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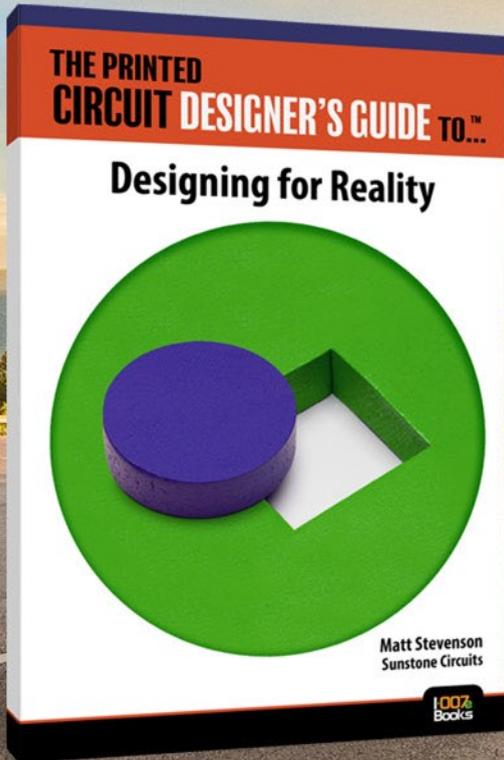
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## Workflow Management

In this issue, we look at just some of the challenges in navigating the maze of workflow management. We look for the new best practices emerging from EMS firms. How does one best protect from parts issues and scheduling changes? How do your new best practices stack up?



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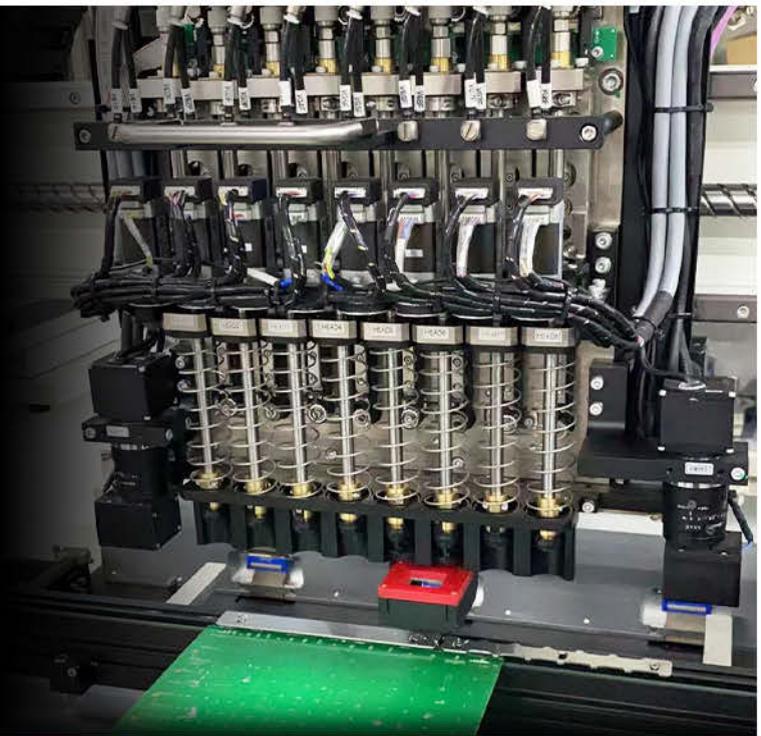
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# The Conveyor Belt Effect

## Nolan's Notes

by Nolan Johnson, I-CONNECT007

How many times have you watched a conveyor belt in a movie played out for comedic effect? It's a familiar trope: The belt starts out slowly, then increases its speed, until chaos ensues. Think "I Love Lucy," "Star Wars," and Charlie Chaplin in "City Lights." These are perfect metaphors for this issue on workflow management, where planning your workflow on the manufacturing floor in these challenging times sometimes feels like being just one step away from disaster—or safety.

I remember being introduced to the "conveyor belt" effect in my early college days. I

had started dating a young lady and because neither of us were flush with cash, our dates consisted of attending a film lab for the English department's "History of Comedy in Film" course. We weren't enrolled in the course, yet we were rich in resourcefulness, so it was a perfect date. We'd hold hands and laugh while watching the likes of Charlie Chaplin, Keystone Cops, Laurel and Hardy, Harold Lloyd, and Buster Keaton (my personal favorite).

These early films taught me a lot about the roots of comedy in cinema and, as it turns out, quite a bit about workflow management.



The one film that served as the crux for the course was Chaplin's 1931 film "City Lights," a dystopian and indeterminate industrial setting for our anti-hero. It's easy to say that "City Lights" presents an Orwellian world, a precursor to the one created by George Orwell 18 years later.

The film centers around the Tramp's work in a factory, where the Tramp is both contrary to established processes, but highly competent in his own way. The dystopian future is represented by a company boss who can use a two-way television to micromanage his employees, the Tramp in particular. (Interestingly, electronic television had only been demonstrated two years prior to this movie.) Perhaps the pinnacle of the movie is the famous scene in which the Tramp gets pulled through the machinery itself. Where he should meet with a bone-crunching death in all the gears, he instead comes out unscathed (as the Tramp always does) and even tightens bolts with a wrench as he moves down the path. It was the type of scene I would see played out repeatedly over the years in other comedies. For some reason, it just always works.

While we may have to keep a light heart about the challenges we face today, we also realize the constantly shifting, chaotic supply chain has wreaked havoc on workflow management. We reached out to several EMS companies and found common threads of struggle and confusion. Planning the workflow onto the manufacturing floor must simply feel like a trip through the machine with the Tramp every single day.

Maybe you feel more like the masterful Lucille Ball in her infamous conveyor belt scene in the candy factory, or C3PO having parts switched out as he narrowly escapes getting clobbered by the robotic arms. Maybe you're more like "The Flintstones," scrambling down a belt the opposite way as quickly as you can. It's a fast-paced world that never stops, but it's how we approach our situations that makes the difference.

In our interview with Jason Sciberras of Saline Lectronics, he details some of his "conveyor belt" moments and how these challenges led to innovation, new software, and a company that is thriving. He's finding his way out of the chaos by using smart tools, smart people, and a level head. We learned about some new best practices for supply chain monitoring and how that increased awareness has trickled down to the scheduling department.

We followed up with CalcuQuote and Cogiscan, two business organizations that provide software options now critical to stability in the supply chain for EMS companies. The ever-thought-provoking Michael Ford contributes two pieces to this issue as he explores both best practices in worst-case scenarios, and modern inventory management.

I'm also excited to share with you a series of interviews from last month's IPC Advanced Packaging Symposium, a two-day forward-looking event in Washington, D.C. You've probably already heard of substrates, interposers, and chiplets, and I promise there will be much more to discuss in coming months. But here's a workflow management spoiler: Advanced packages will require a higher level of assembly precision and will add complexity to your workflow.

Chaplin's "City Lights" was his first "talkie." He saw the future of cinema with soundtracks as a dystopian world for his particular art form. In the closing scene, the Tramp walks off into the "sunset," living life on his terms. But so many others embraced the new technology and thrived. Here's to hoping no one chooses to exit the business rather than adapt to the new world order. **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](#).

# Cybersecurity Requires an Active Approach

## SMT Prospects and Perspectives

by Dr. Jennie S. Hwang, CEO, H-TECHNOLOGIES GROUP

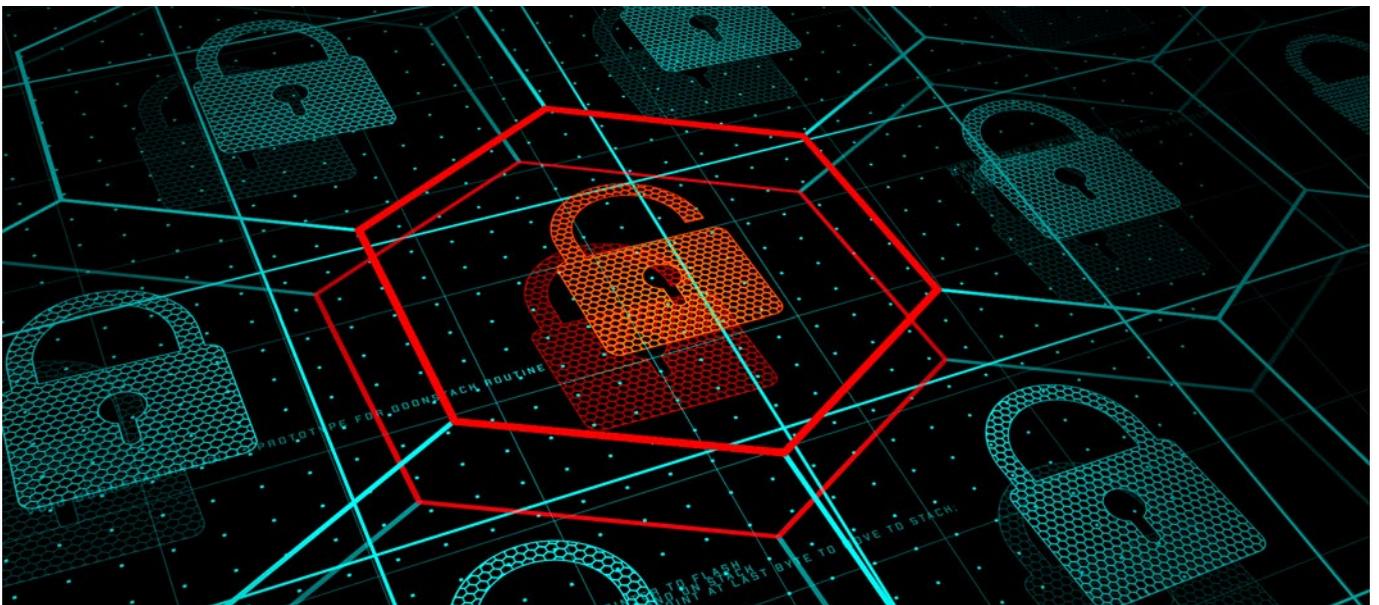
I last wrote about cybersecurity nearly 10 years ago in a column titled “Cybersecurity—from Boardroom to Factory Floor.” So, where do we stand on cybersecurity? As the digital world continues pushing ahead, it comes with new challenges in the cyberspace. Individual systems and/or infrastructure systems are subject to attacks by increasingly savvy adversaries who can leverage new and emerging technologies.

A cyberattack can be surreptitiously detrimental, crippling business operations, the national economy and security, or just jeopardizing an individual laptop. This pervasive and persistent security threat is one of the most formidable challenges of our times.

In my 2013 column, I stated: “Cyberattacks will continue to be a huge concern to U.S. corporations in the foreseeable future. It’s a mat-

ter of ‘when’ not ‘if.’ It is not industry-specific; every company will have to deal with this challenge. The earlier that preparation is made, the better a company is positioned to fend off the attack. The most insidious nature of a cyber-attack is that it could happen anywhere at any time without physical boundaries across national borders.” Indeed, potential hacking is timeless and borderless.

Under this backdrop, is it feasible to reach the level of being un-hackable? And what does it take to reach that level of security? Practically speaking, “un-hackability” is a relative term, which is a moving target as well. In other words, it relies on whether we can alleviate the weak and vulnerable link(s) in the system, set the strategy, and practice to outsmart and outpace the potential adversaries.





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The foundational pillars behind an un-hackable system are hardware, software, data, computing, communication, human, and integration. Each of these pillars must surpass the anticipated capabilities of potential hackers. A holistic cybersecurity needs to embrace all types of security capabilities including:

- Critical infrastructure security
- Application security
- Network security
- Cloud security
- Edge (IoT) security

Also in my 2013 column, I mentioned, “Under a savvy and diligent governing board oversight, a cyber culture can be cultivated over time with persistent and pervasive effort by considering the following 20 actionable items.” The 20th item called out in that article was to “Keep pace with emerging technologies.”

