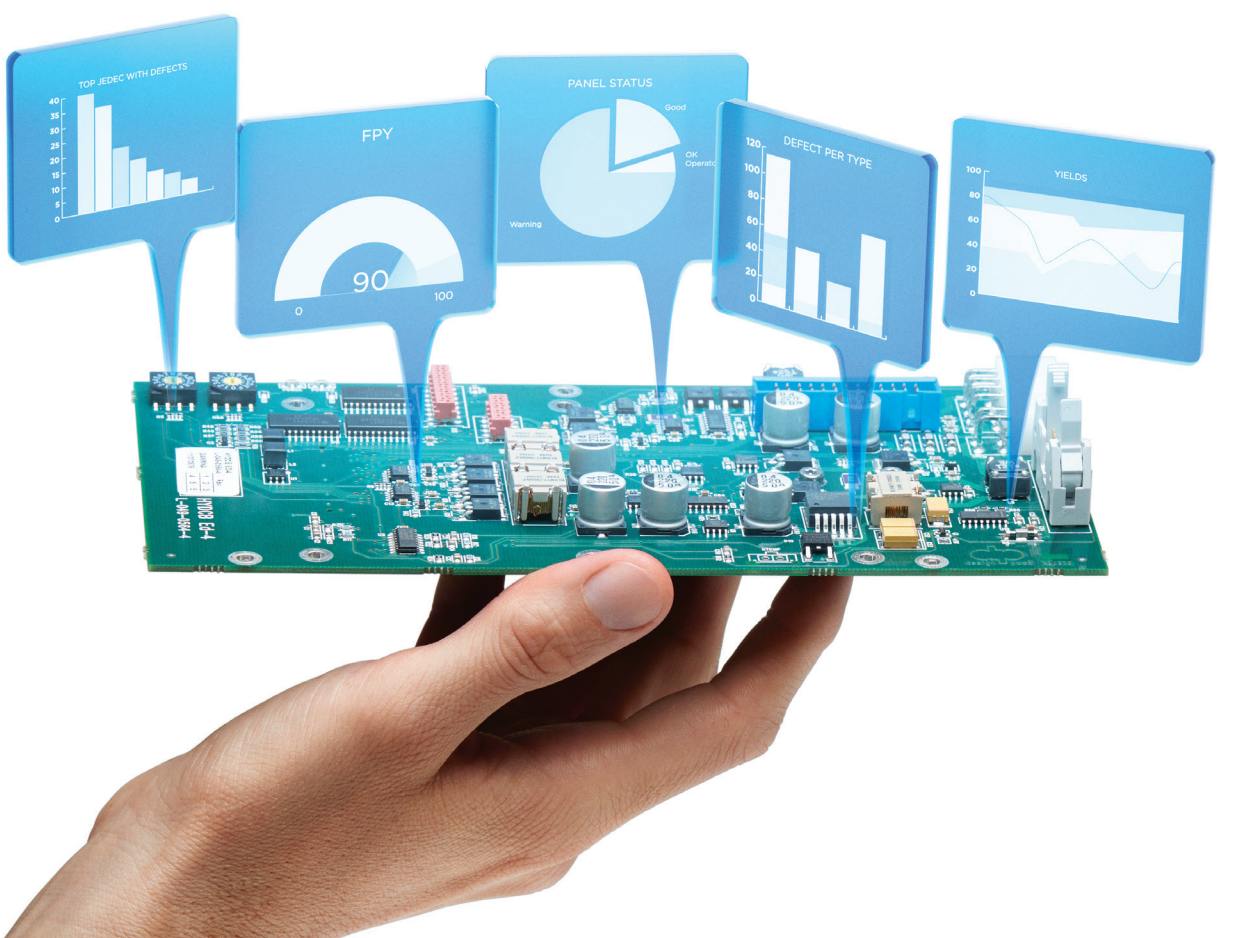


Oren Manor

What You Need to Know About the Digital Factory

Feature Interview by Barry Matties
I-CONNECT007

Barry Matties spoke with Oren Manor, director of business development for Mentor, A Siemens Business, during productronica about the many benefits of a digital factory and what's keeping companies from becoming one. Oren also gives examples of big data analytics along with the move to a lot size of one.

Barry Matties: Hello, Oren. First, can you share some of the advantages of being digital?

Oren Manor: We did an analysis, and one major phone company has a 3.4 DPMO, which is extremely good; that's three defects per million of opportunities. If you calculate the number of devices they are building and the number of components, that's still about $1.5 billion worth of scrap a year. If you do the same analysis with the big 10 EMS companies, take what they do in a year, and calculate their numbers, you get to a potential scrap of about $1.5 billion. If you put them on a 100 DPMO, which means that even in industry-acceptable or high standards of quality, there's a lot of scrap. People are using software; they have CAD and MES systems. They have been able to get to this level of quality, but it's not enough. We need to push it to the next level. And this explains why digitalization here is critical. People say, "This is a Tier 1 problem."

Now, we have a nice story with a customer called Roy; they're a mid-sized manufacturer based in Northern Italy not too far from Milan in Biella. They have five SMT lines, and they're both an OEM and an EMS, which I see more and more. They make products for their own brand and company, but they also contract for other customers because they have the assembly line and capacity. They don't need all the capacity for their OEM business, so they try to make additional money. They came and said, "We have a bigger device. We want the material to be 100% autonomous in the factory. We don't want any human being touching the feeder or moving boxes around. We want all of this to be fully automated."

And with our material management system, we can do that. First, we can acquire the data from the machines, storage, and ERP system,

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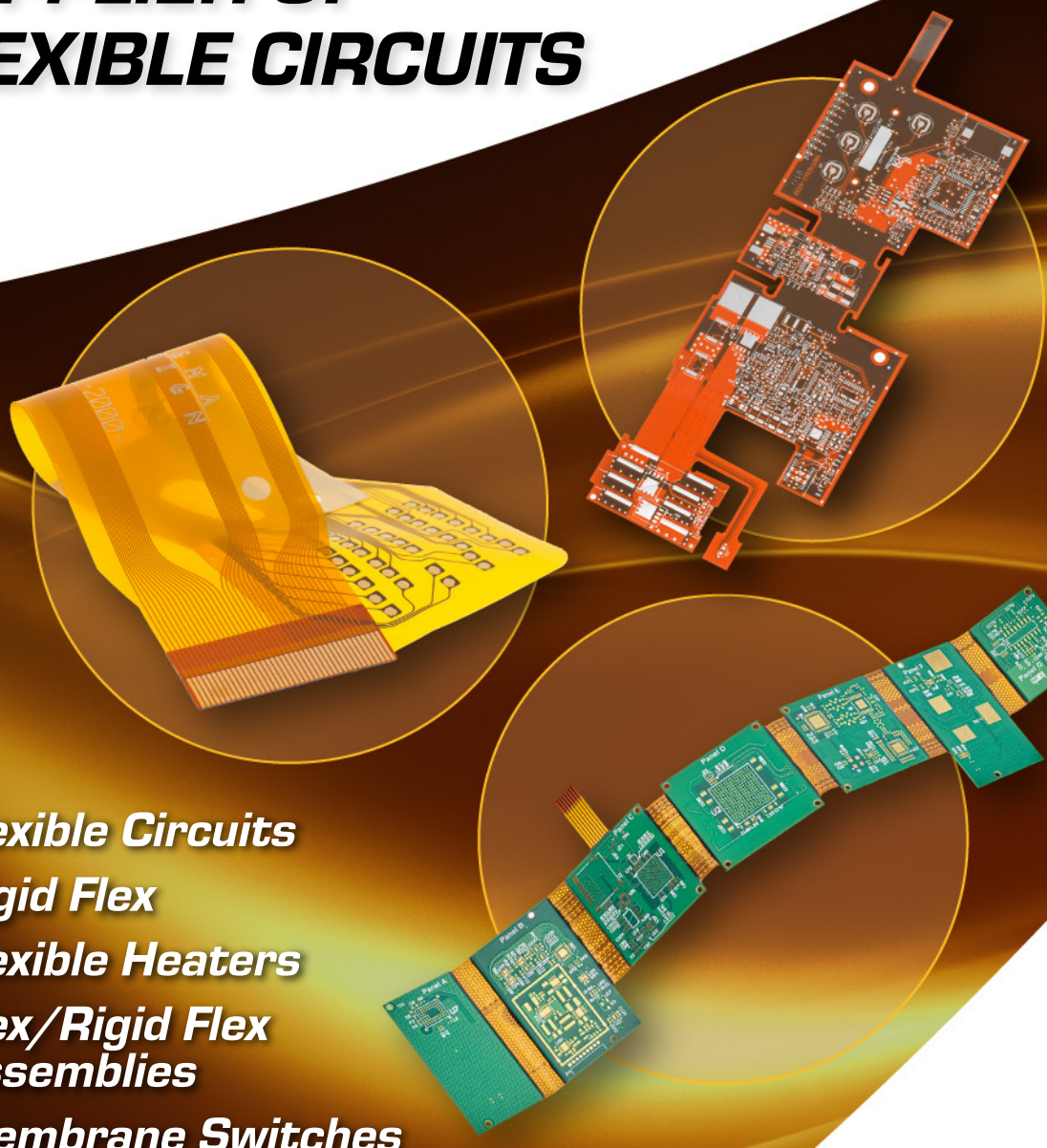

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and we can then give you an analysis. For example, "This material is more expensive, so use it first, or this material is going to expire first, so use it first." We can also do insights here. We take the supply chain data from a couple of components that are interchangeable, such as a resistor or capacitor; once you factor in the quality, the different components change. One component may have a more expensive purchase price, but if you factor in the quality, it's cheaper.

As my grandmother always used to say, "Buying the most expensive is sometimes the best option and comes to be the cheapest." Now, we have a customer CEO who says exactly that: "80% of the cost is material. If I screw up the material, my profit and margin are gone." First, if the material doesn't get to the line when it's needed, then the line is down. The primary reason is the material is not there. Second, if we create the product, it's not working and I have scrap, that's killing my profit. We did an analysis, and you can save a lot with a good material management solution; you can save anywhere from 150K to two million euros a year by reducing inventory and making better decisions.

You can save anywhere from 150K to two million euros a year by reducing inventory and making better decisions.

This depends on how much material you have. I think 150K is if you have one or two lines; that's probably what you're going to save. A shop with four lines could save maybe 400K–500K. We have customers with 15 lines, and when they did the estimation, they said, "We saved two million euros a year because of material, reduced inventory, reduced real estate, reduced air conditioning for this material, etc." This a good example of something that is important for the big players but also very equivalent and applicable for the smaller players if they want to continue to be competitive and profitable.

Matties: They really have no choice because the drive to a digital factory is already there, and the only way you're going to stay competitive is to become a digital factory.

Manor: Exactly. And what's the driver? Compliancy? Is somebody making you do this because you have a contract with an OEM, like a mobile phone maker or a car manufacturer, demanding that you collect all of this data? Or do you want to see a return on investment? If you say, "I'm willing to give you $1 million, but show me how I make money out of it," or, "My internal software sucks, and I don't want to keep these people anymore. I want to go to the commercial software, and I'm going to find a commercial solution," these are the three main drivers. When we talked to the management level, we can work with them based on these drivers. What type of solution should we deploy? What should we attack now?

Matties: So when you have the drivers from a financial or inventory, there's a lot of drivers. What's the primary driver that you see right now? Is it financial, or is it customer demand?

Manor: I would say it's a 50/50. Compliancy is very strong, but you're not going to put in a whole new MES system and spend multiple millions of dollars just because a customer is making you. You'll do the bare minimum and say, "I'll certify one line, and then from your 10 lines, you will put the software on one line and get the certification to be done with it. For an ROI, you're going to do the whole factory."

From our perspective, these ROI-driven products are many times for a bigger solution. We see that material management is something with a very proven ROI. And that's where when customers say, "Show me the money. Let's do a project around materials because the money is there." With quality, it's harder to improve, and if I was a financial guy, I'd go with materials.

Matties: The material is a hard and fast equation. You could show the numbers. It's quantitative.

Manor: The challenge with material is it requires change management. You have to work differently, as well as the operators; you need to go into a more automated approach, and you might get resistance. We need a strong management team to be on board to say, "We are going to dictate it and make the operators and line managers use the software. If they turn off the software because it gives them a headache, and they stop collecting the traceability data, then this whole thing falls away."

Matties: What is keeping people from jumping into digital factory? You've just authored a great book about what they need to know, but what's really the barrier?

Manor: Data acquisition is the first barrier. Collecting data is not easy. It's not easy on the SMT shop floor, and we have a lot of different data formats and machines. It's a very heterogeneous environment; there is no real standard. CFX is a nice beginning, but it's not deployed yet. It's still evolving, and it's going to take a couple of years until we see a production flow with a lot of CFX data. Then, you have to collect all of the different types of data, and some of these machines, such as SPI machines, are generating thousands of measurements per second. If you have a high capacity, you are making millions of records a day, which is an overload. You have to collect the data. Now, you have to worry about storing the data. The biggest challenge later is how to get any insights from the data because you have a massive solution. What do you do with it?

Customers want insights; they don't want to pay for the tool and have them do the stuff. They expect us as a digitalization partner to come with the solution, get the data, store it, and give them insights. They expect us to say, "We have looked at different types of correlation. We are going to run this engine on the data now, and try to see if it is applicable for your factory." For example, consider humidity and quality. Can we save some of the inspection processes? We did a very nice project with our colleagues in one of the Siemens factories in Germany, and we looked at the X-ray, which is a bottleneck machine. We decided to see if the test on the SPI and the AOI are perfect. Can we skip the X-ray? In 30% of the cases, there is zero chance of a failure found in the X-ray out of 10 million PCBs examined. You can definitely skip that. And since X-ray is the bottleneck, you immediately get a 15% improvement of the yield and output. Making all of these tests and inspections makes the process more cumbersome. If you can save and test when you need on the part of the board that you need, you can save money, and this can be done with big data.

Matties: An argument could be made that data already exists in the X-ray because they know that their jobs are coming out error-free, and they don't need your tool to determine that.

Manor: You have to look at millions of records and try to see over because maybe there were three defects because the operator was clumsy. Maybe the air conditioning didn't work, so you want to rule out the environmental stuff. If you look at data for a year, then you rule it out, and you see on average when you can come to decide, "Is my test strategy correct? Can I save some time?" This is a nice example of big data analytics and how I think of using it.

Matties: I think the key points there are data overload and interpretation because they have to realize and choose what their critical measurements are for them.

Manor: Exactly.

Matties: Every factory is a bit different. But I would think across the board, 20% of the measurements are going to work for 80% of the people.

Manor: The technology is there, so anybody can buy Tableau and all of these companies and get big data. Technology-wise, it's not a big issue, but none of these systems are made for electronics. If you want to get a report later on which feeder had the most issues, and you want to get something about the reference designator, there's nothing there. If you're in food and beverage, some of the systems have already been customized; unfortunately, PCB is not such a big industry, and there is nothing off the shelf. Either you take a team and invest a couple of million dollars in building the system, or you come to a partner like us. It's expensive and takes a lot of time to take these big data analytics systems and customize them for electronics. There's no real point. What's the point in putting in all of this effort? You can definitely take some of our reports, and the 80/20 rule, and hire some data analysts and scientists and process experts to dig out more insights out of that.

Matties: Are you working with data analysts that you bring into the companies as a consultant?

Manor: Yes. We have a couple of process experts who say, "We've analyzed a stencil and printing, and we want to show you some of the insights that we've received. For example, what's your philosophy regarding cleaning distance?" Some customers will tell me they clean the stencil every new workload; others say they clean it every hour. Some people say they clean it when they get a lot of defects. You see that many customers don't really have a strategy around it. When you look at the data, you see that cleaning the stencil is the worst thing you can do because the quality right after is very bad. It's like putting new ink in your printer; right after you put in a new inkjet cartridge and the first couple of pages are iffy.

The same is true with the stencil printer. Anything you can do to avoid cleaning the stencil is good. If you look at the data, you can analyze it and decide after what type of defects you should clean it because that's your best approach, and it's probably dirty. When your process is out of control, your stencil is bad; you have an environmental issue, and some other consumables are an issue. Going to the stencil cleaning process is not always the right approach, and we can take data and process experts and do something there. It's a very trivial thing, but you see that with data and process assessment, you can really work with a customer.

Matties: Is the strategy for companies to step in mostly to a digital factory, or are people saying, "We just want to turn it on and be completely automated." And when we say automated, process automation. Larger companies are the ones looking for total automation where smaller companies may be stepping. Do you see some division along the economics?

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Manor: Yes. With smaller companies, it's all about flexibility because they usually deal with the smaller customers, and what they give them is the ability to do a very quick cycle and prototyping. They're usually very close to their customers. The advantage is the customers trust them with the data; many times, it's around aerospace and automotive. They're in the U.S. and Germany and they work with the big OEMs to do a very quick turnaround of data. We have a customer in Colorado where the big thing is we get the order on Monday, and we ship it on Friday. It could be 10 boards, and when we get the data Monday, we do the NPI, start programming, do a few boards, see that it's okay, and then do the batch of 20–50 and ship them on Friday.

The automation is on the process level, but they have to be very flexible because setting up the line, and all of that stuff is less of an issue. With the bigger companies, it's more about reducing headcount and coming to a situation. We've seen a couple of customers now with assembly lines in Italy with no human intervention. We have a couple of other ones as well; one of them is doing a lot of white goods and panels for dishwashers. The whole thing with the plastics is done completely automated, and for them, it's all about reduced headcount and people and improving the quality. That's what they want to automate, and they need the software to do that type of automation.

We've seen a couple of customers now with assembly lines in Italy with no human intervention.

Matties: You mentioned CFX and how you have tools. How do all these packages play together?

Manor: CFX is definitely an enabler to do data acquisition. It's going to reduce the cost of integrating into the factory floor space. It depends on what type of data you want. If you just want to do reporting and dashboards and give the factory the ability to know what's the production going like, how are we doing from a production perspective? CFX can do that data today. It still lacks the capabilities to do more advanced data output and just-in-time material management or Kanban-style material management—all of the analytics that we've been talking about. Here, you need a wider set of data, but it's not sure that all of this is in CFX.

As time evolves, I imagine that this will expand. In the meantime, we will have to kind of take some data from CFX and proprietary interfaces. We have our OML, which we have been using as our own data format, and we have a couple of OEMs who have taken OML and have made their suppliers who supply custom machines do an OML format. Many customers want exact trace; they want to do stuff like automatic program change, where if there is a new product, they automatically send the new program to all the machines. They want to do stuff like bad board marks. If there is a panel with a couple of defective boards, they want to automatically tell the machines "don't place components here." These types of more complicated communication are what some of the customers are requesting to get this level of automation and digitalization; this is what we need to focus on. How do we get the data and the API to do something like this?

Matties: With the digital factory, having a lot size of one is probably the best approach. You're loading up your machines for multiple boards with the components, but what's your thought on a lot size of one or reducing lot size in terms of increasing yield, performance and throughput?

Manor: It's happening, and it's one of the key challenges we see today in the market. If I look at the challenge, a lot size of one is definitely one of the key challenges today. And we have many customers who say that the average batch size a couple of years ago was 5,000, and today, the average batch size is around 100.

We visited the world's largest manufacturer of air conditioning a couple years ago; they said the average batch size is 80, and they do something very common as an A/C. You would think that the average batch size is hundreds of thousands or millions, but it's 80 because it's so customized for every region, tier, market, and geography. Here, there are two challenges. The first one is new product introduction (NPI). How do you get the pro group program fast enough? That's something that we have the tools for, both our DFM tool and process engineering tool. We have a couple of customers who also said that they used to do one or two NPIs a day; today, they're doing 20. We had one dedicated NPI line, and now all lines do NPIs, so that's a challenge.

Many of them have been adding process engineers over the last few years, and what I hear from them is we can't keep doing that. We had three NPI engineers, and now we have 10, or do you want me to have 30? Where am I going to put them? I don't have any space. We need to completely rethink how we do this. They want this to be fully automated, and the program is automatically generated by a click of a button. Our connection to the Siemens PLM solution team center is very applicable. Most of the data to fuel this is coming from the PLM system, such as the BOM or CAD file. These are all managed by all of the OEMs in the PLM. We can take it and augment that with our tools on the PLM backbone.

Matties: The front end is the most important in this. If you don't get that right, nothing else matters.

Manor: Yes.

Matties: We're calling it programs, but it's really the digital recipe that is going to communicate with each individual machine. What's the advantage of a lot size of one? What role would a fabricator need to understand to recognize that's a goal?

Manor: It used to be that you kick the line, and you spend an hour maybe validating that the line is great, and then you manufacture for five hours. But if you have 2–10 boards, you do the one-hour setup and manufacture for 10 minutes. You cannot make any profit that way. You have to take down this one hour that allows you to do really small chunks and work with more customers. The issue is that the end customers want customizable products. They want to go online, select a laptop, and configure the CPU, memory, and interfaces; then, you want the manufacturer to build it the next day and have it cost less than your previous laptop, which was made in chunks of millions.

We are the ones putting this pressure on the manufacturers; now, they have to adapt because otherwise, they cannot give us what we want. Car manufacturers are doing that, and that's where the market is going. A lot size of one allows them to do that. If you are doing a lot size of one, the savings from doing it in low-cost manufacturing countries diminishes. That provides an opportunity for our customers in the West, whether it's the Americas or Europe, to compete with China and Southeast Asia. If you're doing a lot size of one, labor is not the issue; it's the shipping and how fast you can get to the customer. We imagine we will see more and more of our customers manufacturing again where the market is.

Matties: The digital factory is moving forward, and it's going to happen. It's going to be a hockey stick curve as well. Where do you see the paradigm shift or the tipping point?

Manor: We've seen a lot of customers who are thinking that this is for somebody else; it's for the EMS companies, both big and small. Everybody says, "It's a great idea, but it's not for me. The other company should buy it first." They're all saying, "We want it now. We understand the concept of digital twin, including the product, process, and performance." When you start talking about digitalization, we think we have a compelling story with our full digitalization solution, and we can do it. And we have our own factories, so we can test this story in the 50 Siemens factories around the world.

Matties: It's a living, working tool for you rather than just a product that you're selling.

Manor: Exactly. Our internal customers from the other Siemens divisions are the toughest because they don't take no for an answer, and they have the political connections; you can't fool them. But we also gained very strong internal partners from this, which we didn't have as Mentor Graphics. We can say, "This is what we do today. If our NPI time for programming your product is an hour today, we want to get it down to 20 minutes. Let's do a project on how do we do that." Most of what we have to do is create a better digital twin of the product and process and send that into the line. That's another advantage.

Matties: Some people understand what digital twin is, but others don't. Can you give a brief explanation of what it means?

Manor: It's a good question because I think we were doing this at Mentor for many years, but we never called it a digital twin. The idea is that you have a full representation of the physical product and process and the physical equipment in a digital format. This allows you to do a 100% simulation and validation and to do it right the first time. The whole idea is don't debug it in practice, test it on the lines, nor do all of this QA in practice; simulate it fully so that when you go to manufacture it, you know that the product is correct. You know that your process is bulletproof, and you know you can manufacture it to a quality level that you've set and defined.

That's the key thing about this. Anybody can do a lot of trial and error, but when you go to a lot size of one, if you're making 10 boards, and you need five of them to get this working, it's not reasonable; when you did 100,000, it was reasonable, but not anymore. That's why I think getting it right the first time is important, and the way to do this is with this digital twin concept.

Matties: And there's a lot of profit to be made in this digital manufacturing because people complain that the profits are shrinking, but I think what's changing is the way that we're manufacturing. The profits have to be found in the new thinking, not in doing it the old way.

Manor: Exactly.

Matties: This was very informational. Thank you so much for your time, Oren.

Manor: It's my pleasure. Thank you very much.

Oren Manor is the author of *The Printed Circuit Assembler's Guide to... Advanced Manufacturing in the Digital Age.* Visit I-007eBooks.com to download this and other free, educational titles. SMT007

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The Convergence of 5G and Automotive

Feature Interview by Barry Matties
I-CONNECT007

Karthik Vijay is head of the applications engineering team for customers in Europe at Indium Corporation. He spoke with Barry Matties about what EMS or assemblers for automotive should consider, as well as how he thinks 5G will affect the marketplace and manufacturing.

Barry Matties: How do you see the automotive market and 5G?

Karthik Vijay: These are two massive markets, and we are really excited to play in these verticals with innovative material sets. To put that in the automotive perspective, opportunities with powertrain electrification platforms (e.g., 48V, hybrid electric vehicles, electric vehicles) and advanced driver assist systems (ADAS) are exploding. The foundations of this work will facilitate the innovations for the full-electric driverless car of the future. That's what is making it really exciting because I see this as a once in a 20–30-year opportunity. Automotive typically doesn't adapt to new material sets that quickly, and rightfully so because there's a lot of reliability testing and lifetime criticality that needs to be validated. That's still happening, but the goalposts are changing pretty fast.

With 5G, we are involved in various stages of the ecosystem right from the material sets inside the components to the base-stations used. To give you an example of the convergence of 5G and automotive, V2X is a core platform that will be facilitated by 5G. That means that the vehicle is connected to everything: vehicle-to-vehicle, vehicle-to-tower, vehicle-to-people, etc. As mentioned, both the automotive and 5G markets are open to innovation, and it is a great time to be involved with new material sets.

Matties: What opportunities are you seeing?

Vijay: If you look at electrification, a direct consequence of moving up the electrification chain is increased service temperatures. Standard alloys like tin/silver/copper [SAC] are not going to make the cut, and there is an immediate opportunity for high-reliability solders in PCB assembly. The reliability criteria have changed from -40/+150°C for 1,000 cycles to 6,000 cycles. Likewise, the ecosystem has changed with the explosion of power modules used in electrification in 48V, HEV, and EV platforms.

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Again, this has opened the door for advanced materials to maintain bondline control and increase cycling reliability with the lowest cost of ownership. In fact, I was in a conference recently where it was stated that for the next 10 years, automotive electrification and ADAS platforms are going to constantly evolve and automotive manufacturers are completely okay with one-off solutions for specific challenges, which will then eventually converge to standardized solutions. The industry is open to adapt and implement specialized solutions for specific challenges.

Matties: As an EMS provider or an assembly provider to automotive, where do you think the critical factor is that they really need to understand?

Vijay: I think expanding their know-how and understanding of what automotive customers want specific to electrification and ADAS is going to be critical for them to be a true partner in assembling complex boards, so that's step one. Step two is better integration with material suppliers to ensure that the right material is designed in from the get-go given that the reliability landscape on these complex platforms is rapidly changing.

Matties: Is there a difference between doing business in Europe and in Asia where we see a large automotive boom?

Vijay: From a volume perspective, there will be differences, but if you look at all the design work, a lot of it's still being done in Europe because it's the powerhouse for high-reliability and high-power, and it will remain that way for the time being. Specifying and validating still happens in Europe, but Asia is catching up pretty fast.

Matties: It's about reliability with autonomous vehicles, but there's a step in between autonomous vehicles and where we are today. There's a lot of talk about ADAS, RF, and 5G. What do you think 5G means to the marketplace from an assembler's point of view?

Vijay: That's a good question. I would not take the very simple definition that 5G means faster download speeds. It's not that big a deal, but it's about integration into various aspects. I'm not necessarily going to go into the consumer aspects on IoT with washing machines talking to phones; that's nice and fun. But the impact of 5G is in the communication aspects. For example, if you look at a football field, traditional RF towers can service say 10,000 people, but in a full football stadium where there could be 50,000 spectators, you cannot have the same old technology. 5G is going to facilitate that seamless communication for those dense pockets with radical redesigns, saving on space and money, as well as reducing the latency. That is really cool. Likewise, when you're traveling in a car, and you want to make sure accidents don't happen, every car will talk to each other; 5G will facilitate that. The same will happen with the tower, so that's a big deal and true material science. That's how 5G will improve safety and reliability.

Matties: From an assembler's point of view, we're still placing components on the board, and it's not necessarily a challenge for them.

Vijay: Not necessarily because with 5G, the type of component sets are changing. A direct impact would be higher-power, higher-heat outputs. To put that in a material and solder perspective, whatever material is used to solder, you had better be sure that your voiding is even lower, the thermal conductivity is a lot higher, and then the entire stack up becomes a lot more important. For the assembler to be aware of this makes them incredibly more powerful when dealing with high-power 5G infrastructure leaders.

Matties: I appreciate your time today. Thank you very much.

Vijay: Thank you. SMT007

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Old Dogs, New Tricks

Quest for Reliability

by Eric Camden, FORESITE INC.

I hear two phrases way too often on a production floor: "We have always done it this way," and its first cousin, "We have been building this board for 20 years and never had a problem." Inevitably, these phrases are always uttered by a "seasoned" engineer in the industry that probably should know better. Don't get me wrong, these phrases are going a long way in my effort to send two kids to college, but they aren't very helpful regarding reliability. Times change, and technology changes even faster, and if you don't keep up, you will be left behind. This means focusing on emerging technologies and the associated risk that may be unique to that package. As an industry, we experienced this with QFNs several years ago, and to be very honest, we are still dealing with that exact package and the failures associated with it to this day.

What we learned from processing many bottom-terminated components (BTCs) is that standoff height is a key parameter when it comes to reliability. When building products with a water-soluble flux, the impedance is the ability of the wash and rinse solution to fully flush underneath the component body and remove the flux residues. If a no-clean flux is used, the issue is the ability for the active parts of the flux to outgas as they are designed to do during a thermal excursion, leaving behind near-benign levels of ionics. With such a low standoff height, the gasses accumulate between the outer edge of the component body and ground pad, which leaves a thick residue that will readily absorb any atmospheric moisture and easily set up electrical leakage paths, or even electrochemical migration creating a dead short.

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After failures related to QFNs started to pile up, a light was shone on that component and all the difficulties related to processing it. Component manufacturers continue to learn from their users, so they started offering options for crosshatch and windowpane ground pads, which help increase the standoff height from the surface of the PCB. That simple bit of engineering helped increase reliability and reduce field returns, which isn't to say that everyone has learned that lesson and aren't still battling the problem. There are hundreds of research papers and presentations available for free on the internet, I have been the author of quite a few, but I still regularly see customers come to us with the same old QFN/BTC problems. In the spirit of being a continuous learner, feel free to use the Google machine between fits of cursing at your once rock-solid process. Lots of good, free information is available for those who search for it.

I have only been in the industry for just shy of 20 years, so I wasn't around when surface mount started replacing through-hole technology on a large scale, but I assume that it was quite the shift in electronics manufacturing. The shift I have been exposed to is the one we are still in the midst of, which is miniaturization. We all want a 48" 4K television that fits in our pockets or purses, and we are getting closer every day. But throughout this endeavor, the hurdles have become substantial roadblocks to reliability.

One of the main sources of failure I see around here is electrical leakage, or electrochemical migration. Doing things the way you have always done them simply does not work when you start reducing spacing and standoff height. In the old days, spacing was almost never an issue on primarily PTH assemblies because it would take a quart of contamination to bridge the gap that would set up the electrical leakage path. Remember, it takes some sort of conductive residue, bias differential, and moisture to complete the dendrite fire triangle.

If you have a good 5 mm or more of open space between leads, the risk of electrical leakage was much lower than what it is today when parts routinely have 0.5-mm spacing between conductors a single small drop of active flux or process residue can create a dead short. This means education on how to optimize the assembly process to ensure that a wash process is fully removing all of the residues, or in the case of no-clean flux, all of the bad actors are properly outgassing and not lurking in the dark corners of your parts waiting to attack. When PCB real estate resembled a small town in Nebraska, there were standard assembly profiles that would work across many different part numbers, but now that PCBAs look like a topographical map of New York City, the days of one size fits all are gone (Figures 1 and 2).

Being aware of things like large thermal mass components or parts tied to heavier ground planes that wick thermal energy away from the component and the effect on solder joint quality and reliability is of paramount importance. If the parts are to be washed after assembly, being aware of large body com-

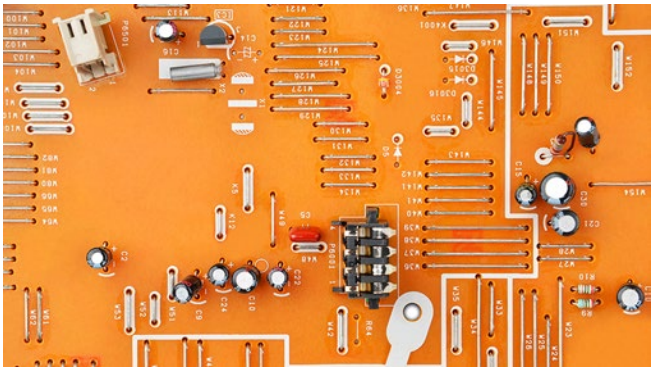

Figure 1: "Small town," Nebraska.

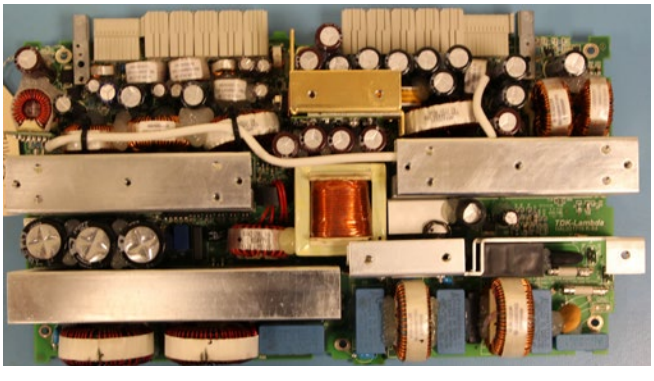

Figure 2: New York City, New York.

ponents and how they deflect the wash and rinse spray and cause shadow opportunities is equally important.

So, what can an old dog do to keep up with the times? The good news is there are a lot of options out there for continuous education. As I previously mentioned, the internet is a good starting place when you are up against a condition you haven't seen before. It's likely that you aren't the first to ever experience whatever you're having trouble with, so lean on the experience of others whenever possible. You can usually find something out there that will only cost you some time.

Another great learning opportunity is to become involved in one of the major industry bodies like IPC, SMTA, IMAPS, and iNEMI, among many others. These groups are usually comprised of experienced industry experts from every corner of the field. Most all offer national and local shows that have learning opportunities from those same experts, as well as show floors that have all the latest and greatest equipment and materials for emerging technology. Yes, they also support your legacy assembly processes, but you probably don't need a booth for that. Further, these groups often offer webinars that you can join for free without leaving the comfort of your office. I like to be on as many of these as possible, even if it's a topic I think I have a pretty good handle on because you never know if a bit of new information on an old topic will pop up.

Technology is going to keep marching forward, with or without you. To keep up, you'll need to get off that proverbial comfy porch you know so well and keep learning new tricks, no matter how you have always done it. **SMT007**

Eric Camden is a lead investigator at Foresite Inc. To read past columns or contact Camden, click here.

SEMI on the SMT-ELS Protocol

Nolan Johnson and Tom Salmon, SEMI SEMI's Tom Salmon, VP of collaborative technology platforms, discuss the SMT-ELS protocol, which is being developed collaboratively as a replacement for SMEMA. Tom overviews the technology involved and industry acceptance.

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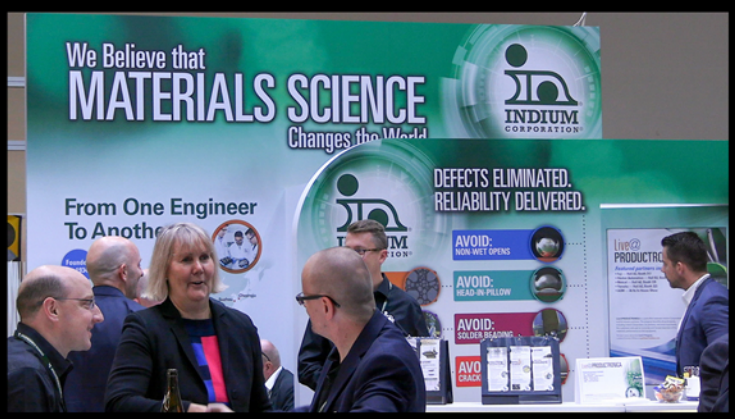


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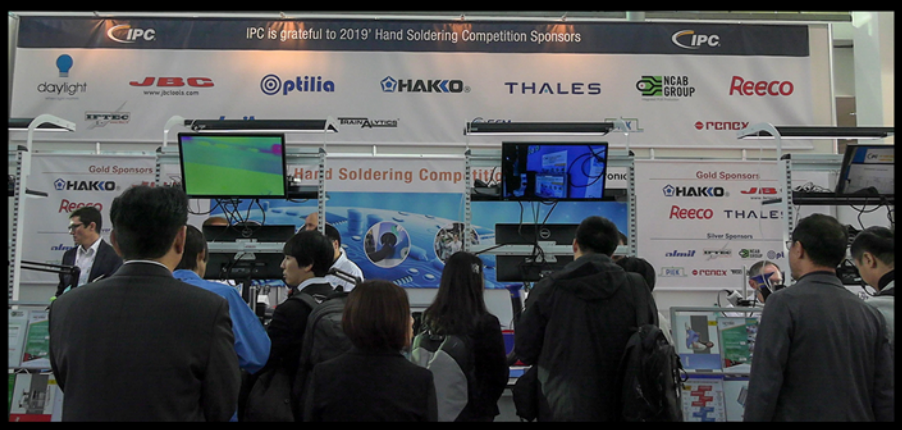
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Altium's Roadmap: Beyond PCB Design

Feature Interview by Nolan Johnson
I-CONNECT007


Ben Jordan

Nolan Johnson and Ben Jordan discuss the convergence of design data, manufacturing, and the cloud as an interchange infrastructure. While design environment centric, this conversation provides insight for manufacturers as Altium aims to create a platform for all the stakeholders, not just design.

Nolan Johnson: Ben, how long have you been with Altium, and what do you do in your current role?