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## The foundational pillars behind an un-hackable system are hardware, software, data, computing, communication, human, and integration.

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### Omnipotent Technologies

What are game-changing technologies behind the cybersecurity capabilities? Take artificial intelligence as an illustration. I’m reluctant to mention the phrase “artificial intelligence” as lately it has become household vernacular. However, AI brings “ammunition” against attacks. In practice, AI and computing power are intimately intertwined. With the recent acceleration of computing power, the advancement of AI is expected to gain momen-

tum, although fundamental breakthroughs must still be made to reach the next level of performance.

This emerging technology also comes with risks as AI enables another level of attack abilities. The logical question is what the plausible strategies and methodologies are to integrate AI into the security infrastructure in a timely fashion that will fend off an AI-empowered attack. It is worth noting that defense is one thing and offense is another; one must be able to go on the offensive as well as defend.

Another illustration is quantum mechanics. While “quantum” has also been over-used as well, it works here. A quantum computer’s omnipotent computing power, in virtue of quantum’s “quirky and spooky” nature of superposition and entanglement, can solve problems that are far too complex for classical computers and supercomputers to figure out in a finite timeframe. Even the processors with trillions of transistors are falling way behind.

The potential impact of quantum computing on cybersecurity is profound and is expected to transform cybersecurity and change the global landscape. Its anticipated capabilities pose a significant threat to cybersecurity infrastructure, as it can disrupt current encryption systems, requiring a change in how the data are encrypted. This includes solving the algorithms behind encryption keys that protect the data and the internet’s infrastructure.

The public key cryptosystem, RSA, has been widely used for secure data transmission. As of now, not one individual, company, or country has reached or even is near to the level of the computing capability in qubits required to totally disrupt the current encryption system. Reportedly, a quantum computer would need to be as large as 70 million qubits to break that encryption. IBM<sup>1</sup> and Google<sup>2</sup>, among others, have roadmaps to achieve 1 million qubits by 2030. Nonetheless, indisputably, a leader in quantum computing holds the omnipotent key. The competitive race is fiercely marching on.

## Global Race

Speaking of the race, in 2016 China blasted the world's first quantum communication satellite into orbit from the Gobi Desert. "The newly-launched satellite marked a transition in China's role—from a follower in classic information technology (IT) development to one of the leaders guiding future IT achievements," said Pan Jianwei, chief scientist of Quantum Experiments at Space Scale (QUESS) project with the Chinese Academy of Sciences (CAS)<sup>3</sup>. With the help of the new satellite, scientists are testing quantum key distribution between the satellite and ground stations and conducting secure quantum communications. QUESS is designed to establish "hack-proof" quantum communications by transmitting uncrackable keys from space to the ground and provide insights into the strangest phenomenon in quantum physics—quantum entanglement.

Quantum communication boasts ultra-high security by exploiting the quirky properties of subatomic particles, as a quantum photon can neither be separated nor duplicated. Thus, it is impossible to wiretap, intercept, or crack the information transmitted through it.

In upcoming decades, it remains to be seen who will win the quantum computing or quantum communication. All embracingly, it appears to indicate that the disruptive quantum computing abilities are still many years away. One thing for sure is that we must address security in the quantum world. This is valid and critical.

## The Role of Hardware

For our industry, it would be remiss not to call out hardware. Hardware technologies to increase the bandwidth and capacity within the desired power and thermal envelope, including processor, memory, GPU, interconnect, among others, make the applications of AI feasible. In hardware chips, the system design, development, manufacturing, and the supply chain that enable the functions and perfor-

mance of the omnipotent technologies are the critical part of the equation. On top of hardware for machine learning, the hardware for "deeper" learning abilities requires integrating the natural language processing and neural network that mimic the functionality and connectivity of neurons in the human brain in the hardware system, which is yet to evolve.

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**In hardware chips, the system design, development, manufacturing, and the supply chain that enable the functions and performance of the omnipotent technologies are the critical part of the equation.**

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## Other Than Technologies

To defend against hackers (human, machine, human-machine teaming), in addition to technologies, other key elements of establishing a resilient cybersecurity system include people talents, sound policies, and effective processes to tackle the challenges of the complex and ever-changing cyber-physical-human infrastructure.

In a nutshell, to be un-hackable, always be on the lookout for new and innovative ways to stay one step ahead of hackers—not only to react, but to anticipate and to envisage. **SMT007**

## Reference

1. "IBM plans a huge leap in superfast quantum computing by 2023," by Robert Hackett, *Fortune Magazine*, Sept. 15, 2020.
2. "Quantum computing is entering a new dimension," by Robert Hackett, *Fortune Magazine*, Dec. 3, 2020.

3. “What the World’s First Quantum Satellite Launch Means,” by Robert Hackett, *Fortune Magazine*, Aug. 16, 2016.

### Appearances

Dr. Hwang will deliver two professional development courses: “Solder Joint Reliability—Principle and Practice,” from noon to 3 p.m. Jan. 22, and “Preventing Product Failure and Manufacturing Defects,” from 1:30 to 4:30 p.m. Jan. 23, at IPC APEX EXPO 2023 in San Diego, California.



**Dr. Jennie S. Hwang**—an international businesswoman and speaker and a business and technology advisor—is a pioneer and long-standing leader to SMT manufacturing since its inception as well as to the development and implementation of lead-free electronics technology. Among her many awards and honors, she was inducted to the International Hall of Fame—Women in Technology, elected to the National Academy of Engineering, named an R&D Star to

Watch, and received a YWCA Achievement Award. Having held senior executive positions with Lockheed Martin Corp., Sherwin Williams Co., and SCM Corp., she was the CEO of International Electronic Materials Corp. and is currently CEO of H-Technologies Group, providing business, technology, and manufacturing solutions. She has served on the board of Fortune-500 NYSE companies and civic and university boards; the Commerce Department’s Export Council; the National Materials and Manufacturing Board; the NIST Assessment Board; as the chairman of the Assessment Board of DoD Army Research Laboratory and the chairman of the Assessment Board of Army Engineering Centers; and various national panels/committees and international leadership positions. She is the author of 600+ publications and several books and is a speaker and author on trade, business, education, and social issues. Her formal education includes four academic degrees, as well as the Harvard Business School Executive Program and Columbia University Corporate Governance Program. For more information, visit [JennieHwang.com](http://JennieHwang.com). To read past columns, [click here](#).

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## U.S. Departments of Labor, Commerce Announce 120-Day Cybersecurity Apprenticeship Sprint to Promote Registered Apprenticeships

At a National Cyber Workforce and Education Summit at the White House, Secretary of Labor Marty Walsh and Secretary of Commerce Gina Raimondo announced the 120-Day Cybersecurity Apprenticeship Sprint, an effort to support numerous industries’ use of Registered Apprenticeships to develop and train a skilled and diverse cybersecurity workforce.

The 120-Day Cybersecurity Apprenticeship Sprint supports a commitment to expand Registered Apprenticeships to meet industry’s need for talent and to connect underserved communities to good jobs. Improving the nation’s cybersecurity apparatus is critical to the nation’s economic and national security.

The partnership between the departments of Labor, Commerce, other federal agencies and the White House Office of the National Cyber Director seeks to recruit employers, industry associations, labor unions, educational providers, community-based organizations and others to establish Registered Apprenticeship programs

or to join existing programs to ensure the nation’s economic sectors have greater numbers of qualified cybersecurity workers. The sprint will continue until National Apprenticeship Week, Nov. 14-20, 2022.

There are currently 714 registered apprenticeship programs and 42,260 apprentices in cybersecurity-related occupations. Since Jan. 20, 2021, 199 new programs have been created – a 28 percent increase during the Biden-Harris administration. The 120-Day Cybersecurity Apprenticeship Sprint will build upon this progress and focus on creating new pathways for workers in cybersecurity or a related field through partnerships with K-12, higher education, workforce partners and training programs. Introducing more employers to the potential of cybersecurity Registered Apprenticeships is essential to fill the nearly 700,000 open cybersecurity jobs, which span all industries.

(Source: U.S. Department of Commerce)



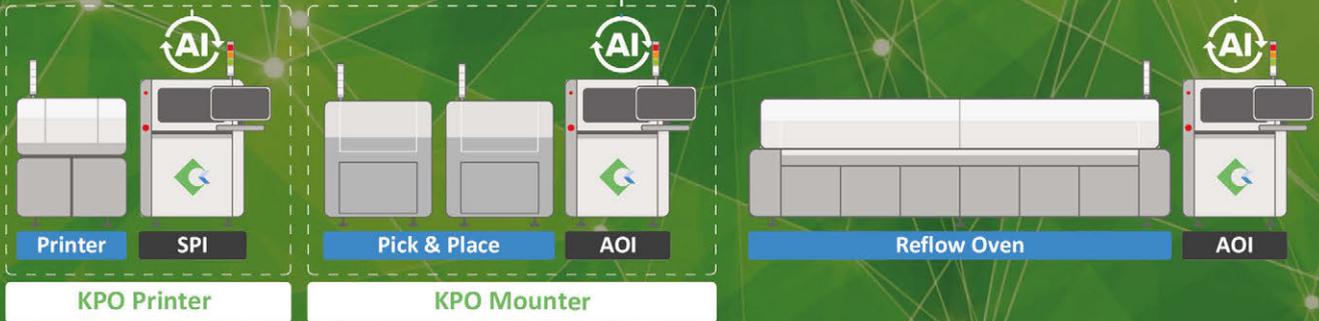
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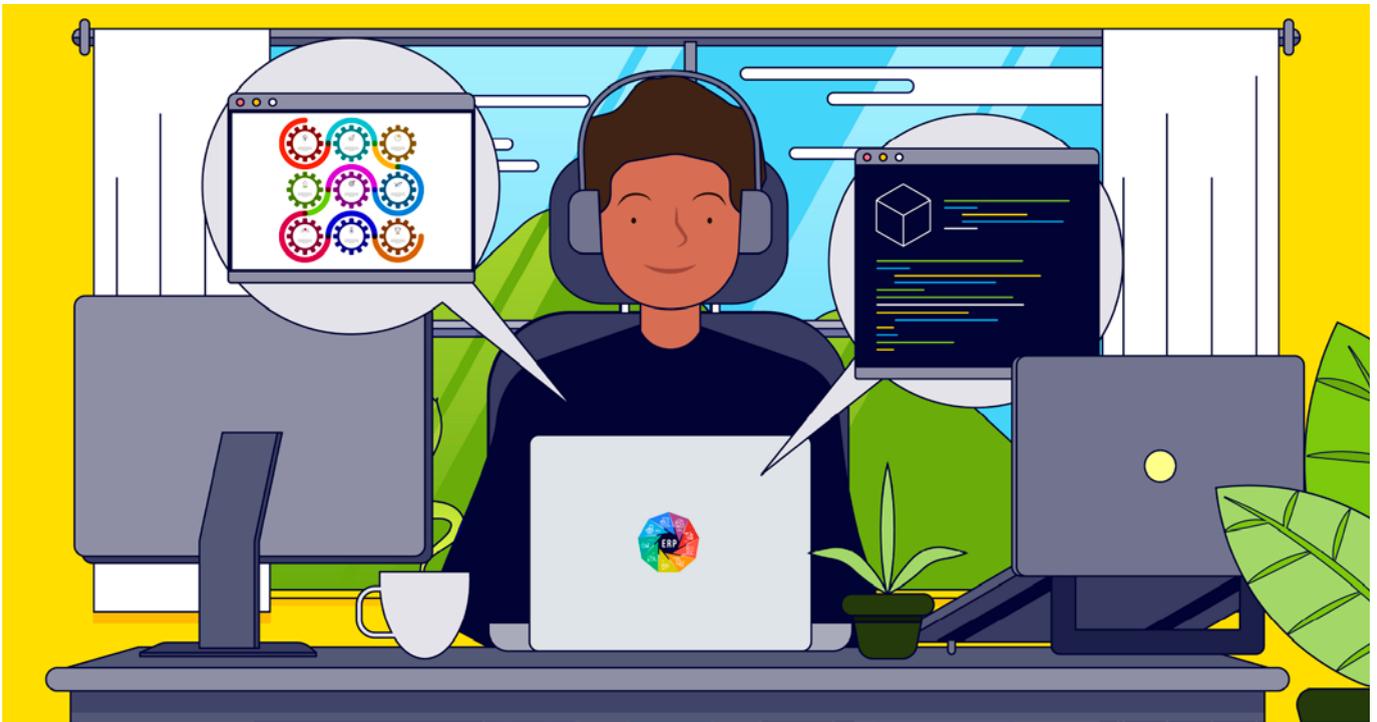
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# Laying It on the Line

Feature Interview by the I-Connect007 Editorial Team

What are the current challenges in managing workflow on a manufacturing floor? The I-Connect007 Editorial Team breaks down the process with Jason Sciberras, president of Saline Electronics Inc., who shares insight into how his team has responded to the challenges faced across the industry. Jason says his key strategy has been the willingness to invest in technology, step back and look at the problems, and be bold enough to take risks. The payoff? A company that's growing and customers that keep coming back.