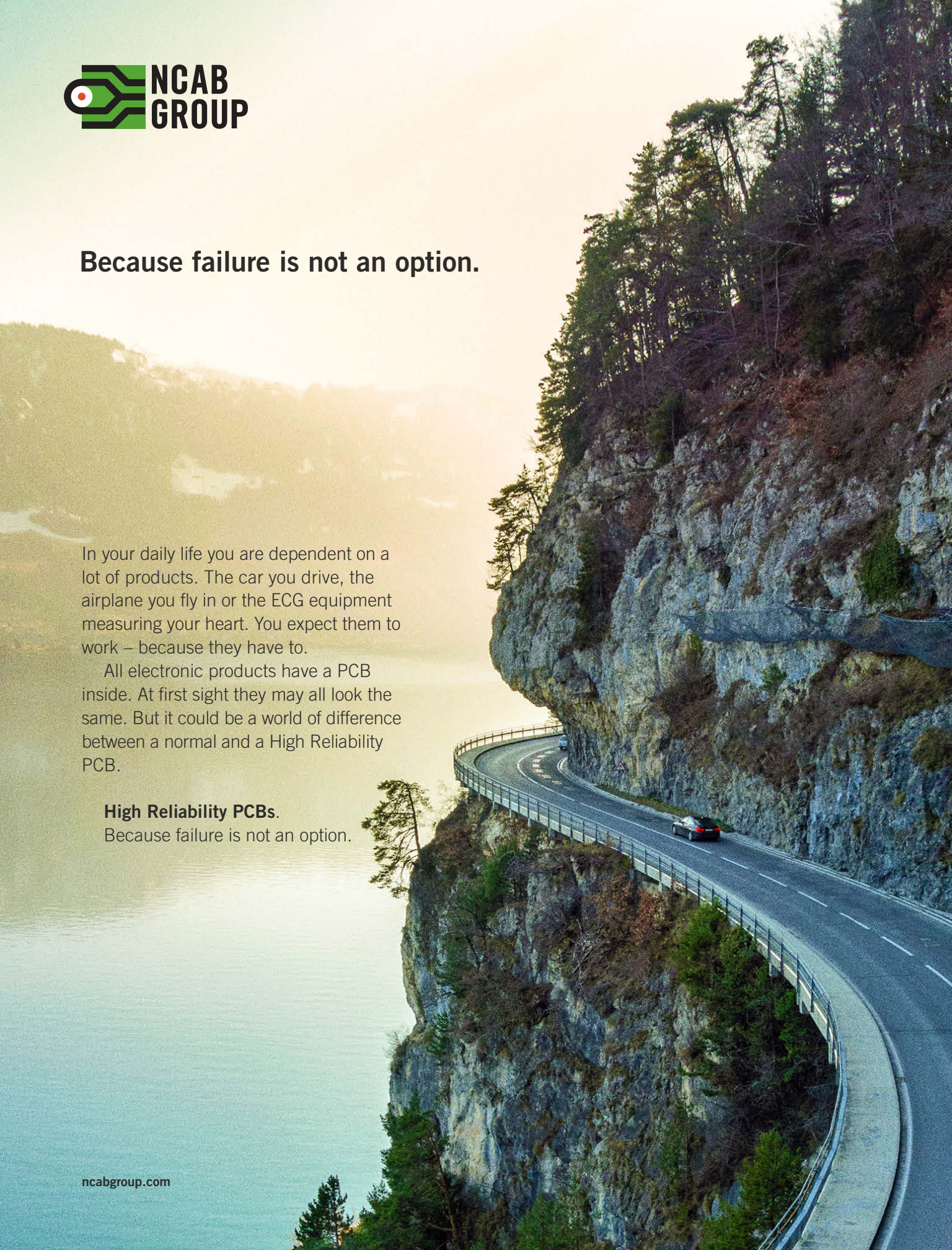
Ben Jordan: It's funny that you ask because I've been at Altium 15 years exactly today.

Johnson: Congratulations!

Jordan: Thank you. I started as an applications engineer. I have an engineering degree as a background, but I've been interested in electronics and PCBs since I was eight-years-old. Joe Grand was one of the keynote speakers at AltiumLive, and he wanted to see a show of hands of people who had etched their own boards using ferric chloride; he shared a similar story, and I've done those things too. I made my own boards when I was a teenager using ferric chloride, burning holes in my parents' concrete, and disposing of it in non-thoughtful ways because I didn't know any better.

I am deeply technical at heart. And PCB design is an interesting job because, on one extreme, it requires absolute focus and flow. I understand how designers get into the process of designing a circuit, and routing a board puts you in a state of flow. If it's something that you're going to do in life, it puts you in a state of absolute concentration.

Now, I work in Altium's corporate marketing team with Lawrence Romine, who is quite popular and famous around here. However, I don't have a real title, which I don't think is important. I've been at Altium for so long as a technical person who helps with messaging, creating videos, and putting together productions. My role, the way I see it, is to communicate the value of what we do and how users can get more from the software to become better designers. I look forward to announcing what's coming up, including the future of what we're doing, the problems we want to solve for designers and the design industry, and how it goes beyond PCB designers.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Johnson: Altium has been talking about a pivot toward the user experience. AltiumLive attendees just saw a demo of Altium 365, Concord Pro, and a number of tools demonstrating that the vision is real and growing. Can you give us a recap?

Jordan: One year ago, we announced the platform called Altium 365, and the primary purpose of it is collaboration. This year, we also demoed Concord Pro with Altium 365 and what's coming in Altium Designer 20, and we put a lot of effort and R&D into improving the bread and butter of design. The end-user that's in that state of flow I mentioned earlier needs better tools for getting more done in less time. There's this constant pressure on us all, and we have to shrink board sizes. We're working with smaller components, so there's always effort going toward making the CAD better. But we also recognize that a lot of the inefficiencies and frustrations in our industry come from all the things connected to the CAD, but not the CAD itself.

We're working with smaller components, so there's always effort going toward making the CAD better.

Johnson: Outside the silo, as it were.

Jordan: Exactly. And it's about the communication between design engineers, PCB designers, and the supply chain. That's an issue, and we have been trying to improve that over time. We're continuing to ensure that parts are available so that you know you have reliable, trustworthy data on the parts; when you design them in, you can have a greater degree of confidence that they will be there when you go to production.

The other side is communicating with your customers. If you're a design house, who is your customer? Your customer may be another department, such as your product marketing team, saying, "We've done our research. We know that we need to add these features, and we need to do a new version of our products with this specific feature." Make sure that they have the tools to close that loop with design so that when you build what they've asked for, or you're in the process of designing what they've asked you to do, they can see that earlier and make changes, adjustments, and improvements on that journey. You don't want to waste time building it three or four different times until you understand, finally, what they wanted.

Finally, there's the communication with not just assembly but also PCB fabrication. In fabrication, 80% or more of the designs in the world are still going to fabrication by file transfer via email or uploading Gerbers to an FTP server. We wouldn't do it if it didn't work, but there are still problems associated with that, which we live with and don't recognize them necessarily as real issues because it's the way things have always been done.

There's this famous story of a mom who's baking for Thanksgiving, and she's cutting some portion off the turkey and putting it in the oven. One day, an outsider comes in and asks, "Why did you cut the legs off the turkey before roasting?" She says, "I don't know. My mom always did that, so I do it. Let's ask her. Mom, why did you always cut the legs off the turkey?" Her mom replies, "Because my pan was too small, and I couldn't fit them."

We do things in design with Gerber files and drill files, and we do it the way we do it because it's what we know. Amit Bahl from Sierra Circuits spoke at our evening event, and he said something that made me laugh because it's so true; he said, "Let's do a show of hands. Who copies and pastes their manufacturing table from one design to the next because you don't want to recreate it from scratch every time?" A bunch of people raised their hands, but there's danger in doing that.

With 365, we're trying to create a platform for all stakeholders, not just those in design. Design is at the hub of the wheel, but there

are other people around the edge, such as the customer, marketing, service and support for the product, test and prototype, assembly, and fabrication. All of these people need to see the data in the way that they need to see it, but you want to take it from one central source of truth that's unadulterated and doesn't change on its way through passing from hand to hand. Instead, with a platform like Altium 365, we can have one system where the data is trustworthy and in one place.

Johnson: The vision you're painting screams like an air raid siren for a collaborative online platform.

Jordan: Collaboration goes way beyond multiple people designing one board to get it done in less time, and we demoed that this morning. I did the schematic, Antonio Becerra Estaban [Altium field applications engineer from Spain] did the PCB layout, and Narek Darbinyan [field applications engineer from France] did the MCAD, mechanical enclosure, and board shape for us; we were able to bounce it around those domains with different people, so there's that side of collaboration. Having one system enables that kind of smooth collaboration without breaking the data models.

Johnson: Lawrence has been making one key statement throughout this conference: "We're going to do this using the cloud. If you have worries about that, okay, but if it's not the cloud, then what?" I'm interested in getting your thoughts on having the cloud behind something like this. It makes sense that this would be the right kind of tool, and yet a lot of people have ongoing trepidations. How do you answer that?

Jordan: That's important. In our industry, there's still a large concern. The concern is not about whether the cloud is reliable or connected or not because we know it is. We've used it for other things for a long time, such as online banking, web and mobile apps and browsers, etc. In most countries, we have good internet connectivity, so that's not the problem. It comes down to who do we trust with our intellectual property? Designs are an important piece of intellectual property. But then we see people doing things like emailing Gerber and drill files and IPC-D-356 netlists, and that's almost enough information to reverse-engineer the product. It's not secure to email these things.

Others know this and have systems for secure file sharing, but they still do it. I know of government contractors who use a secure file-sharing service and computing in the cloud; they have a layer of encryption over it, and we can do the same thing. Fairly recently, Amazon released a version of EC2 called "Government Cloud," which allows people to have that additional layer of security and backup. I don't know all of the details about it, but I know it addresses these issues. Thus, it's only a matter of time before people have to be honest and realize the cloud is not the issue here; it enables us to share this information in a secure way. As Lawrence said, you're already banking on it. Sometimes, we value IP over money, and I can see how we would do that, but the truth is if it's good enough for your bank, it's probably good enough for your business.

Johnson: You're making the point that this is much more established than some may realize. This sort of technical infrastructure has become a reality for us.

Jordan: And in the electronics industry, we're not the first ones to do it. Altium may be the first in PCB design to create a platform like this, but our friends in the MCAD world have already been doing this for a long time. Dassault has its 3DEXPERIENCE platform, and I'm sure Siemens have something similar, but I'm less familiar with them. With the 3DEXPERIENCE platform, for example, I know they've been doing this for some time, where there are different players. There are design engineers, marketing professionals, product managers, product life-cycle people, and production people who don't design the product but need to access the product data in a way that helps them design the factory to make the product. All of those people need access to the same information but in a different view or portal with various permissions and layers of security.

Collaboratively building things like this has been around for quite some time in the mechanical world; it started with the automotive companies. Everyone has heard of Toyota and its famous just-in-time system, and mechanical software vendors have built those systems for mechanical design and production from the automotive industry. We all know how cutthroat that is with IP. We also know how it's the only way they can produce cars on a five-year cycle and make them meet all the safety and reliability requirements; it wouldn't be possible otherwise.

Johnson: Cloud infrastructure is with us now, and it's here to stay. Back to Lawrence's question, it seems good enough for a number of other places. Having watched the demo and seeing what you showcased, the user-experience improvements inside the silo—making Altium Designer 20, for example, an improved, easy-to-use and interactive experience, especially in routing—are impressive.

Now, through Altium 365 and Concord Pro, there's an opportunity to start to create a place to have constructive, concurrent dialogues with suppliers upstream and customers downstream, driving from the designer's seat essentially. What I saw in the collaborative environment implies a lot of opportunities to open up into other PCB fabricator processes: analyzing, quoting, working from that data, etc. What are Altium's thoughts on that?

Jordan: That's a good question, and that's why we have someone like Leigh Gawne on board, who is our chief software architect. He is an engineer, and he was a customer. A lot of this has come from his knowledge of the process and the frustrations with it as somebody in the trenches. At the same time, those of us who follow what Altium has been doing over the last few years would know we acquired not just Octopart and Ciiva to look at the supply chain side of things and component availability, but we also acquired a small startup, quick-turn, prototyping assembly company called PCB:NG based in Brooklyn, New York. We've employed a number of other people who are specialists in production because that's the next phase of this.

The natural extension of this is we want the 365 platform and Concord Pro to have additional features. You mentioned plugging in other things, and that's exactly the point; we're figuring out how to close that side of it so that someone who has to build the device can collaborate more directly with the designer and feed back information like, "If you move this part a little bit, we'll be able to lower your cost by 20 cents a unit." There are all sorts of different use cases we're dreaming of, but we don't want to be the company that makes the products. We're the software company, but we acquired PCB:NG so that we would have a factory to learn where all the problems are and what can we do. IPC is taking great strides to make the factory smart, and that's wonderful once the data's in the factory, but we must solve that problem of the gap between CAD and the factory.

Johnson: That is outside the scope of CFX, Hermes, and other smart-factory protocols. Their job is to make sure that the machines end up delivering to the specifications that are in the design data.

Jordan: Yes. That's an interesting and exciting space with a lot of opportunities for improve-


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ment in the overall efficiency. We want to make every part of the process as efficient and nice for everybody who touches it as possible. We want designers to love designing. And in production, we want designers and production engineers to have a good time in that hand-off and to have a great relationship with each other. We believe the software and platform can go a long way to doing that. We think that we can automate more and solve more problems there as we discover what they are. Every time an engineer or a PCB designer generates outputs and sends them to fabrication, there are question marks, which generate anxiety. We believe we can hammer those question marks into exclamation points.

Johnson: We talked briefly about what's inside the CAD silo for the designer. That is the space designers say they want to stay in, but they have to do all of this other necessary stuff. Part of your mission is to make the overall user experience for your customers when they're outside the silo as easy, effective, error-free, and efficient as possible so that they can spend more time in the silo.

Jordan: Right. Swim in your lane, and you can go as fast as you want to go. That's a good way of putting it. Allow people to do what they love, love what they do, keep doing it, get faster over time, and do what they do best. Design the products for the manufacturers to build them, and make sure that they have all the data they need and not one byte more or less.

Johnson: Pivots are risky. Are you staying true to your core, or does this change Altium's core?

Jordan: We will never lose our focus as a company either on our primary users, which are electrical engineers and PCB design specialists. As we showed today, we're committed to making the design side of it better and better, as well as solving these other problems with CAD. All of this comes down to this one thing that Lawrence mentioned, too; we want to focus on user experience. That would be the one thing we want to make sure we're saying here at AltiumLive.

Johnson: You have redefined what user experience means in our industry. We usually talk about, "That's the fit and finish, and the look and feel, of the application structure." That's not it for you anymore; you've broadened it.

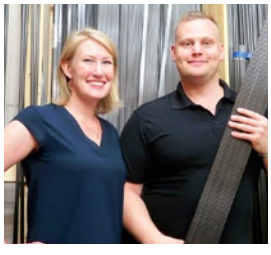
Jordan: It's much bigger; it's going from an idea to a factory-producible and economically producible product that people want to buy and use.

Johnson: Excellent. Thanks, Ben.

Jordan: Thank you, Nolan. **SMT007**

Breaking the Stereotype: Millennials in Manufacturing

I-Connect007's Barry Matties recently visited Goodwinds Composites, a company that he's watched grow from a small distributor serving the hobby industry to a full-fledged manufacturer serving many industries. Leland Holeman started this business as his first career job right out of college. Amelia Cook, his sister, joined a short time after, and the two of them have worked together since to transform this company into a healthy business. During the conversation, they shared their story along with some of the lessons they have learned.



Amelia sums up the learning process with, "We've gone through different stages of business growth. In the first five years, we worked our tails off to keep our customers happy and deliver the best that we could. Over the next five years, we created manufacturing cells and innovated. The next five years are going to be about finding new markets for the products that we make, increasing our throughput, and innovating into some other carbon or fiberglass opportunities." Click here to read the entire interview.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Choosing the Right Defect

SMT Solver

Feature Column by Ray Prasad, RAY PRASAD CONSULTANCY GROUP

I am intrigued by the theme of this month's issue—"What You Need to Know"—because it is such a broad subject. There are lots of things we need to know. So, like most of you, I could hardly wait to read this issue of *SMT007 Magazine* myself. While others focus on addressing various aspects of this expansive topic, I will address some key issues that I think are important for us all to be aware of and learn about. And before I proceed, I am going to make some assumptions about my readers to narrow the focus of this column. The subjects are not technical but managerial, and the target audience is managers in the SMT assembly industry and engineers who aspire to be future managers.

Why is it important? Most companies attempt to achieve higher yield in SMT products through trial and error at considerable expense and frustration. Even though we have been manufacturing SMT products in high volume for almost three decades now, less than 10% of companies have first-pass yield (FPY) of more than 90%. In other words, 90% of companies are conducting too much rework. Rework adds to the cost of the product and reduces the reliability of solder joints due to an increase in intermetallic thickness each time the solder joint is reflowed. So, what are the reasons for this high defect rate?

- The processes are at very high speeds, and machines must perform them
- The equipment must be characterized thoroughly; this can be defined as understanding all parameters that affect the equipment's performance, and vendors may say it is easy, but it is not
- Most large companies have assigned engineers to optimize, and most small companies learn as they go, but learning as you go is not an option because revenue or product schedules (or both) may be impacted adversely

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With the advent of fine- and ultra-fine-pitch, high-pin-count BGAs—0402, 0201, and 01005 resistors and capacitors—as well as the widespread use of no-clean flux, yield problems are getting worse, especially when you use large BGAs and BTCs in addition to a smattering of through-hole components on the same board in a lead-free process.

It is also worth noting that no matter what our job titles are in various departments—such as purchasing, design, manufacturing, quality, inspection, test, or repair—the key focus of what we do is to make sure no defective products are shipped. That means the purchasing manager is responsible for not just focusing on cost but also on the quality of incoming material, such as components, PCBs, and other materials. And DFM managers are responsible for the overall defects.

The key focus of what we do is to make sure no defective products are shipped.

1. Choose the Right Defect

Let me be clear; we all want zero defects in our final product, but good luck with that. We certainly can ship products with zero defects, but how can you do that if you don't achieve zero defects in manufacturing? The obvious answer most people will have is to inspect and test followed by repair of defective units, but no; you cannot prevent the escape of defects through inspection and test completely, no matter how sophisticated or comprehensive those inspection and test regimes are unless you choose the right kind of defect.

Choose the right kind of defect? Yes. Even though there are hundreds of types of defects classified in industry standards, such as IPC 610 and J-STD-001, there are only two types of defects that test methods, including functional test and in-circuit test (ICT), are intended to flag. They are shorts (bridge) and opens. Fortunately, we have a great deal of control over which one we get. By the way, they are both bad, and the assembly will not function if we have either one, but one of them is better than the other: shorts.

Which one do you think is the predominant defect in every company? Nearly all companies, including yours, have way more opens than shorts. All you have to do is look into the defect data over the past six months to a year and put the defects in three categories: opens, shorts, and others. Whatever defect does not fit into either the "opens" or "shorts" categories should be put into an "others" category.

The defects in the "opens" category will be higher than the other two categories because they're the type of defect that can pass even ICT since partial opens can appear as good joints when vacuum pressure is applied during ICT; opens often end up being discovered by the customer or in the field. And this is why it is not as desirable a defect as a short.

If you change your design and assembly process to focus more on solder paste deposit and better stencil design, most of your defect 1560s will revert back to shorts from opens and be caught before shipping. Your customers will never know your problems, and there's an easy solution to a difficult problem, but it's rarely practiced. You can, however, learn to change that. You are not achieving zero defects, but you are choosing your defect wisely.

2. Develop an In-house, Company-specific DFM and Process Recipe

No one gets up in the morning and says, "I am going to screw up three things today at work." We all follow the process and procedure, but the problem is that very few companies have written processes and procedures, such as in-house DFM and assembly processes. Even those who spent considerable resources to produce these documents don't keep them updated, as technologies change, and these documents become obsolete within a year. Thus, it is not only important to develop your own unique DFM and manufacturing process documents, but you must also maintain

them as controlled documents and keep them constantly updated, at least quarterly. So, what should the content of these documents include?

Design for Manufacturability

DFM is a key driver, if not the most important part, of manufacturing yield. However, few PCB designers understand manufacturing processes. A DFM document must be company-specific. Using an industry standard, such as IPC-7531 (formerly known as IPC-SM-782 when I initially chaired it for almost a decade starting in the mid-1980s), is a good place to start. But you need to customize it to your application. Some major items that should be included in a DFM for SMT products are:

- Established design rules and guidelines that emphasize the importance of differences between them
- Component selection criteria, including consolidation of parts lists to reduce redundancy and eliminate obsolete parts
- Paneling considerations
- Fiducial requirements
- Land-pattern design
- Solder-mask consideration
- Via-hole location
- Design for test
- Anything unique to your design

With the widespread use of high-pin-count BGAs that cannot be visually inspected, sufficient test coverage for ICT should be seriously considered. Keep in mind that no inspection method is perfect. The only way to prevent defects from escaping to the field is to rely on overlapping test and inspection methods and ensure that the majority of your defects are shorts and not opens. Once a DFM document developed by a well-trained team is finalized and released, the possibility of DFM violation generally does not arise.

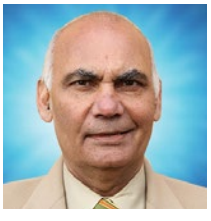
Creating a DFM document is not easy, but it will correct problems at the source and prevent their recurrence. This is critical in an environment where essentially all manufacturing is being outsourced or sent offshore.

Manufacturing Processes

How should one identify key manufacturing process issues? First, characterize each process, including printing, placement, soldering, inspection, test, and repair. You need to document the details of equipment- and non-equipment-dependent variables that control yield. For example, each board has a different thermal mass, so it is a good business practice to develop a unique profile for each product regardless of the type of oven used.

Most companies are ISO-certified these days and think they have a documented process, but they don't. Look at your ISO document. Most likely, there are no details about designs and process. Instead, it is a generic boilerplate document that never goes out of date and ensures that you will easily pass audit and re-audit. But they are useless since they don't have the critical design and process details that a recipe requires. However, it is not the fault of ISO; ISO does not prevent you from including the details, but few companies do so for the aforementioned reasons.

In addition to having the right design, quality incoming materials, good manufacturing capabilities, and trained personnel are critical to achieving high yields. Failing to realize you need a good recipe, the right ingredients, and a good chef to improve yield makes the problem seem like the weather—out of our control. **SMT007**



Ray Prasad is the president of Ray Prasad Consultancy Group and author of the textbook *Surface Mount Technology: Principles and Practice*. Prasad is also an inductee to the IPC Hall of Fame–the highest honor in the electronics industry–and has decades of experience in all areas of SMT, including his leadership roles implementing SMT at Boeing and Intel; helping OEM and EMS clients across the globe set up strong, internal, self-sustaining SMT infrastructure; and teaching on-site, in-depth SMT classes. He can be reached at smtsolver@rayprasasd.com and has an upcoming SMT class April 20-22, 2020. More details at www.rayprasad.com. To read past columns or contact Prasad, click here.

Thursday, February 6, 8:30 am–3:00 pm. **Activities include hands-on, project-based learning, including soldering, PCB assembly and design.**

Help **engage the emerging workforce** at the IPC Education Foundation's **STEM Outreach Event** at **IPC APEX EXPO**. **Sponsorship** and **volunteer opportunities** are still available.

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Supplier Highlights

MacDermid Alpha Named Finalist in Magna Powertrain Supplier Innovation Day 2019 ▶

MacDermid Alpha Electronics Solutions, a world leader in the production of electronics soldering and bonding materials, was chosen as one of eight finalists of the Supplier Innovation Challenge hosted by Magna Powertrain, a leading global automotive supplier, on November 21 in St. Valentin, Austria.

Mycronic Demonstrated Expanded Portfolio at productronica ▶

For the first time since multiple acquisitions in recent years, Mycronic AB demonstrated its full portfolio of electronics assembly solutions at productronica 2019 in Munich, Germany.

CyberOptics Demonstrated MRS-enabled SQ3000 Multi-function System With Advanced Software ▶

CyberOptics Corporation, a leading global developer and manufacturer of high-precision 3D sensing technology solutions, showcased its SQ3000 Multi-Function for AOI, SPI, and CMM at productronica 2019 in Munich, Germany.

Indium Inks Partnership With Mycronic ▶

The partnership with Mycronic will expand Indium Corporation's portfolio of proven products designed to address evolving industry challenges. The collaboration will also ensure that new products are fully vetted and tested before users begin evaluations, testing, and, ultimately, high-volume production.

Precision Graphics Installs Juki ISM Storage Towers ▶

Juki Automation Systems (JAS) Inc. announced that Precision Graphics Inc. (PGI) has purchased and installed two ISM towers and an incoming material station.

MIRTEC Announces Technical Collaboration with Universal Instruments' Advanced Process Lab ▶

MIRTEC has installed one of its award-winning MV-6 OMNI 3D AOI systems at Universal Instruments' Advanced Process Lab (APL) in Conklin, New York. Universal's APL offers comprehensive research, analytical, and advanced assembly services that enable manufacturers to realize rapid product introduction, maximize yield, and optimize reliability.

YES (Yarbrough Electronics Sales) Adds New AOI Equipment ▶

Darrel Yarbrough, founder and president of YES (Yarbrough Electronics Sales), announced that his company added new AOI capabilities with the Nordson Yestech Model FX.

The Mannifest: Faster, Cheaper, Simpler ▶

Looking at the SMT industry right now, Chris Ellis sees some very interesting things going on with shifts in production locations, ease of manufacturing, and intellectual property (IP) protection. OEMs are bringing production back to the U.S. in greater numbers—some even back to Mexico. A significant driver of this over the past year has been the tariffs. For the majority of OEMs he speaks with, it's becoming clear how manufacturing in China is affecting their bottom line.

Juan Arango on Koh Young's New U.S. Headquarters ▶

At a recent open house, Managing Director Juan Arango talks about his role in the company's transition from their Arizona facility to a new headquarters located outside of Atlanta, Georgia. Juan details many of the benefits customers can expect, including brand new spaces dedicated to customer demos as well as training.

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Tom Forsythe

Clean vs. No-clean: A Generational Difference

Feature Interview by Barry Matties
I-CONNECT007

Tom Forsythe, executive VP of KYZEN, discusses what readers should know about cleaning as reliability expectations continue to increase. He also explains what is driving the new interest in cleaning and why engineers from the no-clean generation may not even realize they need to learn more about cleaning.

Barry Matties: Tom, why don't you start by telling us about your new generation of stencil and misprinted board cleaner.

Tom Forsythe: Absolutely. KYZEN E5631 has been under development for some time. The whole challenge for us, of course, is that contaminants, fluxes, and pastes are constantly evolving. Many leading solder makers around the world are trying to improve their performance because our mutual customers are demanding improved performance from them. It trickles down to the cleaning folks to make sure we can remove those residues, whether it's uncured adhesives, uncured paste in a true stencil printing application, or anything down that road. That's the key, and it's an area that we've done a lot of research on over the last 5–10 years. It had been stagnant for a long time, but once you crack the egg and start working around, your development leads you in lots of different directions; that's how 5631 came to be.

Matties: Is this driven by the finer features that are appearing?

Forsythe: The finer features drive back to the stencils. The companies making the stencils have issues because they have to make apertures that are smaller and closer together and more well-defined. As those apertures get smaller, then it becomes a bit more difficult to get things out of those smaller apertures and have flow go through them. It all cascades. But it fundamentally comes down to the materials. The bigger driver on the stencil side is the new materials. Remember, when you reflow paste, lots of volatiles come off. It goes through a state change and creates that hard encapsulant.

When you're dealing with raw paste, all those goodies are still floating around. It's designed

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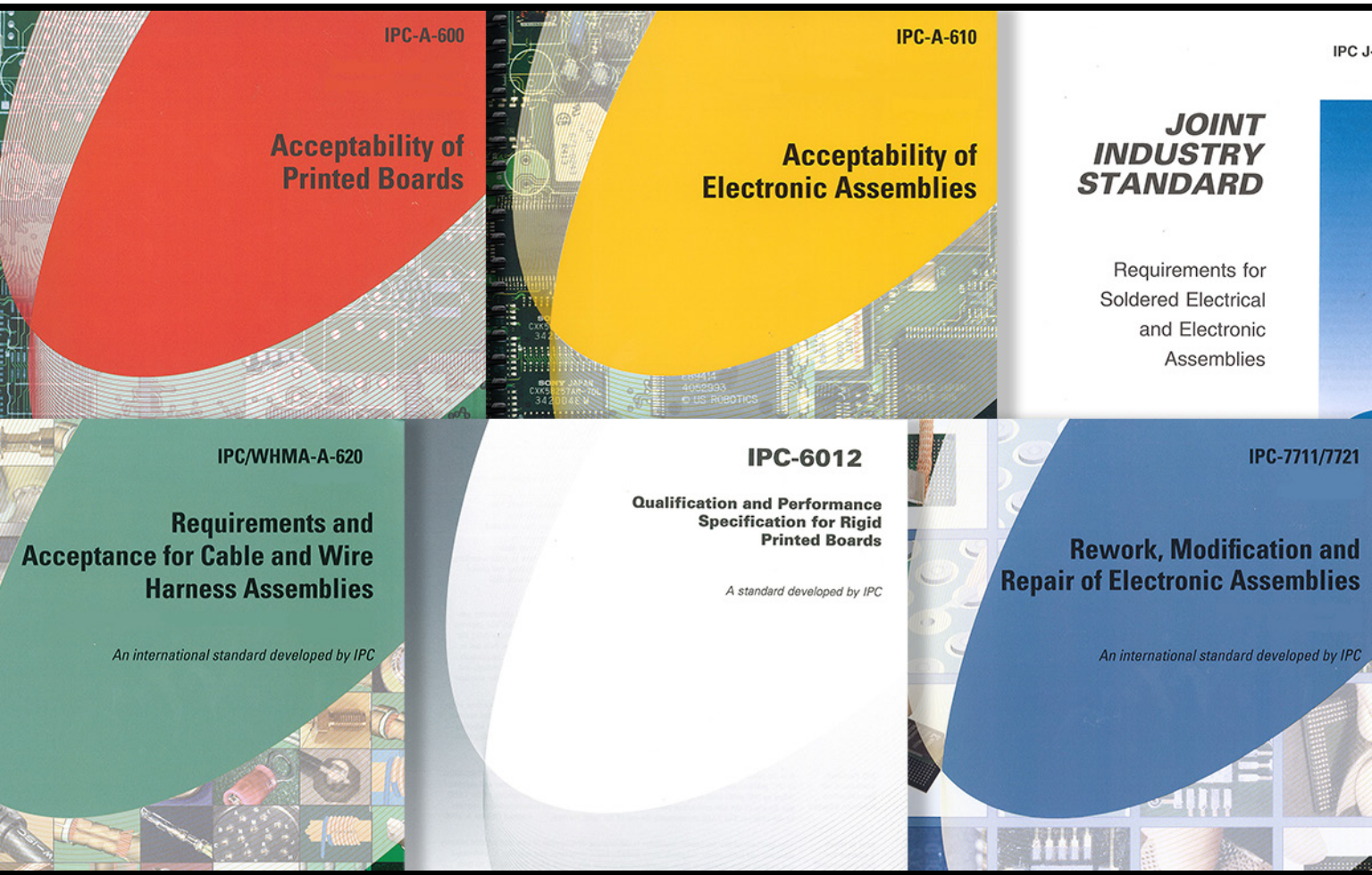

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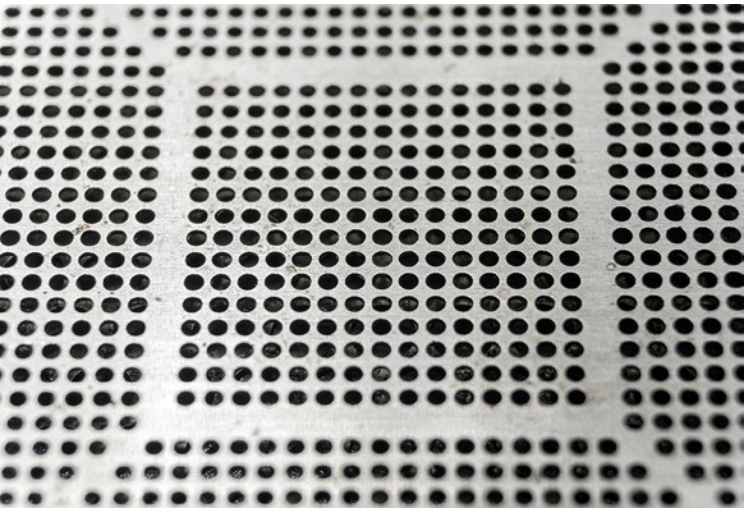
to have good tack time and to be malleable, so they can print it, which makes raw paste a little trickier to clean. Now, it's not as hard to clean as reflowed materials. But the equipment that's used to do it isn't what is often used to do reflowed materials, so that's the whole challenge there. Again, it's one of those areas where everyone has to keep their stencils clean and wants their stencils to last a long time. You don't want materials that are going to have an adverse impact on stencil life or performance.

You don't want those aluminum frames to turn dark or be attacked. Certainly, you don't want the mesh or the adhesive that holds the mesh onto the frame to be attacked. It's perceived quite negatively, not unexpectedly (laughs). Because of that, there are generally temperature limitations. Remember that those stencil frames are expensive, and they like to reuse the frames. You want a thermally sensitive adhesive putting it all together so you can get them off when you want to get them off, but that means you don't have temperature available to clean; otherwise, the stencil falls out, and everyone gets angry. This is an undesirable outcome.

Matties: Is the cleaning method in-line or batch?

Forsythe: Generally, batch and mostly spray systems. Stencils tend to be spray systems. There are some ultrasonic ones around, but they're usually spray systems. Stencils are bigger than just about any assembly, so they're always used in a fairly big, open area. When you're cleaning stencils, you're cleaning raw paste, which means you're cleaning a bunch of solder balls connected with other stuff. It has been recommended for many years that you not clean assemblies or misprints in the same tool. Everyone tries to have good filtration and whatnot, but solder balls are small and pernicious, and you really don't want them on your assembly tomorrow.



Matties: Are you recommending a secondary line for that process?

Forsythe: A second cleaning device. These tend to be offline devices. They're batched and offline. That's been the best practice for a long time.

Matties: And the investment to have that second really is minimal, I would think.

Forsythe: It's more than lunch, but it's less than a house.

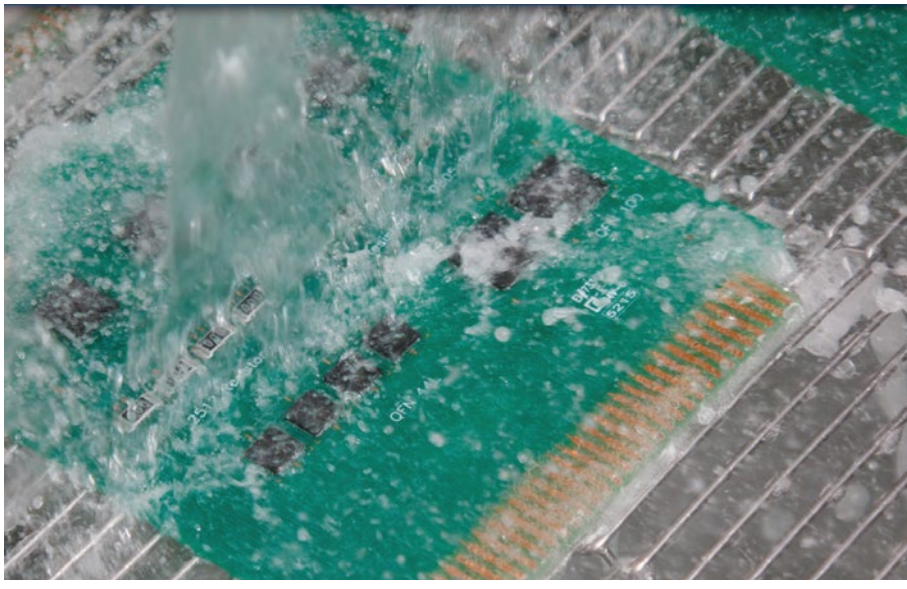
Matties: But it's less than defects.

Forsythe: Yes, these kinds of things pay for themselves a million times over, so those are the best practices, and that's why it is the common practice in the industry.

Matties: You're driving this new product out. Were there problems that people were facing, or is this something that you're showing people who had problems?

Forsythe: There have been challenges all along. We started doing some renewed research on screen cleaning and stencil cleaning because we realized that it had been forever. We were dealing with all the constant evolution of no-cleans, and we finally reached the point where that's largely under control, but maybe we hadn't paid attention to stencil and maintenance cleaning in a while. A lot of the popular products were 15–20 years old, and the world had changed a lot in that time.

So, we thought, "Why don't we take a swing at this?" There have been a number of innovations that have pushed forward. Stencil cleaning is one of those areas that people don't complain about much because they just wish it didn't exist. But once you start doing the research, you say, "Wait a minute. Do you see this?" Well, yes, we see that. It's not so much educating them about what's gone wrong; it's letting them know about a solution for a problem that they know they have that they weren't willing to put big engineering time in to solve.



Matties: What about the environmental side? You're talking about dealing with solders and things. What impact do you see there?

Forsythe: The challenge on stencil cleaning of course is, once again, you're freeing up those solder balls, and those are made out of metal. The metals are not stuff that's supposed to go to drain, etc. If you can filter them thoroughly, you're okay. Typically, stencil cleaning solutions, because of the contaminants from the paste, are not things that generally go to drain. Sometimes, they can, but it depends on the local rules. It's also quite common for stencil cleaners to be the stuff that gets drummed off because then you have all the metal in there. All these materials are at least slightly alkaline. Lead is gone, but any dissolved metals are never a good thing.

Matties: But your solution is biodegradable and non-hazardous.

Forsythe: Exactly. We start out green, top to bottom. The challenge is when the contaminant is not green. That's the case in a handful of areas, certainly back in the tin-lead days with batch cleaners where you'd use the bath a lot; you'd need a lot of lead to get picked up.

Matties: Let's talk a little bit about cleaning in general. What trends are you seeing?

Forsythe: If you're a cleaning company, the trends are all positive. As we talked about earlier, miniaturization and increased density are changing the perception of cleaning because the same contaminant that was okay yesterday is now in a tighter piece of real estate and is less okay today, or perhaps not okay. Customers are dealing with those decisions, and that's simply growing the share of people that see cleaning as a value-added process. That's a very gradual thing. There's no flare going up or a swarm of people rushing for the field after a win on the pitch. It's a very steady, gradual increase.

Matties: It seems like there's still an education about cleaning that is taking place.

Forsythe: Absolutely, and it's even more so these days because let's face it, no-clean has been around for 20 years. Twenty years is the rough description of a generation when you talk about family and ancestors, so we've had a whole generation of people where what they used was called no-clean and believed it.

Matties: That's the qualifier right there. Initially, it was 20 years ago.

Forsythe: It still is. The vast majority of the world uses no-clean, and the vast majority of them don't clean.

Matties: Do they use it successfully?

Forsythe: They do. It is a good match, but it's changing gradually. Even in the early days, when you were working with medical devices or military or commercial avionics, those people never stopped cleaning. They always understood that their risk-reward profile was clear—all risk, so they never stopped cleaning. The broader consumer product producers mostly don't clean, or maybe they do in spots.

But they are also starting to evolve. Look at our phones. Just 20 years ago, we discussed whether they were good phones if you could hear people when you talked. Now, no one ever talks about phone calls. I have kids in college, and my impression is they don't speak to anyone (other than me) on the phone; they prefer other communication techniques.

The phone's utility has evolved a great deal, and with that, our perception of how important it is to us. The reason those avionics were always cleaned was because there was a big risk of peril if something bad happened. More and more, phones are no longer conveniences. In fact, Apple has a new app with an EKG kind of thing. If you're a patient, and you're checking your heart rate for your doctor to review, that's not an optional kind of thing; now your life depends on whether your phone's working

Matties: You're calling it a phone still, but at that point, it could be considered a medical device.

Forsythe: Agreed, which has a different expectation of reliability. The industry is sorting through that dilemma right now. Again, I don't believe there's going to be a vote taken or anything like that. But people are making those decisions, and those decisions are that cleaning is adding value again for a broader cross-section of the market. That's just the phone. Think about all the other things around our homes now that didn't exist a few years ago. The consumer's perceptions of the urgent value that those devices and capabilities bring is changing. And expectations and demands are changing. Whenever reliability expectations increase, cleaning has a role to play.

Matties: We see that in automotive too. Obviously, there's a risk and reward there that is catastrophic.

Forsythe: This is more of a seismic change, though. Frankly, automotive was the leading adopter of no-clean back in the day. They were the ones that made it work and saw the value. Because if your car stops, it's not like it falls out of the sky or anything; it's just not moving anymore, which is an inconvenience. Mostly, that's not a life-threatening event. Electric cars up the ante a bit, and there are higher voltages, so cleaning is having a bigger play. When you make the jump to autonomous vehicles, how is that different from an airplane? It's not. These are trends. Autonomous vehicles are not here. They are on the roadmap, pardon the pun, but they're not really here.