**Nolan Johnson:** We have focused quite a bit on supply chain this year. I'm sure this environment is even more challenging as you plan the work on and through the manufacturing floor. What has that been like?

**Jason Sciberras:** "Crazy" is a great start. It's the biggest challenge we've had in my 20 years in

this industry. Many of our customers have been with us for decades and we've built a reputation, so it's even more challenging. We use a master scheduler to plan out what our production floor will look like for the next four weeks and it's very difficult with all the decommits we've had this year from suppliers and manufacturers.

You often don't find those surprises until the parts are past due. We've had to create a position at Saline, a person who just calls every one of our major distributors with the purchase orders that are coming in the next two weeks to ask, "Are we still on track? Do we still have these parts coming in?" Even with that piece, sometimes we don't find out that the parts aren't coming until there's no tracking number.

We're being flexible and moving jobs around to not have equipment downtime and then suddenly when the parts do come in, you cre-

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Jason Sciberras

ate these big blobs of work that need to get done. It's a unique challenge that I haven't seen before.

**Johnson:** Can you quantify the decommits? Is it twice what it was before?

**Sciberras:** It's a lot more than that. These last couple of months have been better than the first seven or eight months of the year. Still, we're probably seeing two to three dozen decommits a week.

**Johnson:** Against how many jobs a week?

**Sciberras:** Probably releasing 150 to 200 jobs or so.

**Johnson:** That's a big number.

**Sciberras:** Yeah, it's a big percentage, but it takes thousands and thousands of different parts to do what we do. We build very complex assemblies. There are a lot of little pieces and some parts you can put on later, but that causes other issues. If the printed circuit board gets delayed, I can deviate a few parts, but I can-

not deviate the printed circuit board. It's been a unique challenge.

**Johnson:** You've hired somebody specifically to keep in daily contact with your suppliers to look for decommits. That says a lot. Now, have you had to drop into a more detailed analysis of the bill of materials? It sounds like multiple simultaneous solutions right up front for every job.

**Sciberras:** We've got parts where I can't get a specific BGA. Instead of re-laying out the entire board, we've created interposer boards so we can fit an alternate part on there and translate to the parts that are available on the fly just to keep our customers up and running.

## Job Setup and Workflow

**Johnson:** Let's move down the process to setting up. Customers hand over specifications and design details to you and your team at Saline. How has your process of doing that job been changed by what we've dealt with for the past three years?

**Sciberras:** We're so much busier. There's so much more to do on it.

**Johnson:** Is it enough to just work harder or do you need to work smarter too?

**Sciberras:** It's both. The evolution of our process over these last two years has been constant. I have an amazing team that I'm very proud of. It would have been very easy to get discouraged and say, "This is just too hard," or, "What we've done should work." We've had to evolve for sure. How we quote and when we quote is very different than what we used to do. Having good tools that allow us to see what those lead times look like and who's got stock, we must know a lot more information up front and then find ways to actively attack the issues.

There's more of them than ever. We've always had a process where a customer needs it in a certain time frame, but the lead times are a little bit longer than that. How do you attack the component constraints? When it was four or five items, that was fairly manageable. When it's 25, 35, or 45 across every single customer, we've had to redevelop those processes to handle different volumes. Shifting, quoting, and purchasing have become one entity where they really work together to find the best ways to get the customer what they need, when they need it.

**Johnson:** What new tools have you included? Many of these functions seem like they're well-suited for software, letting the computer do the grunt work.

**Sciberras:** We use a software tool called StockCQ which gives us a very good idea of what everybody has. It's an awesome starting point. That software gives us an idea of where we need to put our effort. Then there are quite a few homegrown tools we've designed to give our team bite-size chunks so they can manage and not be overwhelmed by the number of components they're working on.

We are using some of those tools to put the information in front of the people and then automatically updating it in real time so they can see how we're doing.

**Johnson:** I'm sure that has an impact on the major categories for floor planning. There are the materials, supplies, labor, process, workflow, and time. What is the impact from using these external and internal tools?

**Sciberras:** They make a huge impact. We're making progress every single day. We feel it keeps getting better, but it's not as easy as it was before. I have a tremendous team that is working very hard to find ways to make it happen every single day. Without these tools, we would have drowned.

You hear a lot of stories about contract manufacturers that are struggling to just get things out the door with all their different challenges. I'm sure some companies will not be able to survive this catastrophic event. It's just been so difficult. They have helped us grow. Even in these crazy times, we're getting larger. I feel we're winning in places because we're not doing what everyone else was doing. We're not perfect, by any means, but we are getting better.

---

**I feel we're winning in places because we're not doing what everyone else was doing.**

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**Johnson:** Tell me about your homegrown tools.

**Sciberras:** SiliconExpert has been a huge piece for us. We do Mentor Graphics for DFM, but they're mainly helping us understand whether the designs will work and where we are. We use Valor for design reviews. We have some tremendous relationships with our distributors. Because we have been around for 20 years, we have great relationships with distributors that are helping us through. I have a very large IT support team compared to most companies our size. I also started in IT, so it's near and dear to my heart.

The team is constantly using business intelligence software or using software or VBA scripts in Excel to present the information so people can do what they need to. It may take us 10 steps to buy a part that used to take us one. Each tool helps us do that more effectively.

**Johnson:** It may take you 10 steps now under the current circumstances, right?

**Sciberras:** There's still only so much energy to go around and it's important to effectively

utilize that energy. I have increased both my supply chain and my program management departments because it takes a lot more energy to get the customers all the information they need. They're depending on us to give them the information so they can go back to their manager and say, "This is when I'm going to have product." We must work harder to get that information. We've added staff to help us with that piece as well.

**Johnson:** I imagine you have more computer software and compute resources doing the research and more people on the phone having conversations with your customers and suppliers.

**Sciberras:** Yeah, and more often. We meet weekly or even more often with most of our customers to review what we can and cannot build and what the hold-ups are. It just depends on what their needs are.

**Johnson:** You have someone on staff who proactively checks with your suppliers to get that information. Are your customers initiating that or is it internal?

**Sciberras:** I think it's both. We saw allocation coming at the end of 2019. We said, "Okay, not this time allocation. You got us last time." We really prepared hard. We strategized and our long-term customers were all in. We all made great decisions. We could see further out so we planned ahead.

Did they drop the ball? I don't have an answer as to what caused it, but it lasted longer than anybody anticipated. At this point, you have some fatigue, but you also have understanding.

We've all been through this battle together and we've got some great relationships.

Early on, we found the information was so hard to disseminate. We came up with "can build" and "good to build" reports with one of our customers. However, all their products are on a good to build. Maybe you have one component that's used on 10 different flavors on an assembly we build for a customer. It's very difficult to see how they all work together and what I can and cannot build. Well, if I want 300 of this product, can I get 400 of this one? How do they all work together?

These "can build" reports never existed pre-allocation, but nowadays they're a regular part of our conversation.

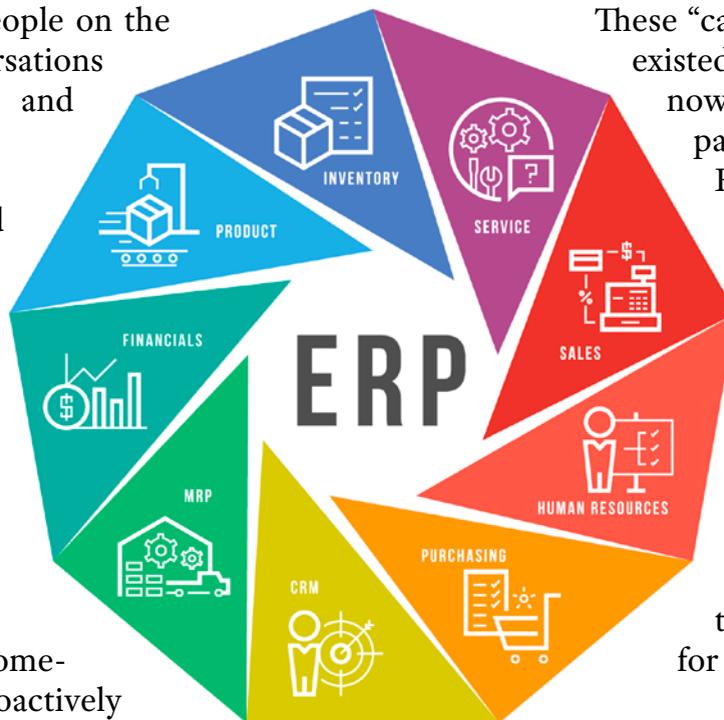
Every one of my program managers does them. Each makes them a part of their conversations with their customers.

**Johnson:** Did you find you needed any upgrade changes to your ERP MES systems or was that stable for you?

**Sciberras:** I'd say the software itself was stable. We stay on top of it, making sure we're using the latest and greatest versions of the software. It is a prime directive here that software is always up to date. While we didn't need to install anything new, how we entered, manipulated, and reported that data definitely changed.

**Johnson:** Tell me about that.

**Sciberras:** It's about the constraints process. A typical order comes in, we look at the constraints and make sure we're actioning those things immediately, so that we have more time



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for our documents, tickets, and package to get scrubbed—for the visual aids to be created, the BOM created, and so forth. But when everything's a constraint, you don't necessarily have the time to go after the constraints.

We've had to modify that process and dedicate more resources. The procurement team has done a phenomenal job of being flexible and continually changing their processes based on what was working and what wasn't.

I believe in commodity-based buying because of the knowledge that it creates; you get experts in specific fields where the workload is. The team had to become very nimble and work in little groups to constantly shift the workload so if someone is overwhelmed they can receive help. We identify where the bottlenecks are so we can react to them. That was a big change.

---

**I believe in commodity-based buying because of the knowledge that it creates; you get experts in specific fields where the workload is.**

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**Johnson:** With parts supply so tight, what else changes?

**Sciberras:** I have an example. Traditionally in our industry, there's some scrap factor. When you set up and tear down a surface mount feeder, you will have some amount of scrap and that's always been acceptable. We all know about it. We know how to utilize it, but when there are 632 pieces of a part in the entire world, the customer doesn't want to hear they will lose four or five during set up.

I paid a lot for these things. Even with changing our setup and tear-down practices for

these critically constrained components, we're actively managing 75,000 individual line items of different components—which ones are critically constrained, will need these special processes, or don't. We've had to evolve and get better so we can minimize the waste that is part of any normal manufacturing process.

**Johnson:** Based on these new practices, it's about balancing the timing, and the fact that the timing is always changing: "We can build it Tuesday. No, we can't build it until Thursday. Today, we can build it Wednesday. No, it's going to be next week." Does that open more room to be asynchronous about programming a job? Can you do setup while you're waiting?

**Sciberras:** Yes, but that's always been part of our process. We have somewhat had the opposite problem: Because we set up, we never want our lines to go down. Our lines must always be running.

We have a pit crew changeover team that does a great job of making sure we set up the right amount of material before the job starts, but to be done in time, we are working off a set of known information. This part will be here on Thursday. You must set up these six jobs in order and suddenly that one part doesn't come in when it's supposed to come in, and all the setup just got thrown out of whack. How do we reconfigure to do that?

It's about the technology, something we have invested in. We have an awesome tool, an intelligent feeder system, from Cogiscan. Because it's all RFID, we're faster than we've ever been at being able to move, shake, and switch from this process to that process. I have six high-speed surface mount lines here. They all use a lot of feeders.

I need feeders to support what isn't running yet, but if one thing doesn't show up, that job you were planning on running tomorrow isn't running because FedEx is running behind. Now, how do you switch "placeholder" jobs? We created this term to describe when we run

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something else until the other thing comes in. Having to shuck and jive like that in real time is crazy.

Ultimately, all this will end. I can tell you that we are a better company at setup, tear-down, and changeover, which at a low- to medium-volume contract manufacturer is everything. We're getting better at the changeover process—the shucking and jiving. When things are available, this will be easy.

**Andy Shaughnessy:** Do you have any advice for those facing the same problems that you've come up against? For some of your competitors, they may not have investor capital to draw from, and just may have to do it all out of revenue. How would they move forward to be nimbler?

**Sciberras:** Information is king. If you do not understand what is happening in real time and you don't understand what your problems are, you have no chance. What is the data telling you?

Start with an understanding of what is happening and the tools you utilize. Invest if it makes sense. That is absolutely critical. I don't think you can play catch up on a thing like that. We've been working on it for decades, constantly investing into the organization so that we can be as nimble as possible, but if all else fails, go back to the data.

Continuous improvement is a journey. It's a real thing. I remember my first couple of weeks on the job, we were just starting to go through ISO; our first ISO in 2002 and ISO 9001, I thought I knew what they meant; I didn't fully. Now I can look back and say it is truly a journey. Enjoy the ride. It doesn't end.

**Johnson:** Thanks so much.

**Sciberras:** It was great to meet you too. **SMT007**

## LOOKING BACK: Previous Reporting on Workflow Management Success



In the April issue of *SMT007 Magazine*, we interviewed Michael Kottke, president at Rocket EMS. In that interview, titled “The Future is Driven by Data,” here was our introduction:

“When we visited Rocket EMS in 2013 to observe a DIY 4.0 factory data collection and management system in action, we were very impressed. This was clearly a factory of the future, even back then. We recently followed up with Kottke to discuss how this work has given the company a huge advantage over the competition. The moment he realized he's now in a data collection business that happens to build printed circuit boards, everything changed.”

While this interview ran as an example of the factory of the future being in the now, Kottke illustrates just how a factory 4.0 data management system can help optimize workflow. This interview plays in nicely with our issue this month on workflow management. To read the full interview, [click here](#).



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# Your Shortage Is Someone Else's Excess

Feature Article by Chintan Sutaria  
CALCUQUOTE

## The Problem

Excess inventory is a ubiquitous issue in the electronics manufacturing services (EMS) industry, and it is made worse by the complexity and volatility of the modern supply chain. Considered an unavoidable cost of doing business, unchecked inventory cost has wreaked havoc on manufacturers without strict controls in place to keep their businesses safe. Excess inventory is not only costly for manufacturers themselves, but also for their end customers. Unwillingly, manufacturers are sometimes forced to eat this cost to avoid disrupting relationships with their customers and with the hope of making up the losses in next year's orders from the customer.

The other end of the inventory position is also a serious problem. While excess inventory can tie up much-needed capital, a lack of nec-

essary inventory can prevent an EMS company from shipping assemblies to their customers. In fact, missing just one part can have a significant impact on the amount of capital tied up in partial kits waiting to be released to the production floor, or in incomplete work orders. The adage, "The most expensive part on the BOM is the part you don't have," became popular during the MLCC shortage of 2018 and has continued to ring true during the latest round of supply chain constraints.

Supply chains and markets experience normal fluctuations, so this type of excess and shortage situation is not necessarily unique. But the impact on OEMs and EMS companies seems to be much more extreme than the normal ebbs and flows of a market. This is because even when the market in aggregate has suffi-



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cient supply, the right components aren't in the right places at the right times. Pains of fluctuations in supply chain include:

- Tied up working capital
- Time and resources spent searching for inventory
- Increased shipping costs due to erratic purchasing
- Amplified price volatility
- Environmental and financial waste
- False demand signals that artificially increase production

## Building the Solution

In 2001, IPC launched EMExcess. Ultimately, the program failed, due in part to the lack of balance between buyers. Everyone was willing to offload their excess inventory, but no one wanted to take the risk of using someone else's excess.

The current supply chain environment is quite different from previous market cycles. This old idea was made new again at IPC APEX EXPO 2022. At the annual conference, I met with Steve Pudles, former chairman of IPC, an IPC board member for 22 years, and currently CEO of Zentech. Seeing our company's ability to make component search more accessible led to a suggestion from Pudles: a peer-to-peer marketplace where companies could directly trade inventory with each other.

This idea began to draw various supporters from all over. With help from IPC, we began organizing roundtables of EMS company executives to discuss the problem of component shortages and excess materials. More than 75 EMS companies were represented in the discussions, and they collectively expressed a renewed interest in building a private marketplace for OEMs and EMS providers. "By involving so many stakeholders in open, roundtable discussions, early in the process, we were able to address concerns and build consensus around what is fair," said Mark Wolfe, IPC's executive EMS advisor. StockCQ was born.



Chintan Sutaria

Today, it is a global, searchable database with hundreds of thousands of unique part numbers. The nearly 100 participating companies are qualified before their inventory is listed to ensure the community is exclusively OEM and EMS companies. Dozens of matches are made each week between sellers and buyers of components.

It is expected that buyers will still always prefer authorized distribution channels over after-market trading. But in the "new normal" of supply chain volatility, buyers are happy to know they have yet another resource where they can trade parts with companies they can trust.

The program is working toward streamlining the transactions and incorporating the StockCQ search into a buyer's normal workflows. For example, during the RFQ process, a buyer who cannot find a part through their primary channels can instantly search our database inventory via QuoteCQ.

CalcuQuote's ability to search components and understand the use case of an electronic components buyer paired with IPC's ability to bring the industry together for solving problems makes a digital marketplace a viable solution to today's supply chain challenges. **SMT007**

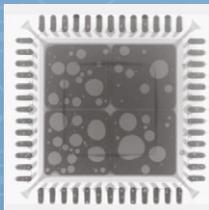
Chintan Sutaria is CEO of CalcuQuote.

# Pyramax Technology to Eliminate Solder Voids

## Pyramax Vacuum

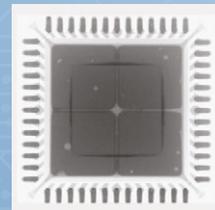


Vacuum reflow is a proven solution for PCB assemblies or products that require low solder voiding for critical performance applications. Pyramax Vacuum has been designed with the requirements of large EMS, OEMs and high-volume automotive segments in mind. The system features controlled heating within the vacuum chamber enabling industry leading thermal uniformity and the tightest control of liquidus time. Processing temperatures of up to 350°C can be achieved with vacuum levels lower than 20 Torr. Integrated controls and fully automatic vacuum operation are achieved via BTU's proprietary WINCON™ control system.



Traditional Reflow

Voiding occurs when flux or solder paste oxidation is entrapped in the solder joint. Shown here is an MFL processed with and without vacuum reflow. BTU's vacuum reflow solution is designed to reduce voiding to <5% (process dependent).



Vacuum Reflow

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# Clinging to Best Practices in Worst-case Scenarios

## Smart Factory Insights

Feature Column by Michael Ford, AEGIS SOFTWARE

We develop best practices to ensure consistent and optimal operational performance, quality, and consistency. The nemesis of this activity is change, which prevents those best practices from becoming stale and shackling the operation. We must take a more modern approach to best practices, one that embraces the ability to change, and is flexible and adaptable to cope with the unexpected (which are actually expected) issues. Knowing how to create change-centric manufacturing best practices comes from experience.

Smart factory related projects tend to be driven from a technical perspective, by both

internal teams and external solution suppliers, neither of which is ideal. Internally, projects tend to be driven by a narrowly focused utilization of Lean and Six-Sigma techniques in refining an operation or process and eliminating every form of waste. This is often done using simulation tools that create the very highest performance, and which result in operational best practices. Any change required in the operation, however, invalidates the optimization result. It is too expensive to repeat such projects every time something changes, so such practices are rarely updated. This is no longer acceptable in an environment that





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brings change on an almost daily basis. If you look around your shop floor and think that shaving off a fraction of a percent of operational time at any station through finite simulation is more important than simply managing to keep operations flowing as changes and challenges occur, then the rest of this article may not be for you.

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## Smart factory related projects tend to be driven from a technical perspective, by both internal teams and external solution suppliers, neither of which is ideal.

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Talking with external solution providers tends to be quite laborious. Most providers focus primarily on sales of their latest technologies, which represent slight iterations of what they had before, or they share lists of mostly irrelevant functions (described in aging presentations) with only a few new graphics. Both approaches have essentially the same problem: They were designed for a narrow paradigm of manufacturing which disappeared years ago. What is left is the need for extensive customization and adaptation. The largest, most established MES solutions seek to hide that significant customization of existing functions will be needed, almost ubiquitously, to make their paradigm fit yours. At the opposite end of the solutions spectrum, the most recent simple app-based platforms seek to defer or move the need for code outside their sales cycle. In each case, these providers are compromised in what they can offer: either an aging data-model or no data-model at all, both of which trigger the need for significant unexpected costs.

By contrast, some external solution providers that strongly engage with their customers understand change. As they visit manufacturing sites, they see that each has different needs and a desire to introduce change to create sustainable solutions. By listening and understanding evolving customer needs over time, these providers understand the market conditions and challenges and they take a different approach to creating and providing solutions. With the whole manufacturing world currently experiencing a wealth of challenges—a perfect storm that includes supply-chain unreliability, increased human resource turnover and skills shortages, energy shortages, inflation, and market-demand fluctuation—many companies are feeling helpless. They feel trapped in a seemingly never-ending vortex of one crisis after another. However, companies that have embraced the need to transform and adapt find there are opportunities to discover.

### **It's the Way You Look at Opportunities**

First, we need to stop thinking about challenges as being unexpected. These are just excuses. “Undesired” is probably a better description. I would be surprised if any of today's challenges have not happened many times before. But when there has been a perceived low risk of a potential challenge, it gradually gets ignored—even when the consequences are potentially significant. Manufacturing has become too trusting of its environment, depending on things that cannot be controlled. Rather than going back to a world where everything needs to be manually checked and personally managed, there needs to be a new method to pick up on things that must never be forgotten, that may potentially put the business into a make-or-break situation.