Matties: I think autonomous vehicles are here. We just haven't turned the switch on because society isn't ready to accept them.

Forsythe: Lots of things need to be figured out. There's the liability part.

Matties: The lawyers are going to go crazy over this. It's a whole new market here. We all saw the video of the person going down the highway at 65 miles an hour in their electric car while sleeping.

Forsythe: It comes back to this; once genuinely widely accepted autonomous

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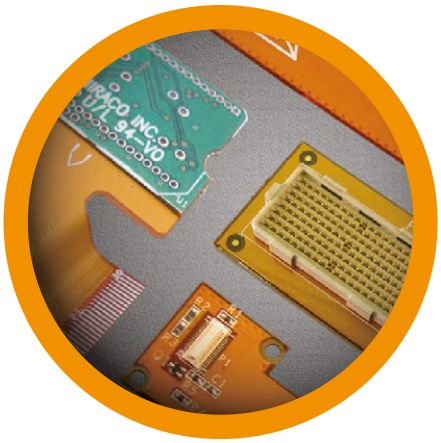

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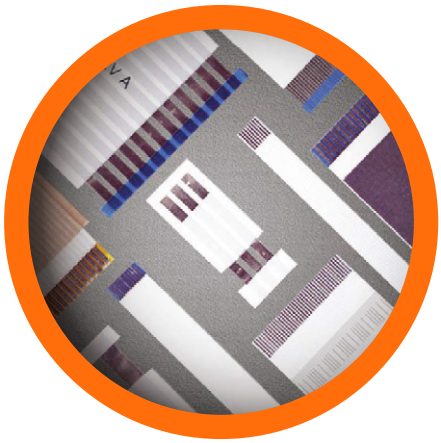

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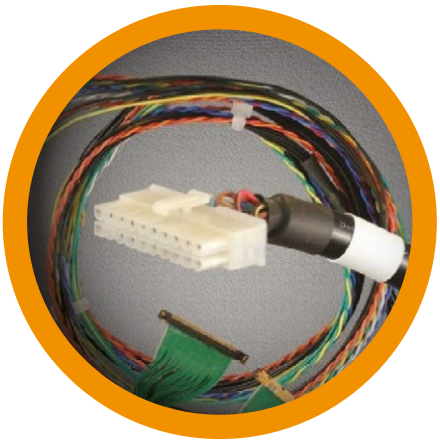

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travel is upon us, the world will have made a fundamental change. It strikes me that that's good for cleaning companies. It's a value chain option that's going to be a big deal.

Matties: My point is I think it's probably already there.

Forsythe: It's coming, and there are opportunities there. Right now, that's a small part of the industry. We expect it to grow, but those are big changes for the automotive industry because they're a generation in to not worry about cleaning. Therefore, the young engineers from 20 years ago are the senior people that know everything that they are teaching people, but they don't know anything about cleaning because cleaning was abandoned. They weren't taught about cleaning.

There is a gap because it has been so long, which is one of the reasons why KYZEN is very active in the education system. We're big on giving papers at SMTA events and IPC events as well as different technical forums all around the world. We're saying, "Here's the science that's going on. You may be seeing some of these challenges, and here are the solutions that add value and resolve those." It's like the movie "Yesterday," about the guy who wakes up and no one else has heard of the Beatles. If you woke up and didn't know what electronic cleaning was, how would you know that it could solve your problem?

Matties: That's a great point. I hadn't considered what you just said. We have a generation of people that did not grow up on cleaning.

Forsythe: It's incumbent on us and others in the industry to write the papers, give presentations, and educate people to help them fill those gaps. We've done that all along. It has always been a part of our program in a very aggressive way. Our chief technology officer, Dr. Mike Bixenman, is always speaking because he's always on the program someplace. You need to explain what's going on because it's not black magic; it's science, and science makes sense. You can have proprietary solutions and science. That's what we try to do.

Matties: What advice would you give a young engineer who's coming into a field where cleaning hasn't been a standard practice?

Forsythe: It depends where they are on the food chain. If they're making consumer electronics, they probably have time. But in automotive, it's time to learn. If they're in aerospace or medical, they're going to learn. And the people to learn from are nearby because those people never left. Cleaning is one of the tools. What do engineers bring to an operation? They bring tools to resolve challenges that present themselves because the assembly process has a million inputs and one output. When everybody's SPC curve leans a little high, usually, there's an issue because the whole concept isn't based on everything leaning the same way. That's why ships tip over. Cleaning is one of those tools that they can benefit from, just like a vast array of other things, such as understanding reflow, printing, and processes that they deal with every day. That's how you can resolve challenges when things go bump in the night.

Matties: And sometimes, when it relates to cleaning, the ill effect of a dirty board, if you

will, doesn't show up until perhaps months later.

Forsythe: That's correct. It turns into a lifecycle issue. Generally, that's where people find their inspiration. It's like, "Wow, we're starting to have these issues. We've been doing it a certain way for a long time. We had the data, and everything was great." But the electronics world is a world of constant, incremental change. Occasionally, there are big whooshes, but what happens eventually is you fall off the edge of the world, and something doesn't hang together. People are encountering those challenges. They're saying, "What do we do?" And hopefully, they've read one of the articles that we've written or a white paper at APEX or SMTAI and said, "Let me call them because it sounds like they know how to solve this problem because my boss really doesn't like this problem."

Matties: I would make the case, even if you're dealing with an engineer that is from the no-clean generation, that they may not even realize they need to talk to a cleaning person.

Forsythe: Agreed. That's one of the challenges. We try to get the word out, and that's where industry organizations are a tremendous resource for the engineers in our industry because people will share. We get a lot of suggestions by going to a chapter meeting and talking with people. If you're a younger engineer coming along, that's where you can learn from the gray-hairs. There's wisdom in doing it.

Matties: Tom, it's always great to chat with you.

Forsythe: It's great to see you. I'm glad you could come to productronica. SMT007

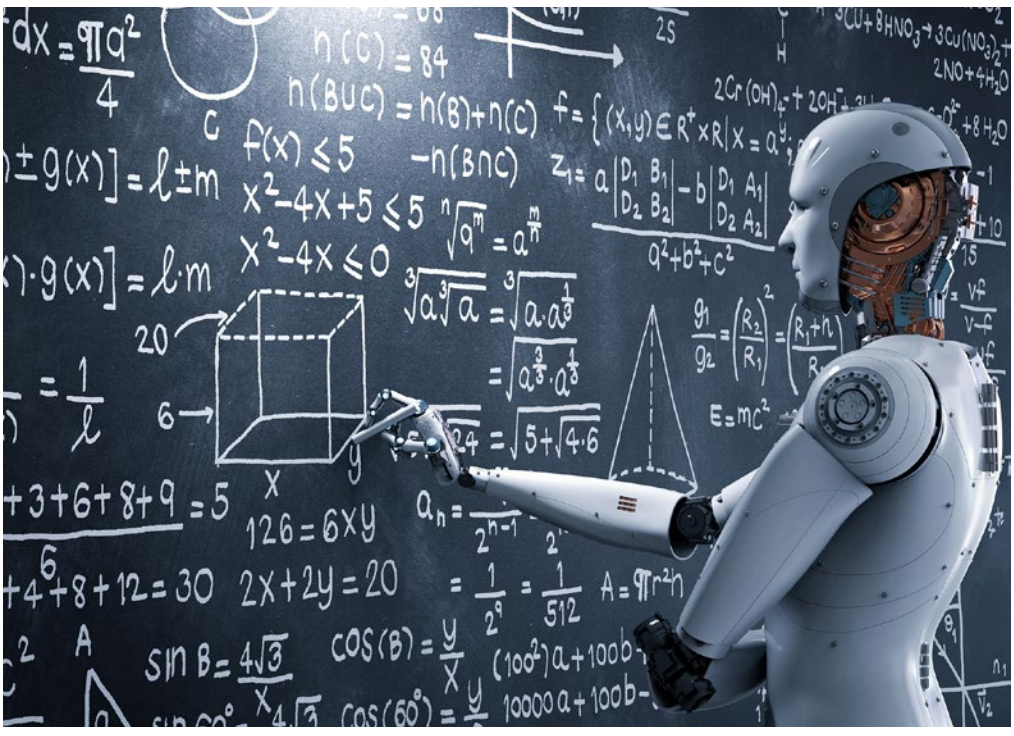
Cimetrix on Their CFF Platform

Nolan Johnson stopped by for a chat with Ranjan Chatterjee, VP and GM, smart factory business, for Cimetrix. They discuss the CIM Control Framework (CCF) platform, a software environment to deliver SMT automation with minimal setup and a rapid ROI. Click image to view video.

What You No Longer Need to Learn

Smart Factory Insights
Feature Column by Michael Ford, AEGIS SOFTWARE

The deep, technical skills and knowledge of today become the building blocks of tomorrow. Naturally evolving layers of technological applications allow us to build and make progress, layer by layer, rather than staying relatively stagnant with only incremental improvement. To gain ground in manufacturing, we need to embrace next-layer hardware and software technologies now, which have accumulated knowledge built in, so that we can focus on applying these solutions as part of a digital factory. A whole new set of skills and knowledge is required to learn and become an expert in evolving strategies and techniques to do this, attracting a whole new generation of manufacturing career opportunities.



Layers of Technologies

Not so long ago, relatively speaking, the people who were at the forefront of inventing the humble transistor were very excited. Numerous applications of transistorized applications appeared on the horizon that would revolutionize the electronics industry. Once the use of transistors had become established, however, the focus quickly changed towards the packaging of multiple transistors into standard encapsulated functional blocks, which became known as integrated circuits (ICs). These put hundreds, thousands, and then millions of transistors together in a little black plastic package. The need for knowledge of how to make a transistor faded into becoming a common understanding; the active focus in the industry was now on chip design.

Product designers today have over 95% of their designs done for them—embedded within the complex chip-sets that they utilize and apply as a commodity—without a lot of thought about the complexity of the internal design and content. We are still looking for better transistors, better semi-conductor design, and bet-

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ter chip integration, but this is done far away from the design and assembly of the actual end products. We are evolving layers upon layers of technology, each of which is a building block to the next. And one revolution fuels the path for the next.

Layers of Manufacturing Hardware

It is a similar situation in the assembly manufacturing industry. Attend any IPC committee meeting, for instance, and you will meet those who have pioneered every exhaustive aspect of how to make and assemble a PCB. These people have explored the technologies involved in etching laminates all the way through to avoiding the unwanted creation of the minutest of solder "whiskers," just to name a few examples. The technologies discovered and solutions created to make their way into commercial products, such that the user of the resultant machine, material, or solution can be insulated against the issues that were once prevalent.

Of course, we continue to strive to improve the core technologies even more, but the domain in which this happens has narrowed significantly, and more is in the hands of the developers of the related machines and materials used in the various processes. We don't all need to know these core technologies as much anymore in assembly manufacturing, so fewer resources are required for this kind of specialization. This is just as well because, as the refinement and complexity of such technology increases, so does the cost of specialized skills. The original owners of these skills are also leaving the industry now as they mature into other areas of specialization, such as golf. All of their blood, sweat, and tears are embedded in solutions they helped create. The focus of active assembly manufacturing can now move on towards applications at a layer above.

Layers of Software

Many people are now saying that the importance of software in assembly manufacturing is at least as important as the hardware, even with its half-century of built-in technology. The layering of software technologies applies just as much as it does to hardware. Many of us started out coding in "assembler"—the base language of microprocessors. Programming languages—such as "Basic," "Fortran," "Pascal," and "C"—soon provided a way to create assembly code automatically from a higher-level language.

Pre-written functions in these languages became available in the form of software libraries, such that developers could use them to build the core and foundation of their applications (most famously, of course, for Windows). More than 95% of actual executable code running in software applications today is pre-written and already part of a library or software development kit. Software architects can now quickly create complex applications without thinking about the layers of processor execution commands, the appearance of windows and controls, etc.

Layers of Manufacturing Technology

Hardware and software are the constituent components of the tools and machines that manufacturing uses. Significant changes in each of these areas promotes corresponding change opportunities in manufacturing practices. One simple example is related to the incoming inspection of materials as they enter the factory. Today, this is just one of the hundreds of added value functions that make up the modern, digital, IIoT-driven MES solution.

Incoming inspection policies are simply configured through the selection of simple, intuitive options that reflect the initial incoming testing requirement to satisfy conformance and compliance to business needs and customer requests. The software then qualifies and guides anyone with basic operational skills to perform complex and precise incoming material testing, ensuring the right material selection and testing instruction, sample size, and frequency. Should a material show increased variation in quality, for example, the rules within the software automatically adjust to provide more rigorous screening.

The entire operation is automated, based on accumulated know-how and experience gained over years of incoming inspection practices. Operators and managers performing such

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activities no longer need to learn to be experts in statistics, quality metrics, record-keeping, and reporting. The need for an expensive layer of engineering specialization is replaced with an embedded solution. This example repeats over and over throughout the entire scope of digital IIoT-based MES solutions.

What You Really Need to Learn

It is now a question of the focus of resources. Indirect labor fixed cost has always been a key factor in manufacturing success, which, ironically, has caused a reluctance, in most cases, to recruit and assign what initially is seen as additional people to work with and understand the application of sophisticated machines and software solutions. They can create much value and opportunity, and even the most progressive of companies do not realize the full potential.

Rather than getting into a position of knowledge and trusting in modern tools, the assignment of lower-layer engineering continues based on old practices. In almost any manufacturing facility, there are sure to be cases where machines, their software, and tools, such as MES, are capable of automating and replacing routine, and often specialist, daily workload tasks from being needlessly performed. If only time and resources were available to fully understand and appreciate what tools are out there, the focus of attention could be shifted towards the best practice use of application of those tools; this would eliminate a great deal of needless work and bring greatly increased capacity, productivity, and quality with reduced lead-time and waste.

Thus, the first thing to learn is that which no longer needs to be learned. Old practices should each be revisited, requalified, and justified in the context of what the latest process hardware and IIoT-based MES software provides. It is often a mistake to look for such solutions based on internally created lists of issues that people feel should be addressed. Many of the items in these lists will be fixes for practices that are, in all likelihood, no longer relevant. It is far more rewarding in terms of an evolutionary leap to identify sources of innovation in the market that lead and create the next layer application of technologies and provide the best insight into the smartest investments.

Let's start learning! **SMT007**

Michael Ford is the senior director of emerging industry strategy for Aegis Software. To read past columns or contact Ford, click here.

Oren Manor on the Siemens-Mentor Integration

Oren Manor, director of business development for Siemens, introduces us to the in-booth production equipment that integrates factory automation, motion controls, and MES solutions. He points out that the recent effort to automate SMT lines is now expanding into the areas of final assembly, box build, and manual assembly as well.

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Risk Mitigation: An Essential Guide

Feature by Kimberly Johnson and Tony Torres
APCT GLOBAL

Want the real truth about global risk? Not only is it more real than ever before, but it is rising because of a nearly infinite number of variables. The consequences can be more devastating—in one blow—than ever before. The traditional economic focus on quarterly reporting complicates maintaining a long-term vision and further complicates investment in risk identification, planning, and, thus, mitigation.

Risk mitigation in the global supply chain is nothing new to many industries. What is new, however, is the exponential rise in potential risks and the reality that those are risks that simply cannot be predicted. What are some factors for a winning strategy that might not immediately come to mind? Here are a few essential recommendations to the global PCB industry that might significantly lower the risk impact on a company's productivity, time to market, and financial success.

Ask Questions Early and Often

Unasked questions introduce many risks that could have been identified early and then accounted for in the mitigation plan. No longer is it the case that you wait until there is an issue or major problem to ask a question.

Some engineers who work for companies may feel isolated; that is, they have a problem, but they don't know how or where to start solving it. You should work with a supplier, for example, whom you can ask to confirm or clarify questions that may lead to new options for reducing costs and risks. You should have a partner to contact whom you do not hesitate to call, where your call is welcome and responded to in a timely fashion. In fact, an experienced PCB manufacturer should be proactive, offering to answer questions you haven't even asked.

The Elephant in the Room

If you were to survey hundreds of thousands of companies about what they would predict, or have experienced as, the biggest risk in their global supply chain, some answers might align. In general, however, every company has unique products, technical challenges, timeframes, and delivery and transportation requirements.

The elephant in the room is simply this: The biggest risk a company faces is the need for unique solutions to address its specific situations.

The right solutions happen when you care enough to ask the right questions.

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Companies today simply do not have the funding or the time to hire personnel who are experts in the technical, support, and logistical details of the global supply chain. For that, a partner and an expert with whom to collaborate is necessary. By not partnering with an expert team that can provide a 360-degree view of their specific landscape of needs, product teams could introduce a plethora of unknown risks and, almost certainly, neglect to include risk mitigation planning.

The Right Fit

Companies are looking to maximize their spending by using their current supply chain. Sometimes, they will force lower-end technology into a higher-end facility, so their price point will increase significantly. At other times, companies will go to a lower-technology facility to manufacture their higher-end technology; the result will be yield fallout. By working with a global team, the company can make sure they put the right technology in the right factory to achieve the best cost and technology solution.

These diverse manufacturer relationships ultimately provide customers with a win-win scenario. If you can focus on placing the proper technology into the right factory to maximize your yield and timeliness, then you will get the best solution at the lowest possible cost. From a risk perspective, both financial and timely delivery are addressed successfully.

Now More than Ever

The global supply chain should partner with the finance department of client companies to use the companies' resources most effectively. It's not just about cost-cutting anymore; it's about services and long-term planning. The risk mitigation inherent in choosing the right PCB supplier can significantly affect a company's financial risk.

The goal is to get time to market before your competition. Companies are looking to produce prototypes so that they can demonstrate their product's capabilities. Once the customers know what the product and the companies can do, then they can launch into production. As the world has changed and evolved—everyone is on their cellphone or computer most of the day—we all have access to the latest and greatest of anything that comes to mind and being developed and brought to market. Any company that is looking for a time-to-market solution should also be invested in risk identification and mitigation, as well as what financial risk they face if their supply chain is disrupted.

Another financial risk strategy is to work with a supplier who offers inventory management programs. Not only do many suppliers offer program management and inventory projection analysis, but—as a prime example—many PCB manufacturers are striving to transform a custom PCB into an off-the-shelf commodity, like any other component in a build. They also offer quick transit time to the customer's door in as little as one day.

The Real Deal

There are hundreds of PCB manufacturers to choose from; standalone factories around the world can produce any number of technologies and volumes. There are brokers, essentially acting like middlemen, who do not produce PCBs but who represent manufacturers. And there are hybrids, manufacturers who engineer and specialize in product areas, yet also work with factories around the world.

Which is the best choice to reduce risk throughout a product's lifecycle? Ideally, one that offers you the most comprehensive solution to your specific needs.

Does your company have enough funding or time to qualify manufacturing facilities in different regions of the world? If you visit a facility one time, do you have the time and budget to visit quarterly or annually? Is there available staff to extend the workday to other global time zones? Could your on-site staff globally oversee the production and proactively work with the facility in real-time? These are just a few areas of potential risk reduction. Some of those burdens and risk issues can be alleviated by working with a company that has manufacturing, engineering, and full-service staff.

Huge risk factors are inherent in segmented

engineering staff, both in terms of recipe transfer and real-time production engineering attention. Some companies have an engineering team work on the prototype or first run, and then transfer to another group specializing in volume production engineering. To reduce risk throughout the product lifecycle and real-time build activities, ideally, the same engineering team would never leave that product, would understand all the engineering details, and would know exactly how the transition to production should go, and then that same team would do all the tasks involved. Taking it one step further, after the first-run prototype is approved, the manufacturer should ensure a full recipe transfer for the customer company into their next production build in the life cycle. This would allow them to work on their next project and program.