Digital transformation should not be treated as just another buzzword. Businesses must make quick and accurate decisions to react effectively to change. The sheer complexity of issues routinely occurring with prod-

uct information, materials, quality, and execution across any manufacturing floor, makes decision-making fraught with compromise and brings the risk of incurring losses in performance and opportunity. The role of modern, technology-based solutions should be to create an environment in which such key decision-making is supported, so that it becomes immediate and accurate. Digital best practices should be defined from semi-automation of top-down decision-making activities following the needs of the business.

The essential action here is to take out manual data-gathering, modelling, and analysis processes that are error-prone, slow, and compromised when left to the unaided human, then move them into the digital domain. Let's look at two examples.

The first example relates to new product introduction. The predominant practice today is also the worst, something that goes back 30 years or more. The exchange of product information between design and manufacturing uses diagrams, pictures, and lists that are often sent insecurely by email. Engineering is then relied upon to convert the information, create operational plans and work instructions, as well as costing out the manufacturing operation, confirming capabilities, timings, etc. However, there should not be any need for significant engineering involvement. Data needed by manufacturing, including 3D CAD, the layout of a PCB, and the bill of materials (BOM), can be securely and digitally transferred using a choice of standard dig-

ital formats. The data is converted through an automated system, creating electronic work instructions as well as machine ready data. But this is just the beginning, as meaningful manufacturing management in terms of quality, materials, test, inspection, governance, and traceability are all related back and set into context with the original product data.

Rather than having a wealth of reports with very little value, using digital automation provides a fully accurate contextualization of every aspect of production. Decisions related to cost, timing, capacity, quality, yield, delivery, alternate materials, etc., are now qualified digitally. People then make the final decisions quickly, based on an accurate, holistic understanding of the situation. The result of this digital best practice reduces the time taken for new product introduction, which then increases the accuracy of job quotations and eliminates the unexpected challenges of expertise needed to resolve an issue relating to capability, capacity, or quality. Changes in product

designs (including variants) can be quickly and easily managed. This allows operations to be more flexible and without losses.

The second example relates to an unexpected material shortage. It takes things to the next level, meaning that it avoids the need to make decisions at all. ERP says "yes" to material availability and allocation when the work order is created and production starts, but then materials needed later cannot be located. The warehouse and the shop floor are scoured for



materials. They must be “somewhere,” maybe in discarded, part-used carriers, perhaps taken for test or inspection, or even allocated to another work order. Instead, consider recovering and re-working spoilage or even scrapped parts, find alternatives or substitutions. In the physical world, many of these actions become tiresome and expensive fool’s errands, as there simply isn’t time to do all these things without affecting operational or quality performance. In the end, a solution is not likely to be found. With MES-based digital transformation, all these actions are accelerated by the intrinsic knowledge because they detail the precise location and status. This would obviously help, and in many cases the day could be saved, but this is hardly the very best practice that we can create with these tools.

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**In the physical world, many of these actions become tiresome and expensive fool’s errands, as there simply isn’t time to do all these things without affecting operational or quality performance.**

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The above scenario, with a Smart MES in place, would never have happened. Knowledge of individual materials based on IDs allows automation of data collection related to precise instances of consumption and spoilage of materials (whether from machines or human operations), logistics (which includes warehouse management), assignments to production stations, part-used material returns, test, and inspection. This is set into context with the production requirements, including the product data, allocations of work to production sta-

tions, and the intended schedule. Any materials shortage is then predicted, in most cases long before commitment is made to start the work order. This provides time to find alternate materials, including ordering replacements through the connected ERP, and becomes an event that is invisible to the operation itself, which is not disturbed. Accurate inventory data shared with ERP creates more opportunity to source materials so as not to constrain planned output for the customer, even where materials are in short supply. We now have our new, digital best practice.

These are just two examples where manual practices based unrealistically on optimized operations are replaced with digitally based best practices that address consequence of change. I was told recently that the modern, single-platform IIoT-based MES solution has around 60,000 functions, all of which are working together to represent a mature ontology and enable such improvements and best practices.

Digital transformation, with the modern MES solution at the heart, contains a mature data model and ontology that enables the complete re-writing of existing best practices to deal with challenges driven by undesired changes, even before they become issues. This illustrates the key difference between companies showing real-world business-enhancing solutions, as opposed to solutions that focus only on technologies.

Don’t hesitate to reach out to me with any such examples that you may have or seek to discuss. No one will ever be the final expert here, as we learn more, and see more changes, every day. **SMT007**



**Michael Ford** is the senior director of emerging industry strategy for Aegis Software. To read past columns, [click here](#).



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# Material Management and Control

Feature Article by Davina McDonnell

COGISCAN

In a market that is trying to catch up with increasing customer demands and quickly ship products out the back door, no electronics manufacturing plant can afford to lose any time or resources during the production process. Manufacturers are forced to do more with less and get the most out of every single precious component.

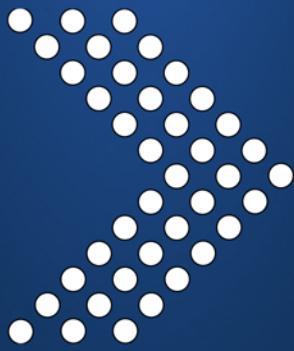
When you finally get your hands on inventory, perhaps after months of delays due to part allocation or supply-chain snafus, it's critical that not a single part is wasted. While reducing waste has always been a big focus for electronics manufacturers, it's now a top concern for

factories around the globe to ensure the right material is in the right place at the right time.

## Getting Control of the Kitting Process

One area fraught with the possibility for material mismanagement is the kitting process. Considering most PCBAs today use hundreds of different components, kitting the materials for a production run can be both arduous and time consuming. In a fast-paced environment like electronics manufacturing, if the kitting process isn't controlled and managed properly, it can expose a manufacturer to opportunities for waste.





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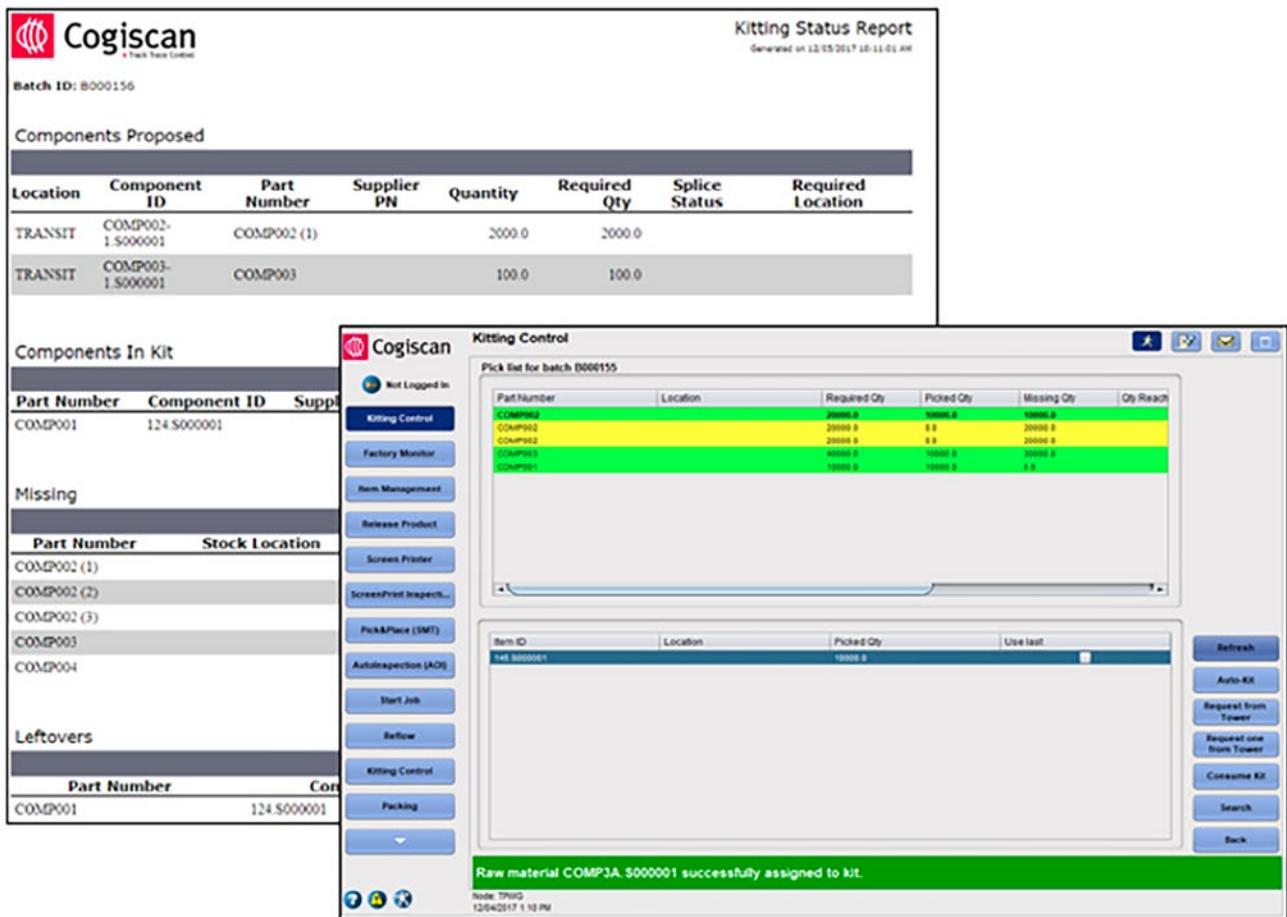


Figure 1: Screenshot of a kit getting built in Cogiscan’s application.

With Cogiscan’s kitting control module, operators are precisely guided through the material picking process with a detailed kit list for each job—listing exactly where the components are located, how many are needed for the scheduled job, and precisely where they need to be loaded. Whether the components are sitting on stockroom shelves, or within an intelligent storage tower, the kit list will define the precise location.

As every factory runs a bit differently, this kitting module allows for custom-defined rules based on inventory consumption preferences. For example, a manufacturer can set up the system to pull materials based on FIFO rules, to consume partial reels first, or to select and kit reels that have enough components to get through that entire job to maximize line productivity and reduce material replenishment time. Each manufacturer has the freedom to

customize the kitting preferences based on the real-time production environment.

## Setup Control for the SMT Factory

Accurate kitting is only half the equation to ensure the right materials are selected and ready for production. The other important factor is the actual setup of materials and machines. With Cogiscan’s setup control module, manufacturers can verify that all the right elements are being used correctly. This includes validation of components, tooling, and consumables, as well as the machine program.

Instead of waiting until the job is running on the SMT line, manufacturers can verify accurate setup in the offline setting. So, if there is an error found in the setup configuration by the system, it can be corrected before being released to the line.