Manufacturers that invest the time to get an upfront intake profile to better understand customer needs can then create a custom program that suits those needs. This will reduce additional time and concerns of customers, and provide a solution that offers both peace of mind and risk mitigation.

Speed-on HyperDrive

"We need five panels in 24 hours, and we'll need 1,000 pieces in two weeks. Then, we'll move 10,000 pieces in four weeks and do a 100,000-piece product ramp-up after that."

Can product concept to market at volume get any faster? Yes. It will. And along with increased speed comes greater risk. How a manufacturer can put into place such a fast-transitioning program—and what they do to ensure recipe transfer, complete Q&A, AQL sampling, and spot-on delivery time—are just a sample of the basics of a risk analysis. Smart companies insist on working with manufacturers who have a significant history of success in ramping in multiple stages, apparently simultaneously.

Competitive Risk

In other industries, specifically ecommerce, conversations in the PCB industry between buyers and suppliers have shifted to include fostering collaboration that will spur innovation. This particular supplier relationship brings tremendous value that fuels a company's growth. As technologies and DFM innovations are skyrocketing, a PCB may play an integral and valued part of a company's success.

Who Is Kept Up at Night Worrying About Risk Mitigation?

You would think that just one person is concerned about risk mitigation: the company CEO. In all practicality, though, within the last year or two, everyone in a company structure seems more than mindful of the risks and "situations" that have impacted their role within their company.

A completed PCB is the foundation of the product. If you don't have one, you don't have a product. You won't be able to populate it, put it into your final product, or, ultimately, ship it to your customer. PCB risk mitigation is very important to the CEO, your finance team, your engineers, program managers, your quality and procurement teams, and people in the supply chain. Ultimately, it is the person who's focused on getting the product out the door who must know how to take a deep dive into effective, risk-reducing supplier relationships.

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When You Only Hear Crickets

Then, you have a problem. PCB companies are very aggressive in marketing and reaching out directly. A quick way to rule out providers who may offer you a low price, but will ultimately expose you to significant risks that can contribute to real losses, is to follow this process. When you evaluate a new supplier, ask to schedule a site visit that will help you determine whether they are a fabricator or a broker.

Is their technology competency real, and is it a match for your company? Quiz them on a few typical risk scenarios and evaluate the quality and depth of their answers. What you want to avoid is a PCB supplier who just takes an order and a commission, but is not able to help when, inevitably, "things happen." Work with a company that meets your technical, support, and risk profile. Most companies will value having peace of mind knowing that their PCB manufacturer has their back.

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Just in Time

A significant risk, financially as well as to the brand reputation of a company, involves supplying the product when it is needed. As design and manufacturing cycles continue to concatenate, significant risks are introduced into the transportation strategy. There are several ways to mitigate these risks.

It is essential to work with a supplier who has experience in planning or rapidly responding to transportation disruptions. There are many transportation options, such as air and ocean, and smaller shipments at regular intervals, with larger shipments to follow as next-step manufacturing ramps up. Pre-existing, dependable relationships with multiple carriers reduce delivery risk situations. And it goes without saying that crisis mode may not be the wisest time to start developing a new relationship on your own. Here's one example:

"Near Thanksgiving, a company needed product brought in from Asia. They had planned to have a couple of thousand pieces delivered. Based on customs being closed for the Thanksgiving holiday, and when it was going to be shipped, it wasn't going to arrive at the customer until the week after the holiday. When the customer brought that concern to our attention, we confirmed that they needed five pieces to make the build for their end customer. Since this was a smaller production lot, we were able to get those completed and shipped out earlier, clearing customs before they closed for the holiday weekend. The company was able to complete their product, deliver it before the holiday break, enjoy their holiday, and avoided having to pull a team in and pay them holiday overtime."

It is ideal to work with an experienced supplier. If you suddenly find yourself in a bind, you want to choose to work with a team whose prime focus is real communication. Their goal and focus should be to provide you with a complete solution. Having clearly assessed the details of your situation, they will look for solutions to mitigate all risks.

Future Trends

Several new industries coming into the marketplace are new to the PCB industry, the global supply chain, and their risks. These industries—such as autonomous vehicles, 5G networking, as well as industrial applications, such as smart pools and lighting—will offer PCB manufacturers new growth opportunities and new technology solutions to develop with them. Yet, when investing in understanding the risks and mitigating them quickly and successfully, clients should look to a complete solution provider to underscore the extreme growth and technical response required. **SMT007**

Kimberly Johnson is the executive VP of global operations for APCT Global.

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Electronics Industry News and Market Highlights

How China Built a Single-photon Detector That Works in Space ▸

One of the emerging uses for single photons is to pack them with quantum information and send them to another location. This technique, known as quantum communication, exploits the laws of physics to make sure the information cannot be read by any eavesdropper.

Kirigami Inspires New Method for Wearable Sensors ▸

As wearable sensors become more prevalent, the need for a material resistant to damage from the stress and strains of the human body's natural movement becomes ever more crucial. To that end, researchers at the University of Illinois at Urbana-Champaign have developed a method of adopting kirigami architectures to help materials become more strain tolerant and more adaptable to movement.

Digital Platform Experimentation Project Uses Quantum-inspired Computing and Deep Learning Technology ▸

Fujitsu Limited, the Singapore Management University (SMU), and the Agency for Science, Technology, and Research (A*STAR)'s Institute of High-Performance Computing, announced the launch of the Digital Platform Experimentation Project.

Bosch Sends Sensor System to ISS ▸

With the help of Bosch's SoundSee technology, it is possible to analyze the information contained in emitted noises. In a research partnership, Bosch and Astrobotic are exploring ways to use the technology on the International Space Station to determine whether machines or their individual components need repair or replacement.

Meet Ari, the Smart Bike That Helps You Catch Green Lights ▸

With more bikes than ever taking to the city streets, researchers have designed an e-bike that could help riders cruise the "green wave" while also improving trust between humans and machines.

U.S. Chamber of Commerce Foundation Announces Finalists for Ninth Annual Hiring Our Heroes Awards ▸

The U.S. Chamber of Commerce Foundation announced the finalists for the ninth annual Hiring Our Heroes awards. The 24 finalists demonstrated leadership in addressing the challenges faced by veterans, transitioning service members, military spouses, and military caregivers in their search for meaningful employment.

How NASA Is Helping Humans Reach the Red Planet, Using GPUs ▸

A group of NASA scientists and engineers is working with colleagues from Old Dominion University and NVIDIA to simulate with unprecedented accuracy the physics needed to land the first manned Mars mission. To do so, they're using the fastest supercomputer in the world, the NVIDIA GPU-powered Summit system at Oak Ridge National Laboratory.

Solar Cars at $15 Billion: Just the Beginning ▸

Solar vehicle bodywork has just progressed from curiosity to key enabling technology. A new IDTechEx report, "Solar Cars, Buses, Trucks, Trains 2020-2030" explains why and forecasts the next ten years with solar cars at $15 billion just a beginning.

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Take Your CAPA to the Next Level With 8D

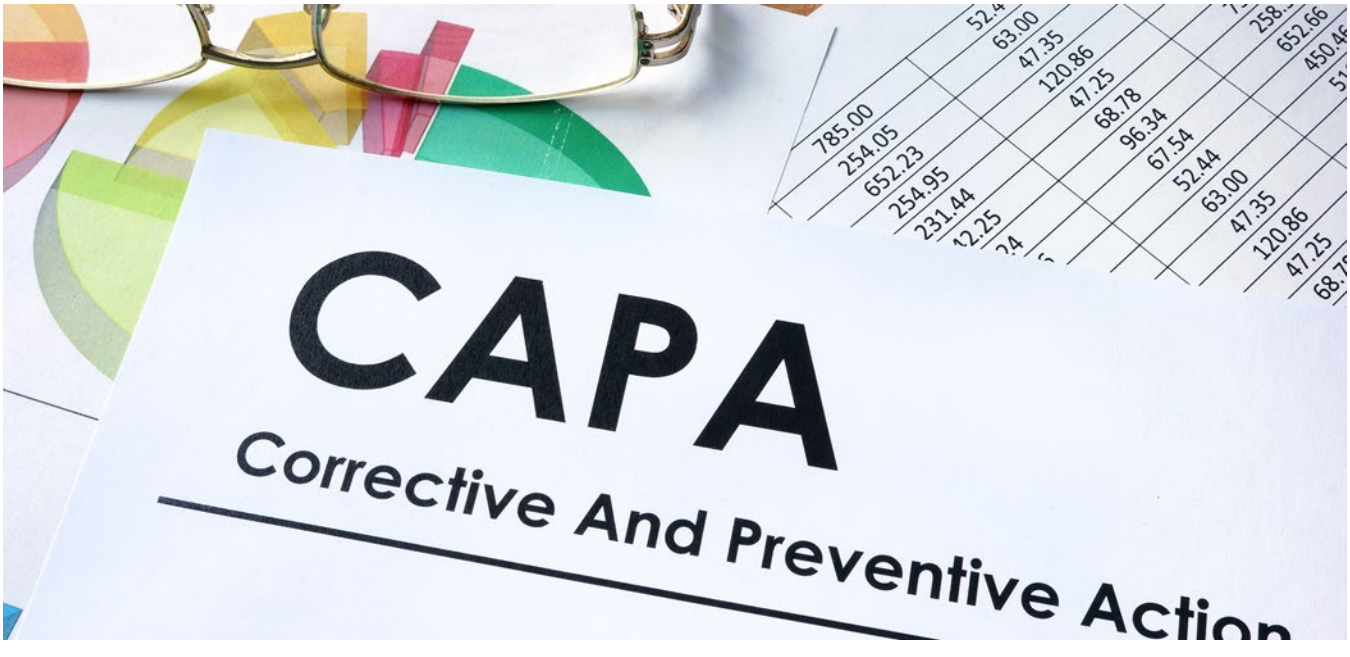
Operational Excellence

by Alfred Macha, AMT PARTNERS

Quality professionals understand that the strength of an organization's quality system can be determined by reviewing the corrective and preventive action (CAPA) system that has been established. ISO auditors and regulatory inspectors will assess an organization's CAPA to evaluate the effectiveness of the quality system. Customers often use the mechanism of a corrective action request (CAR), which is part of the CAPA system, as the mechanism to request for a supplier to address a recurring quality issue that affects on-time delivery, product quality, or service performance. Given the visibility and attention this brings to an organization, it is an opportunity to shine by making the CAPA system best-in-class. And how can you do that? By using 8D methodology.

Before I introduce the 8D approach, it is important to understand the requirement of CAPAs. Every quality systems standard—from ISO 9001, AS9100, ISO 13485, and TS 16949 to regulatory clauses established by the FDA or other government agencies—defines corrective action requirements in their standards. One of the best definitions is provided by the FDA [1] in its summary description of CAPA:

"The purpose of the corrective and preventive action subsystem is to collect information, analyze information, identify and investigate product and quality problems, and take appropriate and effective corrective and/or preventive action to prevent their recurrence. Verifying or validating corrective and preventive actions, communicating corrective and preventive action activities to responsible people, providing relevant information for management review, and documenting these activities are essential in dealing effectively with product and quality problems, preventing their recur-



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rence, and preventing or minimizing device failures. One of the most important quality system elements is the corrective and preventive action subsystem."

Having established the requirements, it's time to look at the 8D approach. This approach has been used by many organizations over the years and is widely recognized as best-in-class by top-tier OEMs in the aerospace, computing, automotive, and life science industries. The "8D" represents the eight disciplines in a CAPA system. The approach provided in this column is what I have used to train quality organizations in contract manufacturing. This is specific to product non-conformances.

D1: Establishing a Team

The 8D CAPA should not be drafted and implemented in a silo by a single individual. Preparing and implementing a CAPA is a team approach and effort. I recommend that you identify representatives from functional areas impacted by the corrective action request. Treat a CAPA as a small project that requires team collaboration and due diligence.

D2: Problem Statement

Be very specific in describing the problem. The best approach is to create a table that gathers the necessary information to help you define the problem in its entirety. Table 1 can help achieve this objective.

D3: Immediate Containment

Stop the bleeding of the non-conformity reported. For product quality-related corrective actions, consider using this table to ensure containment actions have successfully been addressed (Table 2).

Requirement	Data Gathered
Who: Customer or individual reporting the discrepancy	
What: Problem scope and characteristics (quantity and lot(s) affected)	
When: Date of occurrence	
Where: Location and/or process step where the problem was identified	
How: Test or inspection method used to identify the problem	
Verification: Are pictures, samples, or failure reports available?	

Table 1: D2 example.

Containment Considerations	Immediate Containment Actions	Date Action Was Taken	Verified By
Material (lot quarantine and verification)	Finished goods		
	In-process		
	Supplier		
Inspection plans	QA inspection		
	In-process inspection		
Traveler and production files	Electronic files update		
	Traveler correction		
	Remedial work instruction updates		
Training and communication	Quality notification		
	Training		
	Other		

Table 2: D3 example.

D4: Investigation and Root-cause Analysis

Before you initiate a root-cause analysis exercise, make sure to gather all the facts with a thorough investigation. A common flaw during the root-cause analysis stage is to make assumptions and jump to conclusions without evaluating all factors. You can use Table 3 as a reference to evaluate all potential factors that could be contributors (this table a derivative of the fishbone diagram).

Once you have established the highest risk factor(s) that contributed to the non-conformance, you can use a traditional "five whys" approach to help you drill down to the root cause (Table 4). There are other methods you can use to complete the root cause analysis, but the "five whys" approach is practical to implement.

D5: Developing Permanent Corrective Actions

Once the team has identified the root cause(s), then appropriate corrective action plans need to be drafted. Keep in mind that each corrective action plan needs to be verified for effectiveness. Corrective actions should not be ambiguous or general in context. Be specific on what specific procedure, process, system, equipment, or method will be adjusted or improved (Table 5).

D6: Implementing and Verifying Corrective Actions

This discipline is what differentiates good CAPAs from average systems. A corrective action system is only effective when the verification phase has successfully been completed. Successful implementation requires that the

Criteria	Factors Evaluated for Risk	Risk Level (High, Medium, or Low)	Evaluation Summary for Each Factor Considered
Manpower			
Methods			
Materials			
Machine			
Measures			
Maintenance			
Management			
Environment			

Table 3: D4 example.

Why Level	Question	Response	Is This the Root Cause?
Why #1			
Why #2			
Why #3			
Why #4			
Why# 5			

Table 4: "Five whys" approach.

Action Plan	Responsible	Due Date	How Will This Be Verified for Effectiveness?

Table 5: D5 example.

Action Plan	Verified By	Verification Date	Effectiveness Review Summary	Records, Reports, and Data Reviewed

Table 6: D6 example.

Preventive Action Plan	Expected Benefit	Who Will Implement This?	Planned Implementation Date	Actual Implementation Date

Table 7: D7 example.

measurement or metric selected for effectiveness demonstrates improvement or correction of the problem (Table 6).

D7: Preventive Plans

The objective of preventive plans is to proactively address items identified during the root-cause analysis stage that could possibly be issues in the future. It is up to the team to determine the validity of a proposed preventive action plan before it is drafted in the 8D plan (Table 7).

D8: Recognition and Lessons Learned

This section is necessary to confirm that an 8D CAPA has successfully been completed and to conduct a "lessons learned" review to see what went well and challenges encountered during this corrective action. CAPAs bring a wealth of information to the organization, and this section of the CAPA allows for the team to summarize accomplishments. It is important to recognize team members during management review meetings once CAPAs have successfully been completed. These projects bring value to the organizations that receive these 8D CAPA reports, as well as the customers who receive them. **SMT007**

Reference

1. U.S. Food and Drug Administration (FDA), "Corrective and Preventative Actions (CAPA)," September 8, 2014.

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Ridhi Kantelal

Upgrading to a Digital Line

Feature Interview by Nolan Johnson
I-CONNECT007

Ridhi Kantelal of Arch Systems breaks down what fabricators considering bringing in digitalization and upgrading their lines should know, and why they may see the most benefit from focusing on the data engineering aspect rather than the actual retrofitting of their systems.

Nolan Johnson: Ridhi, tell me what Arch System does, what your role is, etc.

Ridhi Kantelal: I am the business development and sales lead at Arch Systems. We use a combination of modular hardware and software to extract data from any kind of machine, including legacy and standardized data, and then build applications on top of it, such as global KPIs and predictive maintenance. We do this because of our modular approach. We have multiple ways of extracting data—everything from putting a sensor on the side and measuring the shots for something like a stamping machine to reading the ones and zeros, the protocols, and understanding everything this machine is doing. We do everything in between, which is not something that many companies can say, and we can do it in a cost-effective, scalable way.

Johnson: Arch has come to this market niche from a slightly different angle. There was a bit of a pivot there at some point.

Kantelal: Yes, it is very interesting. The company started as a project to monitor water wells in Tanzania. CTO and Co-founder Tim Burke worked as a field engineer for the Peace Corps in Panama for three years. While he was there, he realized the need for a good monitoring solution, but he also realized how a lot of times the technology of products were being developed to solve problems for a water system for a village. When they tried to expand within the village, it was super successful, but trying to expand to other villages didn't work because each town has its own system. Some have hydroelectric, and others have solar power. You can't use one solution that fits all; you need something that's customizable to be able to do that.

When he started pursuing his Ph.D. in material science, he worked with a charity on the side to develop the hardware electronics and software to be able to do a modular, customizable, industry-grade IoT solution that would work in remote conditions and harsh environments with competitive pricing, which are all things that you find useful on the manufacturing floor.

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Johnson: How do you shift from that to an Industry 4.0 and monitoring environment?

Kantelal: There are a lot of different types of water wells, including digital and analog meter systems. At the end of the day, we were retrofitting legacy equipment in water wells in Tanzania and other parts of Africa. It's the same technology, and we're still retrofitting machines, but in this case, they are now on the manufacturing floor, not in remote villages. You still need to understand machines, how they work, and which are analog and digital. If they're digital, what do they have, and how do you get data out of it? Even if it doesn't necessarily give you that data that you want. How can you read and understand the machine to be able to extract what's meaningful?

Johnson: So far, it sounds like a consulting process.

Kantelal: There's always going to be an element of that. We work with large enterprise customers. Each one will have their own needs and manufacturing specificities, but we do have products. ArchFX Broker and ArxhFX cloud are single, scalable products. There are two elements where consulting can come in, expanding our sets of connectors if a customer has machines we've never seen. A big part of our core IP is the ability to make new connectors literally 10x faster and cheaper than any standard consulting approach. The other would be in working with customers on unique business propositions beyond our global KPIs and predictive maintenance offerings. So, yes, we do that, and we also partner with other consultants to help large manufacturers learn how to digitize step by step.

The technology we've developed makes it easily customizable, but the library of connectors and extraction methods is there. It's a product, and then we also have the software on top of it that's standardized. We have a broker that takes all this data that we collect from different sources and logs and scans it into a standard, such as IPC CFX. Then, we build applications on top of it or allow our customers to build applications or our partners to develop applications on top of it.

In that sense, it's definitely a product, but it's always going to have some element of understanding what the customers want and making sure that we provide them that ROI. We don't go out and sell Industry 4.0, AI, and ML. We ask, "What are your biggest pain points? These are the ways we can help you," such as using machine data and analytics. It's about making sure that you're giving what the customers need and the ROI; it's not just about making sure they have an industrial solution.

Johnson: Is there much work with brownfield facilities, retrofitting, and brand new construction?

Kantelal: Yes. The reality is a large percentage of the manufacturing out there in electronics and other industries is going to be a mix of new equipment that has IPC CFX, Hermes, and connectors and easy ways to tap data out and legacy machines that are 5–20 years old. It's about combining all these because a lot of the value of Industry 4.0 comes from understanding and getting data from across the entire floor and all the lines; we facilitate that to happen.