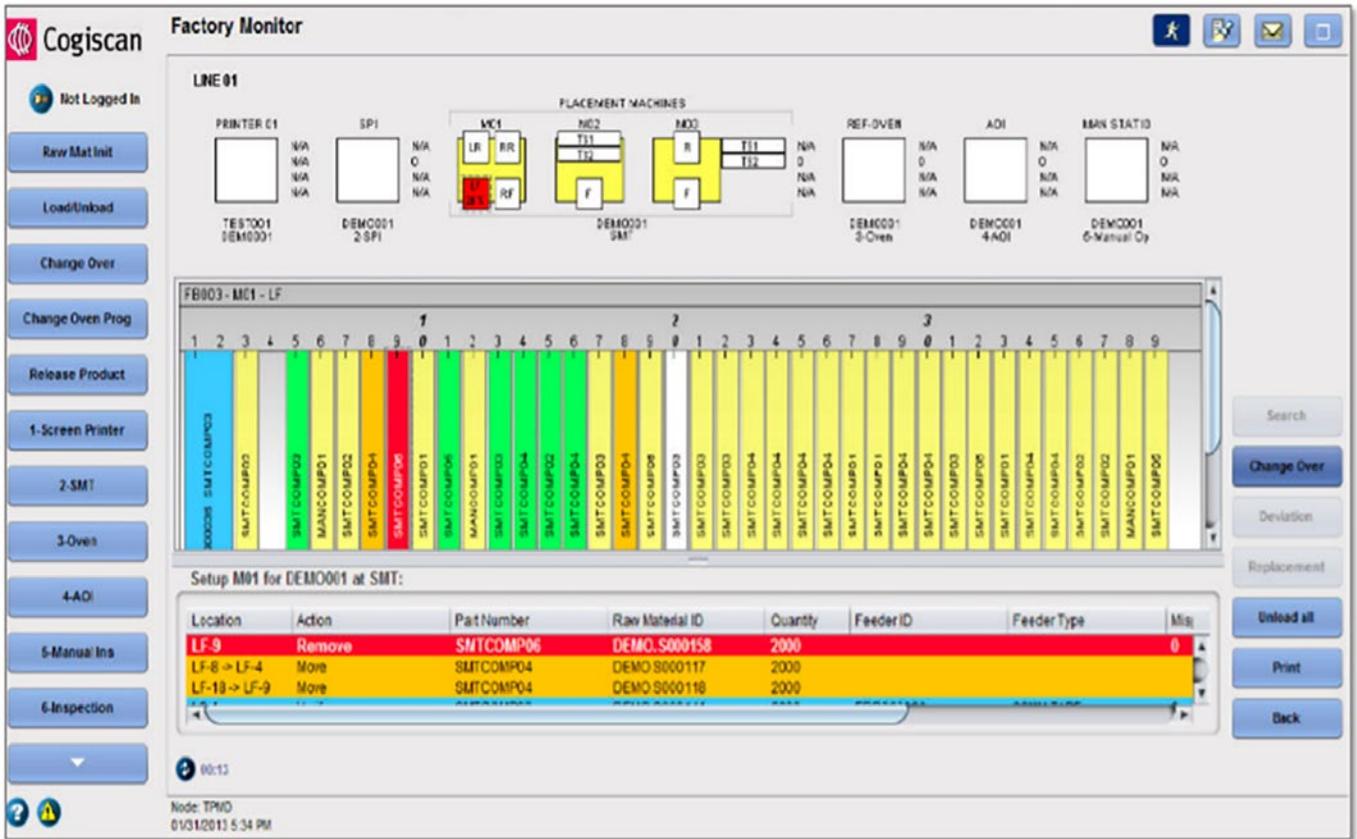


Figure 2: Screenshot of the factory view of setup control for material reservation.

## Keeping Your SMT Line Fed and Running

Having an intelligent kitting and setup control process in place kicks off the start of a production run well but it is not the complete solution to keeping the line running smoothly during material replenishment and change-over. That's where things can get tricky for an electronics manufacturer as too much time can be wasted while replenishing the line.

To avoid line downtime during production and to ensure the right materials are ready to go, manufacturers around the globe leverage our flexible integration solution that enables complete machine connectivity and intelligent communication between storage towers and placement machines. Included with an automatic low-level alert system, manufacturers know their placement machines won't be down for too long waiting on components.

Seamlessly handling multiple lines and various production runs, this system is designed for high-mix, mid- to high-volume requirements. Since most electronics manufacturers run multiple product types on different lines, and many products share components, it can be tricky for operators to manually balance where materials should be prioritized. Within this system, an urgent assembly can be prioritized to get materials first by dedicating a specific storage tower to that priority SMT line (whereas other towers might serve multiple lines at the same time).

In Figure 3, SMD Tower #1 is assigned exclusively to LINE1 (running the urgent product). To make sure that SMD Tower #1 does not serve LINE2 and LINE3, the system blocks this tower from releasing materials to other lines to guarantee the needed parts for the urgent assembly (PRODUCT1) will not be

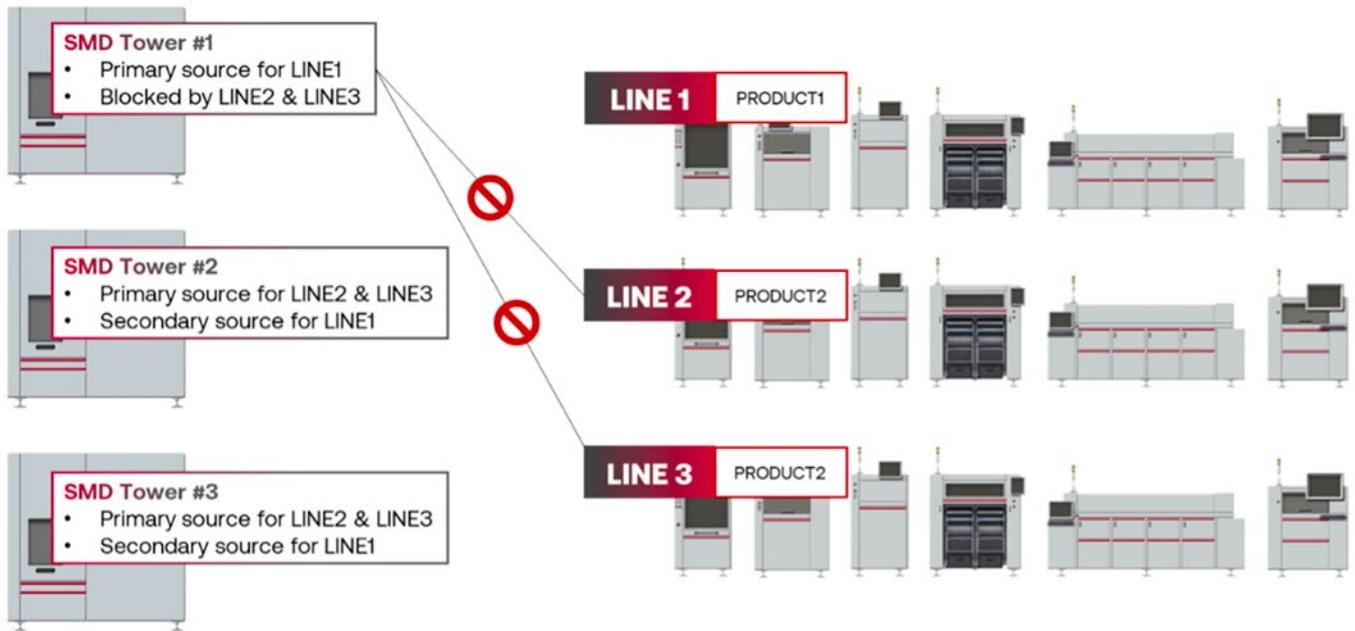


Figure 3: Assignments of the towers and how they work together.

taken by demand for those same parts on other assemblies.

In the competitive landscape of PCB assembly and the fast-paced nature of this market, electronics manufacturers are under tremendous pressure to ensure the utmost accuracy of all elements on the production floor. Today more than ever, it's paramount that products get built correctly the first time. Automating the management of your materials with an intelligent software system through accu-

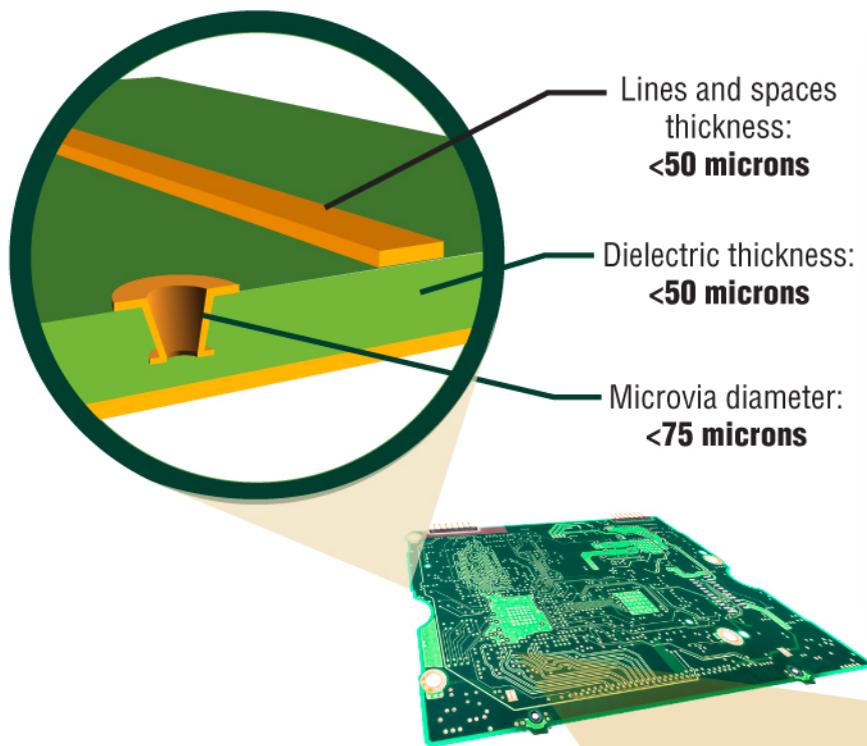
rate kitting and setup control, as well as low-level material alarms, is an effective and simple way to guarantee the best usage of all precious materials during production. **SMT007**



**Davina McDonnell** is global marketing manager at Cogiscan.



# Anatomy of Ultra HDI



## ...and getting even smaller

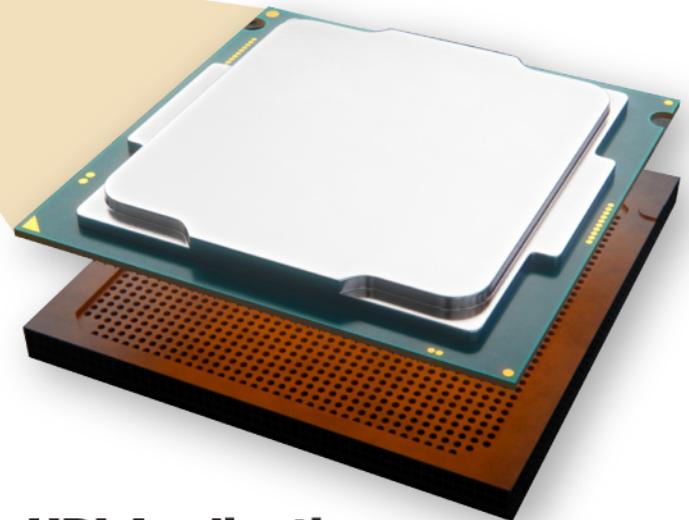
- Lines and spaces 20–40  $\mu\text{m}$  can be achieved using modified Semi-additive Process (mSAP)
- Semi-additive Process (SAP) makes lines and spaces <20  $\mu\text{m}$  possible
- Fully-additive Process (FAP) creates lines and spaces <10  $\mu\text{m}$

## Chiplet Integration

2.5D and 3D IC packaging has gained momentum as an ideal chiplet integration platform due to their merits on achieving extremely high packaging density and high energy efficiency.

New thin, organic materials (ABF) replaces silicon as the substrate.

Source: ASE Technology Holding, Co., Ltd.