Johnson: One of the major market drivers is that the various electronics manufacturers say that the market is driving down their margins; they don't have the profitability they used to. It has also been suggested elsewhere that most of their profit margins are ending up in the scrap pile. They're funding their waste with their old methodologies. New, digital methodologies eliminate the waste and put the margin back into their pockets. Does that ring true with you?

Kantelal: Absolutely. For example, with Flex, we're building a global OEE launching solution, which, if you are able to understand your OEE not just in one line but across all your lines in all your factories, as well as SMT lines across the world, you start to see things. You can decide how to manage your assets. If you understand what's going on in your line and are

able to collect data and analyze it, we can help reduce scrap at an earlier stage in the process so that you have fewer products wasted. That's where a combination of not just extracting data but using it in the right way to give you those results. You can start detecting where training is missing, or if there are anomalies earlier. There's a lot of elements where you can start making a difference in terms of the margins and operational costs.

Figure 1: Data extraction connector PODs.

Johnson: You just brought up the human factor. It seems that it isn't just the equipment. You have to change the human processes to go along with that.

Kantelal: Yes, but we don't do that. We provide the technology and things to allow the customers to see it sooner. We are not going out and retraining. We're not going to pretend we know more about the manufacturing and the training process than the manufacturers themselves. It's about providing the tools that allow you to see inside sooner rather than later. We think of ourselves as a technology that can provide the infrastructure that allows for Industry 4.0 to happen. There are a lot of conversations about AI and ML in the industry, but you can't get there before you have the infrastructure. You have the architecture in place, so there's a step-by-step process that you want to do to be successful. You might be able to do one or two projects in a facility to showcase the greenfield options. But if you want it to be scalable and work across all your plans, you need to be able to take step by step and make sure it scales.

Johnson: Is Arch working with some large customers?

Kantelal: Yes. We've been working with Flex to enable real-time and predictive data analysis in their global factories. Arch's technology is going into key Flex factories, pulling raw data from both old and new machines to generate actionable metrics. It's industrial data management on a grand scale.

Johnson: What about smaller customers?

Kantelal: Not at the moment directly, but we are open to it. We have made developer kit versions of our hardware technology, and we have software as well that we would provide, which makes it very easy to be able to customize what we need. We're looking for partners that would make that possible, but there's so much that needs to be done. We need to start somewhere. But no, the technology would be the exact same thing, so we are making developer kit versions so that manufacturers themselves or system integrators can use our technology to extract the data and connect it to an MES. We're making that possible that way.

Johnson: Imagine I'm a facility manager, and I know that I have extreme pressure from my board, boss, and customers, as well as just watching my operational data, all telling me that I need to move to something much more digital. I'm getting squeezed in all of those directions. From your perspective at Arch, what do I need to know? What are the critical factors that I need to get started on for this to be successful?

Kantelal: We usually start at a much higher level because there is an element of getting approval from the top down. It makes the conversation a lot easier.

Johnson: You're starting off with the business managers and decision-makers. There's the ROI, what you're going to invest, and the solution.

Kantelal: And this is how you do it. For example, with making the IT side of it work, it's not just across one line; it's going to be across the whole company, so it's ensuring that those security aspects are in place. Is it going to be on the cloud or not? We are very flexible in how we work. All those decisions, including how it's set up and what it's going to look like, have to be made by the facility manager. What are the biggest issues you face? We always start with that, so understanding your scrap rates are too high, or you have this line and don't know what's going on. We see that a lot, such as, "We know we're getting a lot of scrap, and there are a lot of issues with this line, but we don't fully understand what's going on." Right now, you might be getting data from spreadsheets or people manually inputting it, but you don't understand what's going on. We can then talk about the machines and the steps that are critical in the process. Where do you see the biggest issue so that we don't replace people? We work with them and make their jobs easier.

Where do you see the biggest issue so that we don't replace people?

For instance, maybe you want to connect these machines. As a facility manager or line manager, you may want to have a visual display on the line, so it helps you make decisions on the spot. We have the mobile app version too that sends alerts so you can see things, and the floor manager might want to have that. There are different visualizations for various levels depending on who in the factory it's for, so we would start with that and go from there.

Johnson: As this hypothetical facility manager, I'm going to need to understand what are my key performance indexes. I'm going to need to know where my problem areas are and have them as clearly defined as possible because when I sit down with you, we're going to start looking at more specific applications to fix that.

Kantelal: It's always about making the facility manager's job as hassle- or stress-free as it can be. It's always going to be stressful, but what can we do to help those issues. We don't come in and say, "This is our solution, and these are all the capabilities," because we are a full solution and cover the full spectrum. We do everything and cover a lot of different areas, so we don't see the value of just being able to spend half an hour of your time and going through all the different things we do when, in reality, it's about what's right for you.

Johnson: Walk me through Arch's product family.

Kantelal: ArchFX, or the Arch Factory Exchange, has three core components: ArchFX Connectors is a library of ways to get data out of new and legacy machines, ArchFX Broker is a standard engine to transform data into one standard and load it wherever it needs to go, and ArchFX Cloud is where we provide out-of-the-box solutions, including global KPIs and predictive maintenance.

We have about five different ways of getting data out of machines. We have sensors and little pieces of hardware like connectors and special cables. We have pure software solutions to get data out, so we have all these different ways and combinations of pure hardware and software for getting it out. Our technology runs on Bluetooth, so we have an access point for Bluetooth, and then we have a software broker, where all the data goes from all the different sources. That can be on prem, hybrid, cloud, or whatever is needed. That's where all this data gets standardized. The other element of it is we also have the data governance in place to share this data with the right organizations and people.

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Suppose you're a contract manufacturer, and you're getting a lot of pressure from your customers to share more data from the lines. So far, that only happened when it was custom-developed, which takes a lot of effort and energy. They're only going to do it for some customers and special occasions, but now that we have this infrastructure in place, they can more easily share this data securely to their customers. They also want that data for themselves, their operations, and some of the machine vendors might want certain data to do predictive maintenance on their machines.

Johnson: And there are plenty of original OEMs who are looking to get actionable data from the manufacturers making the products so that they can monitor what's going on.

Kantelal: And the truth is, as a manufacturer, you might not want to work with every single vendor and every single method out there to be able to send that data to them.

Johnson: Good point.

Kantelal: You want something that is like an infrastructure layer that allows all these things to happen, and the broker provides that.

Johnson: Going back to my hypothetical facility manager, the tendency for someone in that role is to get bogged down in the hardware, sensors, PLCs, retrofitting, cables, and connectors, but that's not where the solution is.

Kantelal: That's just a means to an end.

Figure 2: Sensor pods.

Johnson: Let's talk about the software part.

Kantelal: I was just on a panel earlier today, and we talked about the skill gaps in manufacturing. There are a lot of conversations about data scientists and software engineers, but we see one of the biggest key things that can enable the future of Industry 4.0 is data engineering and understanding how data works. You have all these silos, so how do you combine all this data to then be able to do what you want to do with it? That's what we do—the engineering. We're combining all this data from all these different sources and allowing there to be what traditionally has been called a data lake.

Now, once you have a data lake with all this clean, structured data—"clean" is a keyword here because there have always been data lakes—then you can analyze how you want. It just opens up all these opportunities that you probably wouldn't have thought of before, or you thought of it before but didn't know how. The cost and the time requirements were too high before. Now, you can start some queries, put in whatever visualizations you want, and start trying to understand your problems in a different way, combining it in different ways, and analyzing in a different way and come to a solution faster.

Johnson: I'm getting the sense that what my facility manager needs to know is that the attention needs to be on the software. The temptation will be to concentrate on all the hardware and hookups, but the solution is on what kind of information you're going to get out of your system at the end of the day.

Kantelal: I wouldn't say just software; it's about machine data. How you get the machine data is less important as long as the quality is not being affected. We have had cases where the machine vendor had their own way of getting data out, and then we get the data out and compare it. Our data has fewer gaps because we're going straight; we don't have all these different aspects, which is where the data engineering comes into play. It's difficult for

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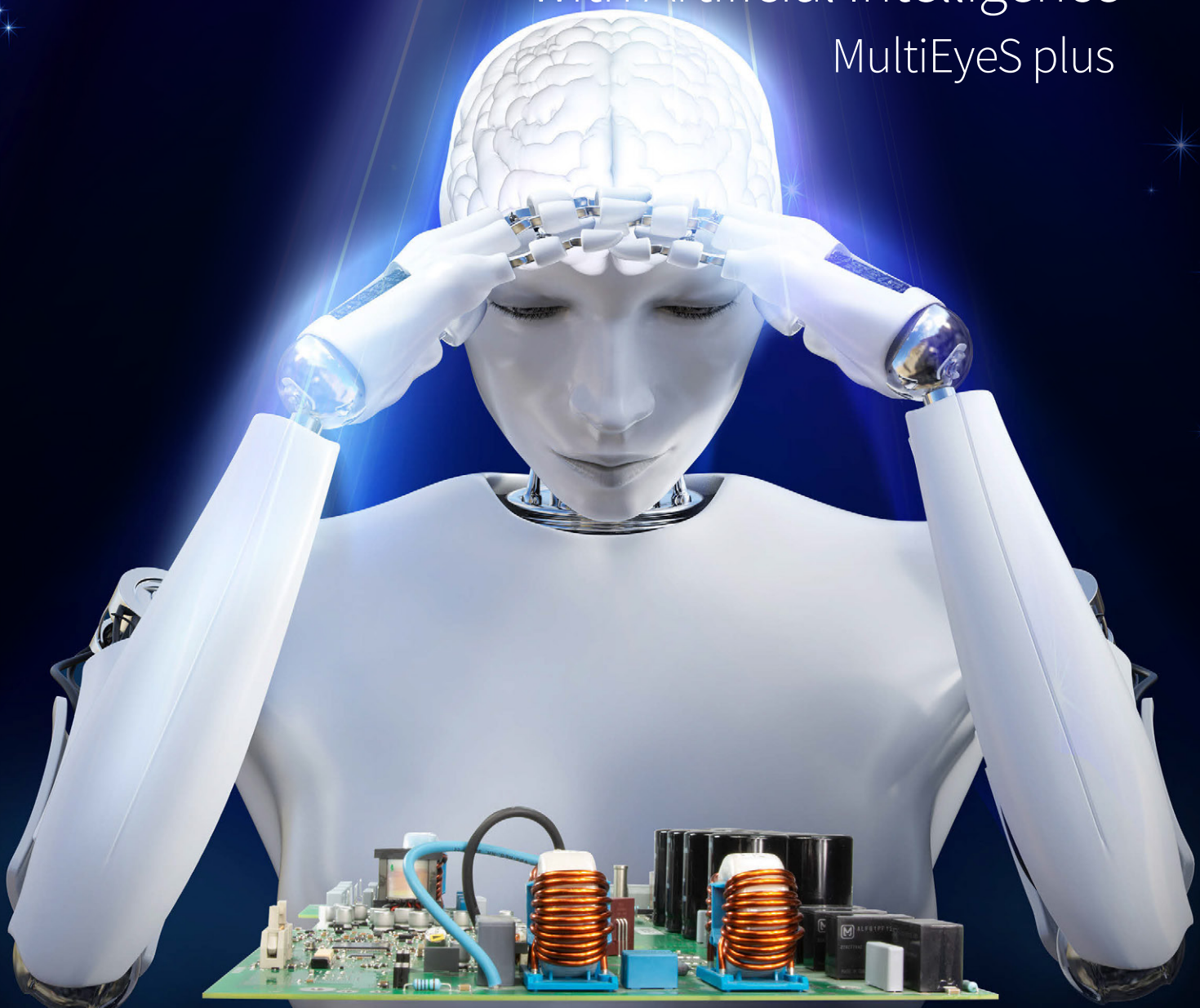

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me to explain in a simple way because I'm not a data engineer, but the way the data gets from the ones and zeros all the way to on the cloud matters a lot in terms of what gaps you have.

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Johnson: That's particularly powerful if you have a distributed manufacturing chain. Now, you can look at that process all the way through from chip manufacturing to board manufacturing, all of the sub-assemblies together, and the final assembly and test.

Kantelal: And also the covering, stamping, and all the different parts and pieces that go into making the final product. That's the other aspect of why we're different because we can go through all of them and still combine and view it the same way in a standardized view, which can be powerful.

Johnson: What do you see happening in supply chains, Ridhi?

Kantelal: I was in another panel about the shifting supply chains. There's a lot of change happening right now. That doesn't mean that manufacturing also has to shift sometimes, and this is where if your main way of getting data from your machines is straight from the machines, you're less reliant on those things. You might have to change operators. If you're changing your location or your facilities, there's retraining and trust that needs to be built. There are a lot of elements that take time before you start collecting data in the same way. But if you get it straight from the machines, it doesn't matter where your location is so much anymore. There are no gaps in translation. For instance, OEE can mean so many different things to so many different people. It's coming straight from the source, it's unhampered, and there's less of a trust issue. You can start working together in a different way and can bring up operations and bring them more efficiently to market as well.

Johnson: It seems to me that with your solution and your company's history of doing things that are more philanthropic, it would easy for you to focus on the 80% + of the industry that are not major players.

Kantelal: We're growing and taking it step by step. The larger organizations have some of the infrastructure in place that makes it easier to work and start there, but our core has always been an open culture. The layer that I was talking about earlier is open-source. We have the development kit as an open-source technology, so you can combine it. Social impact is a core part of our business. Now, we work with for-profit companies, develop the technology with them, and sell it at cost to the social impact buyers. And we have about five right now that we work with, so that's also something different that you don't see too much. Working with the larger manufacturers has empowered us to support humanitarian initiatives, like the water wells in Tanzania, among others. It's a good balance of business and philanthropy. We want to see more of that in the manufacturing world.

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Johnson: Ridhi, this has been great. Thank you very much for your time.

Kantelal: Thank you. I appreciate it. SMT007


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MilAero007 Highlights

NASA Sounding Rocket Technology Could Enable Simultaneous, Multi-point Measurements—First-ever Capability ▶

NASA engineers plan to test a new avionics technology—distributed payload communications—that would give scientists a never-before-offered capability in sounding rocket-based research.

WWII Meteorologist Turned Material Scientist Shares Nobel Prize in Chemistry 2019 ▶

The Air Force Office of Scientific Research congratulates John B. Goodenough, professor in the Cockrell School of Engineering at The University of Texas at Austin, for recently being awarded the Nobel Prize in Chemistry 2019. Goodenough is the eldest recipient of a Nobel Prize at age 97.

Global Market for Counter Unmanned Aircraft Systems to Exceed $2B by 2024 ▶

Frost & Sullivan's recent analysis, Global Counter UAS Market, Forecast to 2024, reveals that heightened demand for commercial unmanned aerial systems (C-UAS) by the military for expensive, technologically advanced, multiple-sensor systems is driving innovative C-UAS market growth opportunities.

Emerging Themes: Day Two Coverage of productronica 2019 ▶

Day two at productronica, and the themes emerge. 5G. High speed. Low loss. New formulations. These were the catchphrases of the materials suppliers. It is clear from all the conversations that designers and board specifiers need to be learning all they can about the new materials emerging on the market.

BAE Systems to Innovate Electronic Warfare Jamming Technology for U.S. Army ▶

BAE Systems will create advanced radar jamming technology that will improve air survivability and mission effectiveness for U.S. Army rotary-wing aircraft and unmanned aerial systems.

NASA-JPL Holds Its Annual Pumpkin-carving Contest ▶

Suffice to say that when the scientists and engineers at NASA's Jet Propulsion Laboratory in Pasadena, California, compete in a pumpkin-carving contest, the solar system is the limit. Now in its ninth year, the contest gives teams only one hour to carve.

Why Military Industries Are Relying Heavily on Digital Automation and Artificial Intelligence ▶

Artificial intelligence in the military sector is more appropriately called "intelligent automation." All types of private and governmental organizations, especially militaries, are examining ways to use digital automation, under names including artificial intelligence, machine learning, or bots.

Lockheed Martin GPS Spatial Temporal Anti-jam Receiver System to Be Integrated in F-35 Modernization ▶

Lockheed Martin (NYSE: LMT) received a $25 million initial contract award for engineering and manufacturing development (EMD) for the GPS Spatial Temporal Anti-Jam Receiver (GSTAR) system that will be integrated into the F-35 as part of its modernization phase, also known as Block 4.

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Curtis Smith

PCB Repair: Thoughtful Best Practices

Feature Interview by Barry Matties
I-Connect007

Barry Matties recently spoke with Curtis Smith of Huntron about the critical factors that somebody needs to understand about the plant maintenance regarding the PCB repair process. The PCB repair process is not just a matter of just getting the equipment anymore but finding the right people with a troubleshooting mindset that can do it. A failed PCB can bring down an entire manufacturing line, and companies need to be able to repair the board and keep their manufacturing going.

Barry Matties: Curtis, can you give us a brief overview of Huntron?

Curtis Smith: Huntron has been in business for over 40 years now, and it started with building a very simple troubleshooting tool for finding faults on a circuit card. It has escalated from there. The products have gotten better, and technology has changed, which has also driven how the products have changed. But we still have our core business of selling to third-party repair, small shops, and large shops who want to do in-house circuit board repair. We help them do their job. As technology has changed to surface-mount, our traditional way of troubleshooting with hand probes entirely changed. We got into robotics right around 1991, which helps our customers automate the process that they would normally have to do by hand. It's a time-saver and allows for labor savings. The equipment itself is fairly expensive, but they regain that back in the time saved by not having to sit there and do something by hand.

Matties: Are you saying you're offering the tools initially, but you also do the actual service of repair?

Smith: We don't do repair ourselves. We'll certainly train people on this because our customer, typically, is somebody who may already be into repair, but they just need to make the process better. We help the customer save time by approaching it more intelligently rather than just, "We think it might be this component here, so let's replace it and see if that fixes

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it." It has been a good business, and our customer base really runs the gamut of anybody who's doing repair; it could be medical, military, avionics, or mass transit.

Matties: Obviously, it's going to be high-end boards.

Smith: Yes, it's not consumer electronics at all because, in most cases, it's manufactured at such volume that it's not worth repairing. Although some of our customers do consumer-level electronics, they don't use our systems to repair. They usually use the systems to troubleshoot process problems. If they have a problem during their manufacturing process, they'll take the problem boards and try to figure out what happened, such as bad, reversed, or missing components—that type of thing on the circuit components. We'll help them with those kinds of things, but we don't do production style testing at all.

Matties: What critical factors do you think people need to understand about the repair process?

Smith: They need to know if they really should be doing it or not and if it's worth it for them to do that. If they're not doing repair already, then they need to consider if they should start fixing their own boards and what that's going to cost them. It's not just a matter of getting the equipment; it's also getting the people that can troubleshoot, which is becoming more difficult. The biggest issue would probably be personnel, not necessarily the equipment. There are all kinds of tools that could help them try to find the problems on the circuit boards. But having people who can take it to that next step, understand electronics, and have a good troubleshooting mind can be hard to find. Troubleshooting takes a certain mindset.

Matties: It's like being an investigator.

Smith: Exactly. Whether you're repairing a car or electronics, you have to take a logical approach to figure out what's going on. It's not just a matter of putting it in the machine, turning it on, running a test, and having it tell us what's wrong; nobody makes that system, even though I wish we could (laughs). In the end, they're going to get some test results, and they have to have people who can understand what it's telling them.

Matties: What person would they be hiring? An electrical engineer, or is this somebody that you bring in and train?

Smith: It could be an EE. It could even be somebody who has a bachelor's degree in engineering, but that gets to be expensive labor, unfortunately. In the U.S., the military's repair programs are pretty aggressive, especially in the Navy and Air Force. They have some good people coming out of those programs who are looking for those types of jobs when they come out in the civilian world.

Matties: The U.S. military is doing a good job of training for that?

Smith: They get basic training, but then they get thrown into the fire, which is where we've learned to work with them. We help them along and give them some systems to help them do their job, but they still have to be able to do it.

Matties: Do you train any of the operators to help them become a repair technician?

Smith: We don't train them to be the troubleshooter; the training we do for them involves our products more.

Matties: Where would they go if they want to learn to be a PCB repair technician? It seems like that's a real career.

Smith: It could be. Trade schools do that on some level, but they are few and far between. A lot of it now is software-based, so you have younger people who want to learn how to do software and programming, which doesn't help us at all.

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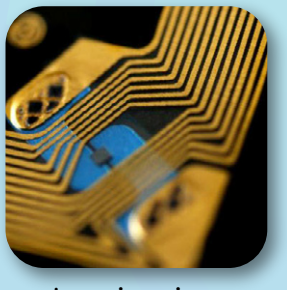

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Matties: PCB repair is not as sexy as other software companies.

Smith: Yes, nobody wants to get into the hardware end of things. There are some technical degrees. It probably could be an associate type of degree where those programs are more focused on putting people into that kind of a job versus just getting a degree of some sort. Of course, military-type programs resource people, but it's getting more difficult.

Matties: In the civilian world, do you see repair technicians working at an EMS or an assembly company, or are they embedded inside the OEMs?

Smith: At the OEMs, I see more of an engineering-level person going into those jobs. Repair people are typically more into companies that don't manufacture anything but still do service. However, they don't necessarily make what they're working on; they're just trying to keep their production lines going for whatever they're making. We see a lot of people with more technician-level skills going into those types of jobs.

Matties: Plant maintenance is probably a big issue because if you lose a card and your line is down, that's costly by the minute.

Smith: Right. Versus a company that is manufacturing electronic circuit cards, such as a contract manufacturer. There are a lot of large companies that do that. The people that go into those types of jobs for troubleshooting are at a more engineering level because they're more concerned about process issues and some design issues.

Matties: This is a part of the industry that people don't talk much about, but it's something that happens all the time. Is there anything that we haven't talked about that you feel like we should include in this conversation?

Smith: If people are interested and are good troubleshooters, I hope they'll realize that those jobs are there and they're in high demand. If you're not the kind of person who wants to go after an engineering degree or something like that, but you still like electronics and hands-on jobs, maybe a repair situation might be a good thing to look at.

Matties: And I would imagine that there's pretty good money to be made in this position.

Smith: Absolutely. Especially if you're good at it, you can have your pick of companies that are looking for what you do.

Matties: Curtis, thank you so much for your time today.

Smith: Thank you. SMT007

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1 New Book Helps Transform Industry 4.0 Concepts Into Reality ▸

Bring your manufacturing practices into the digital age with *The Printed Circuit Assembler's Guide to… Advanced Manufacturing in the Digital Age*—the latest title in I-Connect007's educational library.

2 Southern Arizona Recognizes Yarbrough Electronics Sales (YES) as Outstanding Manufacturer of the Year ▸

The AZTC annually recognizes member organizations that stand out in a number of categories. This year, the AZTC recognized Yarbrough Electronics Sales (YES), Tucson's premier contract manufacturing company, as its manufacturer of the year.

3 The Ecosystem of Industry Standards ▸

I-Connect007 reached out to representatives from several industry standards organizations and talked with them about how they participate in the standards process. Join us for some interview excerpts from IPC's Dave Bergman, iNEMI's Marc Benowitz, and Nextflex executives Scott Miller and Wilfried Bair.

4 productronica Names 2019 Innovation Award Winners ▸

The decision has been made. The winners of the productronica Innovation Award 2019 were chosen just in time for the start of the world's leading trade fair for electronics development and production. An independent panel has decided on the winners from amongst 80 entries across six categories.

5 SMTAI 2019: To the Moon and Beyond ▸


Dr. Mike Hawes

Dr. Mike Hawes is currently the VP for human space exploration and the Orion Program manager for Lockheed Martin. Barry Matties spoke with him afterward to discuss the technology innovations that empower the next-generation spacecraft to take astronauts to explore farther than humankind has ever ventured.

6 Zulki's PCB Nuggets: Smart Pills and Cameras—The Next Frontier for PCB Microelectronics ▸


Zulki Khan

The phrase, "Take two aspirin," takes on new meaning, as medical electronics move into new frontiers of inspecting a human's gastrointestinal tract with new, revolutionary ingestible smart pills and "pill cams."

7 Powerful Prototypes: Panelization–What Is It and Why Would You Want It? ▸

We see orders for a single board, and we see orders for thousands. "A few thousand" falls way outside the realm of "prototype," but in the startup and open-source worlds, the lines are blurred. Once you order more than about 50 boards, a few things change; for example, you should consider ordering your boards in a panel, also called arrays or a palette, of multiple boards.

8 Quest for Reliability: Reliability by the Book ▸


Eric Camden

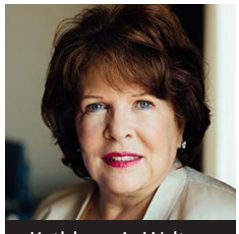
Eric Camden can say that the next time he works on a Class I failure analysis project, it will pretty much be the first. Class I electronics serve a different purpose in life, and if they fail, it's normally not a big deal; instead, it's mainly a minor inconvenience. Eric also speaks to specifications for Class I, II, and III products per IPC definitions as well as the IPC standards process.

9 Libra Industries, Indium Corporation, STI Electronics Pledge Support for Stromberg Scholarship ▸


Rod Howell

SMTA and the JoAnn Stromberg Leadership Scholarship recently received a five-year commitment of support from Indium Corporation, Libra Industries, and STI Electronics. Rod Howell, CEO of Libra Industries, moved the scholarship even further, pledging an additional five-year commitment.

10 Kathleen A. Walters Joins Jabil Board of Directors ▸


Kathleen A. Walters

Jabil Inc. announced Kathleen A. Walters has been appointed to the Jabil Board of Directors.

For the latest news and information, visit SMT007.com. Subscribe to our newsletters or premium content 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!

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Career Opportunities

Technical Support Engineer III

The technical support engineer III is responsible for providing leading-edge, high-level technical support to Indium Corporation's customers, potential customers, and sales staff. Due to their senior position and experience, their role also includes conceiving and devising projects, assisting with staff career development, marketing guidance, and more. The technical support engineer III has learned, mastered, and demonstrated unique and specific skills and information throughout their career. They are responsible for at least one sales territory and for leading other engineers. They train and evaluate colleagues on unique and general information. Continuing education/training is critical.

Requirements

- Technical undergraduate degree (B.S. in engineering, chemistry, physics, metallurgy, or materials science)
- 15 years of direct technical experience in applied materials science, electronics assembly techniques, and/or electronics assembly technical service
- Demonstrated technical competency
- Strong interpersonal, communication, and presentation skills
- Ability to work, with ease, with executive-level counterparts
- Strong alignment with the corporate and departmental missions
- Ability to work cooperatively and effectively in a cross-functional team environment
- Ability to travel with limited notice
- Proficient in Word, Excel, and PowerPoint
- Experience with JMP or Minitab preferred
- Special consideration is given to candidates with language skills in Spanish and/or Chinese

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West Software Application Engineer

This position reports directly to the Orbotech West software support manager and works with customers to support Orbotech's pre-production software products. Acts as a focal point for technical issues, manages product implementation projects, provides customer training, and supports the sales process. Advanced knowledge of Frontline PCB products, including InCam, InPlan, InStack, InSight, Genesis, and Genflex. Ability to travel and manage time to maximize results. Requires both written and oral technical communication skills. Skilled in the use of scripting languages, including C-Shell, Perl, or Python. Knowledge of relational databases and HTML/XML highly desirable. Knowledge of PCB manufacturing processes. Familiar with the processes used in front-end engineering departments at PCB fabrication sites. Requires use of project management skills to organize and complete projects that involve the implementation of sophisticated software tools used in printed circuit fabrication facilities.

An expected average of 35%+ travel. College degree or equivalent technical education, in addition to a minimum of five-plus years of related experience. Experience supporting sales and sales activities is a plus. U.S. citizen with the ability to work and travel within the U.S., Canada, and internationally.

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Career Opportunities

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騰輝電子

OEM Sales Manager
Chicago/Home-Office-Based

Want to advance your career by joining a globally successful and growing world-class CCL manufacturer and help drive that success? We are seeking to hire an OEM sales manager to grow and manage key customer accounts with OEM's and Tier 1 manufacturers in the USA, focusing on Ventec's core market segments: mil/aero, automotive, and medical, offering a full range of high-reliability materials, including polyimide, IMS, and thermal management products.

Skills and abilities required for the role:
- Non-negotiable: Drive and tenacity!

Required:
- 7 to 10 years' experience in the PCB industry in engineering and/or manufacturing
- Detail-oriented approach to tasks
- Ability to manage tasks and set goals independently as well as part of a team
- Knowledge of MS office products

Full product training will be provided.

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

Please forward your resume to jpattie@ventec-usa.com and mention "Technical Sales Engineer—Chicago" in the subject line.

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FREEDOM CAD SERVICES

Sr. PCB Designer–Mentor Xpedition

Freedom CAD is a premier PCB design service bureau with a talented team of 30+ dedicated designers providing complex layouts for our enviable list of high-tech customers. Tired of the commute? This is a work-from-home, full-time position with an opportunity for additional compensation for overtime work at time and a half.

Key Qualifications
- EXPERT knowledge of Xpedition VX 2.x
- Passionate about your PCB design career
- Skilled at HDI technology
- Extensive experience with high-speed digital, RF, and flex and rigid-flex designs
- Experienced with signal integrity design constraints encompassing differential pairs, impedance control, high speed, EMI, and ESD
- Excellent team player who can lead projects and mentor others
- Self-motivated with the ability to work from home with minimal supervision
- Strong communication, interpersonal, analytical, and problem-solving skills
- Other design tool knowledge is considered a plus (Altium, Allegro, PADS)

Primary Responsibilities
- Design project leader
- Lead highly complex layouts while ensuring quality, efficiency, and manufacturability
- Handle multiple tasks and provide work leadership to other designers through the distribution, coordination, and management of the assigned workload
- Ability to create from engineering inputs, board mechanical profiles, board fabrication stackups, detailed board fabrication drawings and packages, assembly drawings, assembly notes, etc.

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Career Opportunities

ROGERS CORPORATION

Advanced Connectivity Solutions

Senior Development Engineer

Rogers Corporation is seeking a senior development engineer accountable for the development of more complex products and processes, the establishment of sound technical bases for these developments, and effective interaction with technology, process, and platform innovation; operations; sales and marketing; and process engineering personnel to commercialize these developments.

Essential Functions:

- Design and conduct experiments and interpret the results
- Report on projects in both written and verbal formats at all levels of the organization
- Perform technical troubleshooting of new products and processes; act as new product/concept incubator for new technologies and platforms, identifying opportunities for improvement and incorporation design for manufacturing requirements resulting in a viable, scalable product
- Provide ongoing process and manufacturing support to newly launched products as applicable
- Provide support in terms of analytical equipment maintenance, methods development, material analysis, and documentation of new process or products
- Manage capital projects for the purchase and installation of new process or support equipment; train employees in new processes

Required Education and Experience:
Ph.D., Ch.E., M.E., or material science, or B.S. or higher in a technical discipline with accomplishment in product development and project management.

Rogers Corporation provides equal employment opportunities to minorities, females, veterans, and disabled individuals as well as other protected groups.

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KOH YOUNG AMERICA

Field Service Engineer
(Location Negotiable)

Are you passionate about delivering an exceptional user experience? Come work as a field service engineer at the industry's leading inspection company that offers great benefits with opportunities to advance while learning alongside accomplished business leaders.

The Company: Koh Young is the leading 3D inspection solutions provider in the electronics manufacturing industry. With is new offices in Atlanta and Guadalajara, it helps its customers optimize their printed circuit board assembly process.

The Position: Deliver technical services–including installation, support, and maintenance–to elevate the user experience. Location is flexible, but OH, IN, IL, MA, MI, FL, CA, or Toronto are desired.

The Reasons: An opportunity to apply leading-edge inspection technology to products you know and use every day. A great environment that supports its team and treats everyone like family.

Join the industry's leading provider of
true 3D inspection solutions

Interested? Submit your resume below.

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Career Opportunities

Gardien Is Hiring!

The Gardien Group, a leading solutions provider in the PCB industry, is looking to fill multiple openings in their China, Japan, Taiwan, and United States service centers.

We are looking for electrical engineers, operations managers, machine operators, and sales executives. Prior experience in the PCB industry is beneficial but not essential. Training will be provided along with excellent growth opportunities, a benefits package, and periodic bonuses.

Our global teams are from diverse cultures and work cohesively as a tight-knit unit. With performance and initiative, there are plenty of opportunities for professional growth.

Gardien is an equal opportunity employer. Employment decisions are made without any regard to race, color, religion, national or ethnic origin, gender, sexual orientation, age, disability, or other characteristics.

Interested candidates, please contact us with your resume and a cover letter. Kindly note that only shortlisted candidate will be contacted.

Apply at careers@gardien.com.

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Assistant Department Manager, Operations, Carson City, NV

This is an entry-level professional management trainee position. Upon completion of a 1-2-year apprenticeship, this position will be elevated to facility/operations manager. Primary functions during training: shadow incumbent staff managers to learn and understand the operations and personnel of the operations department. This position will train and learn, develop, implement, and coordinate strategies related directly to the manufacture of Taiyo products. Additionally, this position will be learning all about the facility, environment, and health and safety functions. Eventually, this position will be responsible for the administration, security and maintenance of the facility and warehouse

Required Experience/Education:

- 4-year college degree in industrial engineering or another similar science discipline combined with work experience in ink or coatings manufacturing
- Ability to read, analyze, and interpret common scientific and technical journals, financial reports, and legal documents
- Ability to respond to inquiries or complaints from customers, regulatory agencies, or members of the business community
- Ability to develop and implement goals, objectives, and strategies
- Ability to effectively present information to top management, public groups, and/or boards of directors
- Ability to apply principles of logical or scientific thinking to a wide range of intellectual and practical problems
- Knowledge of governmental safety, environmental, transportation regulations/laws

Preferred Skills/Experience:

- Bilingual (Japanese/English)
- Toyota Production System (TPS)

Working Conditions:

- Occasional weekend or overtime work

See complete job listing for more information.

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Career Opportunities

eptac

TRAIN. WORK SMARTER. SUCCEED.

Become a Certified IPC Master Instructor

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

Qualifications and skills

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

Benefits

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

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INSULECTRO

Technical Account Manager Chicago/Minneapolis

Insulectro, the largest national distributor of printed circuit board materials, is seeking a talented sales superstar for a Technical Account Manager role based out of either our Chicago or Minneapolis office. This role will focus on maintaining the existing customer base and developing new business within the assigned territory in both the printed circuit board and printed electronics industries. We are looking for the perfect fit of education, experience, and attitude that matches our company culture and enhances the service level to our customers.

Qualifications:

- A self-motivated business professional who is driven to succeed with a minimum of 3 years outside sales experience in the PCB or PE industry
- Proven sales/business development record
- Excellent communication and interpersonal skills
- OEM and electronic assembly experience is a plus

We offer:

- Competitive salary and commission plan with a comprehensive benefits package
- A fun, high-energy company with an entrepreneurial spirit
- A great group of people to work with!

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Career Opportunities

Analyst Programmer, Hong Kong

We believe in caring about our people because they are our greatest asset. CML works with multicultural stakeholders daily to achieve more and bring them the best solutions. That's why we continuously invest in optimizing our culture and focus on providing our team with opportunities to develop their skills (e.g., through professional coaching to achieve their highest potential).

The analyst programmer will assist the IT and ERP manager in Hong Kong to support the company's BI systems, ERP systems, and other related IT-landscape applications.

In addition, this post will participate in system development projects and provide support including, but not limited to, user requirement collection and analysis, user training, system documentation, system support and maintenance, enhancement, and programming.

- Develop and enhance related IT systems and applications
- Prepare functional specifications
- Transfer the relevant business and interface processes into IT systems and other applications to get a maximum automation degree and prepare all required business reports
- Conduct function testing and prepare documentation
- Manage help desk/hotline service

CML is a leading provider of printed circuit boards. We develop tailor-made sourcing and manufacturing solutions for our customers worldwide with strong partnerships and reliable connections.

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APCT, Printed Circuit Board Solutions: Opportunities Await

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

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

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

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

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Career Opportunities

TAIYO AMERICA

Development Chemist
Carson City, NV

Develop new products and modify existing products as identified by the sales staff and company management. Conduct laboratory evaluations and tests of the industry's products and processes. Prepare detailed written reports regarding chemical characteristics. The development chemist will also have supervisory responsibility for R&D technicians.

Essential Duties:

- Prepare design of experiments (DOE) to aid in the development of new products related to the solar energy industry, printed electronics, inkjet technologies, specialty coatings and additives, and nanotechnologies and applications
- Compile feasibility studies for bringing new products and emerging technologies through manufacturing to the marketplace
- Provide product and manufacturing support
- Provide product quality control and support
- Must comply with all OSHA and company workplace safety requirements at all times
- Participate in multifunctional teams

Required Education/Experience:

- Minimum 4-year college degree in engineering or chemistry
- Preferred: 5-10 years of work experience in designing 3D and inkjet materials, radiation cured chemical technologies, and polymer science
- Knowledge of advanced materials and emerging technologies, including nanotechnologies

Working Conditions:

- Chemical laboratory environment
- Occasional weekend or overtime work
- Travel may be required

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Multiple Positions Available

The Indium Corporation believes that materials science changes the world. As leaders in the electronics assembly industry we are seeking thought leaders that are well-qualified to join our dynamic global team.

Indium Corporation offers a diverse range of career opportunities, including:

- Maintenance and skilled trades
- Engineering
- Marketing and sales
- Finance and accounting
- Machine operators and production
- Research and development
- Operations

For full job description and other immediate openings in a number of departments:

www.indium.com/jobs

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Career Opportunities

Manncorp™

SMT Field Technician
Huntingdon Valley, PA

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

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

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

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

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U.S.C. U.S. CIRCUIT

Sales Representatives (Specific Territories)

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

- Florida
- Denver
- Washington
- Los Angeles

Experience:
- Candidates must have previous PCB sales experience.

Compensation:
- 7% commission

Contact Mike Fariba for more information.

mfariba@uscircuit.com

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Career Opportunities

ZENTECH

Zentech Manufacturing: Hiring Multiple Positions

Are you looking to excel in your career and grow professionally in a thriving business? Zentech, established in Baltimore, Maryland, in 1998, has proven to be one of the premier electronics contract manufacturers in the U.S.

Zentech is rapidly growing and seeking to add Manufacturing Engineers, Program Managers, and Sr. Test Technicians. Offering an excellent benefit package including health/dental insurance and an employer-matched 401k program, Zentech holds the ultimate set of certifications relating to the manufacture of mission-critical printed circuit card assemblies, including: ISO:9001, AS9100, DD2345, and ISO 13485.

Zentech is an IPC Trusted Source QML and ITAR registered. U.S. citizens only need apply.

Please email resume below.

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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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Events Calendar

2019 International Electronics Circuit Exhibition (Shenzhen) ▶
December 4–6, 2019
Shenzhen, China

Electronics Packaging Technology Conference 2019 ▶
December 4–6, 2019
Singapore

NEPCON Japan ▶
January 15–17, 2020
Tokyo Big Site, Japan

IPC APEX EXPO 2020 ▶
February 1–6, 2020
San Diego, California, USA

Pan Pacific Microelectronics ▶
February 10–13, 2020
Big Island, Hawaii, USA

The LED Show ▶
February 11–13, 2020
San Diego, California, USA

Embedded World ▶
February 25–27, 2020
Nuremberg, Germany

Electronica China ▶
March 18–20, 2020
Shanghai, China

Additional Event Calendars

Coming Soon to *SMT007 Magazine:*

JANUARY 2020: **IPC APEX EXPO Preview**
Join us in the January issue as we share what to expect and what to look for in San Diego at IPC APEX EXPO 2020.

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