## Examples of Ultra HDI Applications



# Advanced Packaging Gets an Additive Upgrade

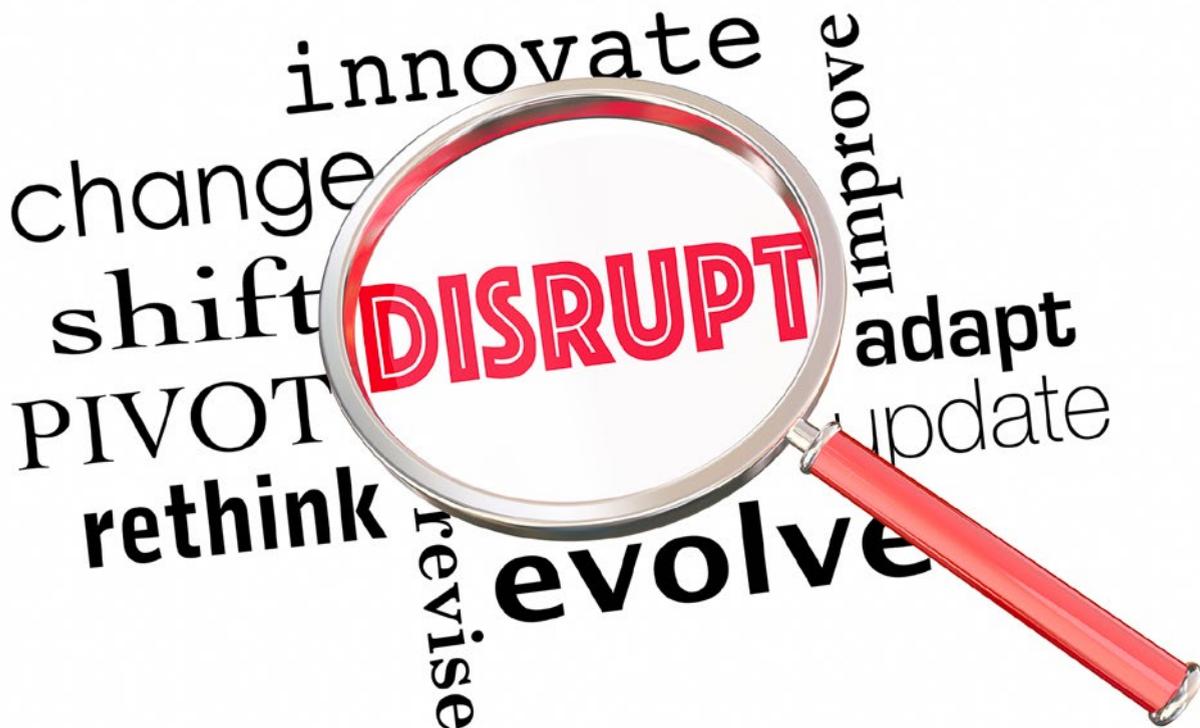
Article by Art Wall  
NEXTFLEX

The recent approval of the CHIPS Act has reignited the U.S. semiconductor industry and shone a spotlight on the intricacies involved in chip manufacturing. As new technological innovations—such as 5G, IoT, AI, automotive, and high-performance computing—come to market, they’re pushing chip manufacturing and integration capabilities. They demand more performance which leads to added complexity in an already extremely complicated process. All this requires a fundamental shift in the way that semiconductors are manufactured and integrated.

It’s no secret that many believe Moore’s Law, the standard basis for semiconductor innova-

tion over the past 50 years, is reaching the end of its reign. With a need to continue shrinking the size of components, engineers are running into roadblocks based on the physical limitations of electronics manufacturing, packaging, and integration. As manufacturers, we’re tasked with finding new ways of improving electronics capabilities, specifically regarding speed and size.

One of the key strategic avenues is rethinking how we approach the packaging and integration of modern semiconductors. This has implications across the board for chip design, including how they are combined and how they communicate between the chips. Com-



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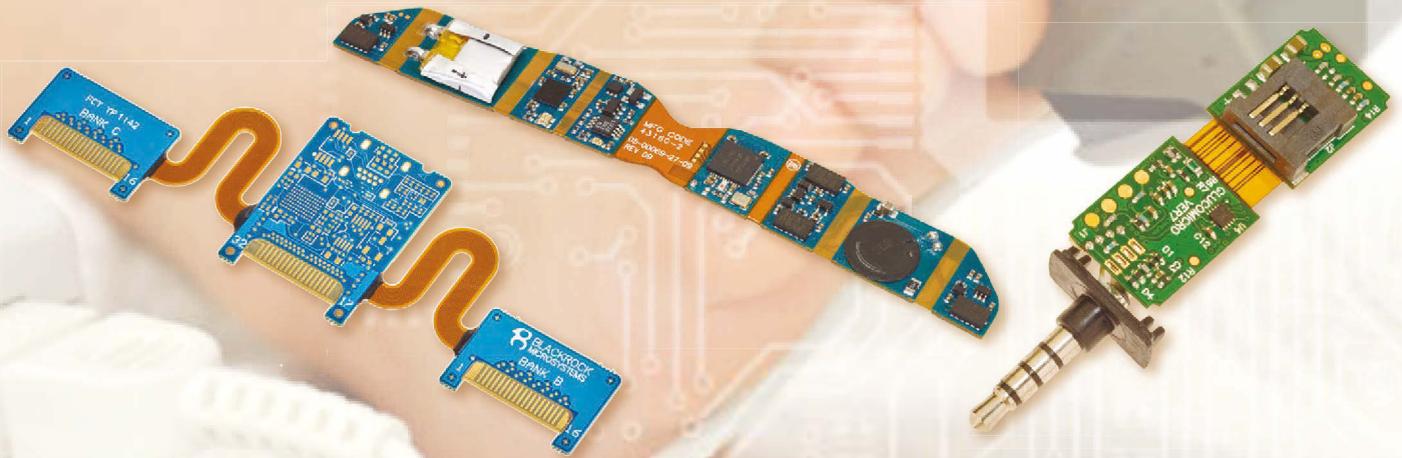
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binning dissimilar chips into an integrated package, called heterogeneous integration, and including somewhat generic chip building blocks called chiplets, is quickly becoming necessary to keep pace with technology advancement.

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**One of the key strategic avenues that's arisen is rethinking how we approach the packaging and integration of modern semiconductors.**

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## **Challenges in Traditional Packaging and Chip Interconnect**

Printed circuit boards (PCBs) are the backbone of electronics, acting to connect integrated circuits (ICs) and discrete components to form a larger working circuit. Historically, individually packaged chips and components are mounted to a PCB and interconnected to deliver functionality.

Following this methodology, all the layers in a board act as separate interconnects, leaving the top and bottom of the board to place components. As the drive to miniaturize while simultaneously becoming more complex requires the addition of more components, this is where we'll begin to see limitations.

An important part of the CHIPS Act was the recognition that not only does the United States need to make massive investments in chip-making facilities or foundries, but also to invest heavily in advanced packaging. Serving as the next step of combining or integrating these chips with novel approaches will be just as important in the innovation of U.S. semiconductor manufacturing capabilities. Some forms of this approach already exist through

methodologies such as multi-chip modules or system-in-package (SIP), but more radical approaches are needed to deliver the required performance of the devices.

## **Advance Packaging Landscape and Complementary Manufacturing Methods**

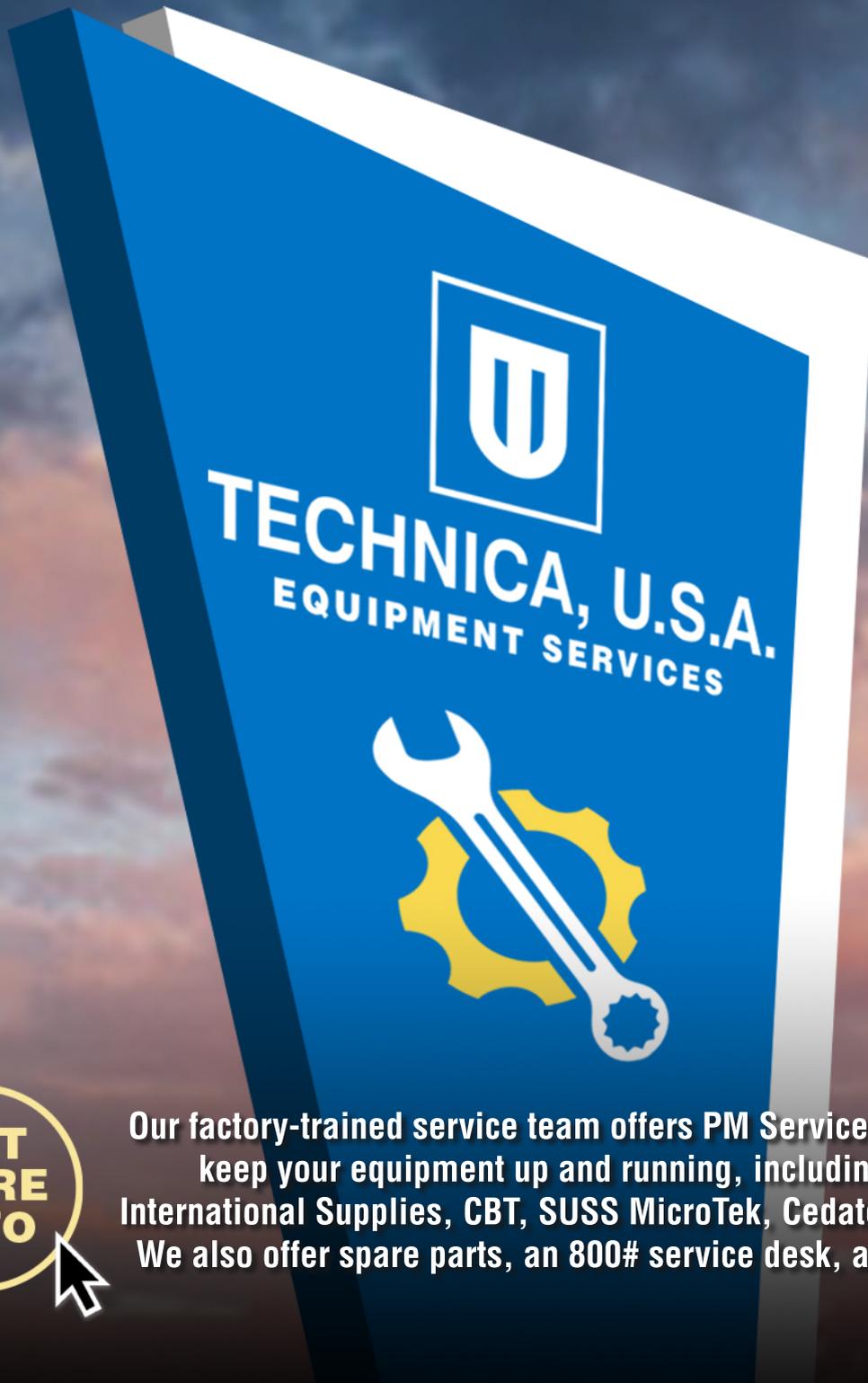
Companies like Intel, Qorvo, Mercury, and Skywater are pushing the limits of integrating chips and chiplets through new approaches to make chip-to-chip communication seamless. This provides many advantages in speed as well as miniaturization, but often requires extremely sophisticated, complex, and expensive tools and processing. While this is critical and important to the next generation of electronics integration and packaging, an interconnect methodology has been developed that can provide complementary capabilities: additive electronics manufacturing.

We see additive manufacturing all around us in the form of 3D printing. But several organizations are actively working on a method to bring these additive and printing methodologies into the process of printing interconnects for electronics. This can enable manufacturers to now print circuits layer by layer, opening the door to new capabilities in interconnection and allowing for components to now be embedded within the PCB itself.

In a sense, this takes care of the conventional packaging steps of the manufacturing process because you can add the raw component within the layers of the board. As a result, we've begun to see a blurring of the lines between chips, packages, and the printed circuit board, otherwise known as system level packaging. With the combination of these new possibilities for component integration and printed interconnect process, we can see many advantages such as far fewer process steps, lower cost, less waste, and rapid prototyping.

This will not replace the more expensive approaches for chip-to-chip integration entirely but can provide a complementary

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solution for the right applications. High-frequency applications are already taking advantage in some cases of chip stacking to improve both performance and miniaturization.

## Additive Processing Applied to Printed Circuit Boards That Can Also Be Flexible

It's easy to see the impact the inclusion of additive processes for electronic interconnects can play in advanced packaging, but this can also extend beyond and serve as an alternative to traditional PCB manufacturing. This would again take advantage of the faster and lower cost these methods provide.

Much of the materials, process, and tooling development in additive electronics comes from a technology referred to as flexible hybrid electronics (FHE). This is a concept where the circuit board is additively printed on a low cost, flexible substrate and bare, unpackaged, thin, flexible chips are directly integrated onto the printed traces. Flexible electronics have many applications such as medical wearable devices, asset monitoring, soft robotics, and more. Not only does this mean that electronic systems can be made flexible, but it also leads to a substantial reduction in weight, which is critically important in applications such as automotive and aerospace.

The opportunities for what we can achieve in the development of chip manufacturing and



Art Wall

traditional PCB processes following the signing of the CHIPS Act feel limitless. With this large emphasis placed on the role electronics play in our daily lives, we can begin innovating in new areas of the process, such as advanced packaging, and implement the benefits of additive techniques.

The simplification of electronic board manufacturing has the potential to revolutionize PCB manufacturing while also continuing to impact the advanced packaging process. We just have to take the first steps to meet the advanced needs of incoming innovations. **SMT007**

**Art Wall** is director of fab operations at NextFlex.

A dark blue banner with a textured background. On the left, the text "jobCONNECT007" is displayed in a large, bold font, with "job" in light blue, "CONNECT" in white, and "007" in yellow. Below this, the text "Companies seeking talent with circuit board industry experience post their jobs with us." is written in white. On the right side, there is a large, light blue magnifying glass graphic. Inside the lens of the magnifying glass, the website address "jobconnect007.com" is written in white.

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# MilAero007 Highlights



## IPC Symposium: U.S. Must Address Critical Gaps in Advanced Packaging Needs ▶

There is a significant capability gap in advanced substrate packaging in North America, forcing all semiconductors to be packaged in Asia and leaving North America at risk in its supply chain. This was a common theme during a two-day IPC Advanced Packaging Symposium.

## Electronics Industry Calls for U.S. Presidential Determination on Key Components Under Defense Production Act ▶

The electronics industry is calling on U.S. President Joe Biden to address urgent industrial base vulnerabilities and deliver on the promise of the CHIPS Act by prioritizing domestic development of printed circuit boards and integrated circuit substrates under Title III of the Defense Production Act.

## CAES Wins Contracts for Development of Next-Generation, Octa-Core, User-Selectable CPU for Space ▶

CAES, a leader in advanced mission-critical electronics for aerospace and defence, announced that it has won multiple contracts with the European Space Agency for the development of the GR765 System-on-Chip, the first user selectable CPU for space

## Boeing-Built SES Satellites Send, Receive First Signals ▶

Two newly launched Boeing-built satellites are sending and receiving signals as they continue their journey to their orbital destinations. “Our

unique dual-launch configuration was again successful on this mission,” said Ryan Reid, president of Boeing Satellite Systems International.

## Copper Foil Market Worth US\$17.32B by 2030 at 10.31% CAGR ▶

According to a Comprehensive Research Report by Market Research Future (MRFR), “Copper Foil Market Information by Product, Form, Category, Distribution Channel, and Region—Forecast till 2030,” the market is estimated to grow at a 10.31% CAGR to reach USD 17,321.8 million by 2030.

## Collins Aerospace Receives Milestone Certification for Combined Vision Systems ▶

Collins Aerospace has achieved a technical standard order for its combined vision system for business aviation aircraft.

## Dr. Hans-Peter Tranitz Appointed Senior Director, Solutions at IPC Electronics Europe GmbH ▶

IPC announces the first employee of its new legal entity in Germany, Hans-Peter Tranitz, Ph.D. Dr. Tranitz will serve as senior director, Solutions, at IPC Electronics Europe GmbH in Munich.

## Taiwan Union Technology Corporation First Company Globally to Re-qualify Products to IPC-4101 ▶

IPC’s Validation Services Program has awarded an IPC-4101 Qualified Products Listing to Taiwan Union Technology Corporation, an electronics materials manufacturing company headquartered in Zhubei, Hsinchu County, Taiwan.

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# An ‘Engaging’ Conversation

## Maggie Benson’s Journey

by Dr. Ronald C. Lasky, INDIUM CORPORATION

*Editor’s note: Indium Corporation’s Ron Lasky continues this series of columns about fictional character Maggie Benson and her company to demonstrate continuous improvement and education in SMT assembly.*

Andy and Sue were going to Mexico in two weeks to audit the factory that Maggie and John were looking to buy. They had secured their passports and were practicing their Spanish. They had agreed to only speak Spanish to each other for the past few weeks.

One night before their trip, Andy’s dad approached him and handed Andy an envelope.

“Son, Mom and I haven’t really done too much since high school as far as offering to help you pay for college or anything else,” he said. “Even without that help, you have accomplished a great deal and we are proud of you. I mentioned before that your girlfriend is one in

a million, so Mom and I want to give you this to help pay for an engagement ring.”

Andy was a little choked up as he opened the envelope from his father and saw that it contained \$2,000. Andy’s family was not the hugging type, but he immediately gave his dad a big bear hug. If an observer were to look closely, they might see tears in each man’s eyes.

The timing was excellent as Andy planned to “pop the question” to Sue before their trip to Mexico. With the \$2,000 he had already saved, he now had \$4,000. As Chuck Tower was now like a big brother to him, Andy decided to ask him where he might find a good engagement ring.

“You know, Andy, I got Tanya’s ring and John got Maggie’s ring from Professor Coleman’s father-in-law,” Chuck said when Andy chatted with him later at work. “He deals in gems and might be able to get a good deal for you.”





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“Yikes! Chuck, I could never ask Professor Coleman for a favor for something like that,” Andy said, sheepishly.

“Let’s ask Maggie and see what she says,” Chuck responded.

“Even that’s scary,” Andy said. “Maggie is our boss.”

“But she’s our friend too,” Chuck added as they walked together to find her.

“What can I do for our two greatest superstars?” Maggie said with a warm chuckle as Andy and Chuck approached her.

“Andy needs to get an engagement ring for Sue, and he is afraid to ask for Professor Coleman’s help,” Chuck replied.

“Andy, it’s about time,” Maggie said, teasingly. “Someone told me there was a pool started on when you would ask Sue to marry you. Professor Coleman is very kind and welcoming. I’m sure she would be thrilled to help you.”

Maggie offered to email Professor Patty Coleman and ask if she would help Andy. Of course, Patty agreed to help, but she wanted to meet Andy first, so he made an appointment and was off to Ivy University.

Andy had never been so nervous, with the possible exception of when he and Sue talked to her parents. Sue and Andy had discussed getting engaged but asking her parents for “permission” was scary. However, they were surprisingly supportive. Andy was pleasantly surprised as he still thought Sue outclassed him and he felt extremely fortunate that she would be his fiancée.

Andy walked in the hallowed halls of Ivy U’s engineering school and up the stairs to Professor Coleman’s office. “So, you are the young lad who needs an engagement ring for Sue March,” Patty teased as Andy entered her office.

*Two days later...*

Patty has called her her father-in-law, Dan, who is in Antwerp, the diamond capital of the world.

“Hey, Dad, I have a deserving student who needs an engagement ring. Do you have anything?” Patty asked.

“Perfect timing. I just got a beautiful sapphire ring with diamonds on the side. How much money does this young lad have?” he answered.

As soon as Patty said \$4,000, she knew it was a mistake to mention the amount of money.

“What a coincidence, it cost me \$3,500, so that gives me a little profit,” Dan responded.

“Dad, you’ve done this before. I’ll bet it cost a lot more,” Patty lectured.

“Well, okay, maybe a little more...” Dan sheepishly replied. “Dad...” Patty admonished.

“Okay, it was a lot more, but Patty, I just turned 70 years old, and it makes me feel good to help a young deserving young,” Dan confessed.

They chatted a bit more, but when Patty saw a photo of the ring, she almost gasped. Clearly that ring was worth multiple times more than \$4,000. Well, at least there will be one happy young couple, she thought.

*A few days later, Patty asked Andy to make a return visit to her office...*

“Well, here is one my father-in-law found for \$4,000. What do you think?” Patty said as she showed a picture of the ring to Andy.

It could not be said that Andy knew much about gems and engagement rings in general. However, even he knew that this was no \$4,000 ring.

“Professor Coleman, that sure looks like a much more expensive ring!” Andy exclaimed, as Patty replied, “Well, my father-in-law often gets good deals. So do you want it?”

“Sure, wow!” Andy gushed. The ring had arrived, with



Figure 1: Sue’s new engagement ring.



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expedited shipping, to Andy's house in three days.

Since Sue and Andy had discussed the engagement, Sue had only one request: to have an engagement party with both sets of parents invited. At this party the ring would be unveiled. The party was scheduled and during the event, the ring was revealed to everyone's astonishment. Both sets of parents applauded when Andy slipped it on Sue's finger. In a few more moments, both mothers were crying.

*A few days later on a flight to the electronics circuit board assembly factory in Mexico...*

"Hey, Romeo, let's see if we can come up with the five most important things we should look for in our evaluation of the company," Sue suggested.

"Well, as we have discussed many times, assembly line uptime is arguably the most important single metric. So, that will be No. 1," Andy said.

"Agreed," Sue said. "How about whether they collect defect data and plot it in a Pareto Chart and have a continuous improvement plan (CIP) to address the defects?"

"That's a great No. 2," Andy responded. "What about line balancing for No. 3?"

"I'll buy that if you go with training and staff competence as No. 4," Sue teased.

"Hmmm, so maybe we should develop a quiz in Spanish?" Andy said.

"I'll take some of the quiz questions that we had when Maggie and John took over and translate them into Spanish," Sue said.

"So, what about No. 5?" Andy asked and Sue replied, "How about the quality of the solder paste? Remember all the issues we had with poor response-to-pause and other performance issues?"

"Let's agree, too, that the general appearance and quality of the facility and the equipment is important," Andy added.

"Okay, then that's No. 6," Sue suggested.

"Since you are writing out the questions for the staff, I will write down these six areas to



Figure 2: Sue and Andy on the plane to Mexico discussing their plans for the audit of the factory.

investigate when we get there," Andy said.

It was quiet for a while as they both attended to their agreed upon assignments. Sue was always better at math than Andy in the many classes they took, so he had worked hard to find some math problem he could stump her with. Finally, he had a candidate.

"Sue, how would you calculate  $7^{1000}$  with only a simple scientific calculator?" Andy asked with a little teasing in his voice.

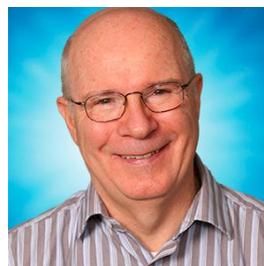
Sue took out her phone, opened the calculator function, entered  $7^{1000}$ , and ended up with an "Error" on the screen.

"Wait, why doesn't it give an answer? Oh, I think I know—the answer is too large," Sue said.

"So, what do you do then to get the answer?" Andy asked. Sue thought for quite a while (she hated being bested by Andy in math).

"I'm not sure," she responded.

Want to know the answer? Stay tuned for next month's column. **SMT007**



**Ronald C. Lasky** is an instructional professor of engineering for the Thayer School of Engineering at Dartmouth College, and senior technologist at Indium Corporation. To read past columns, [click here](#).



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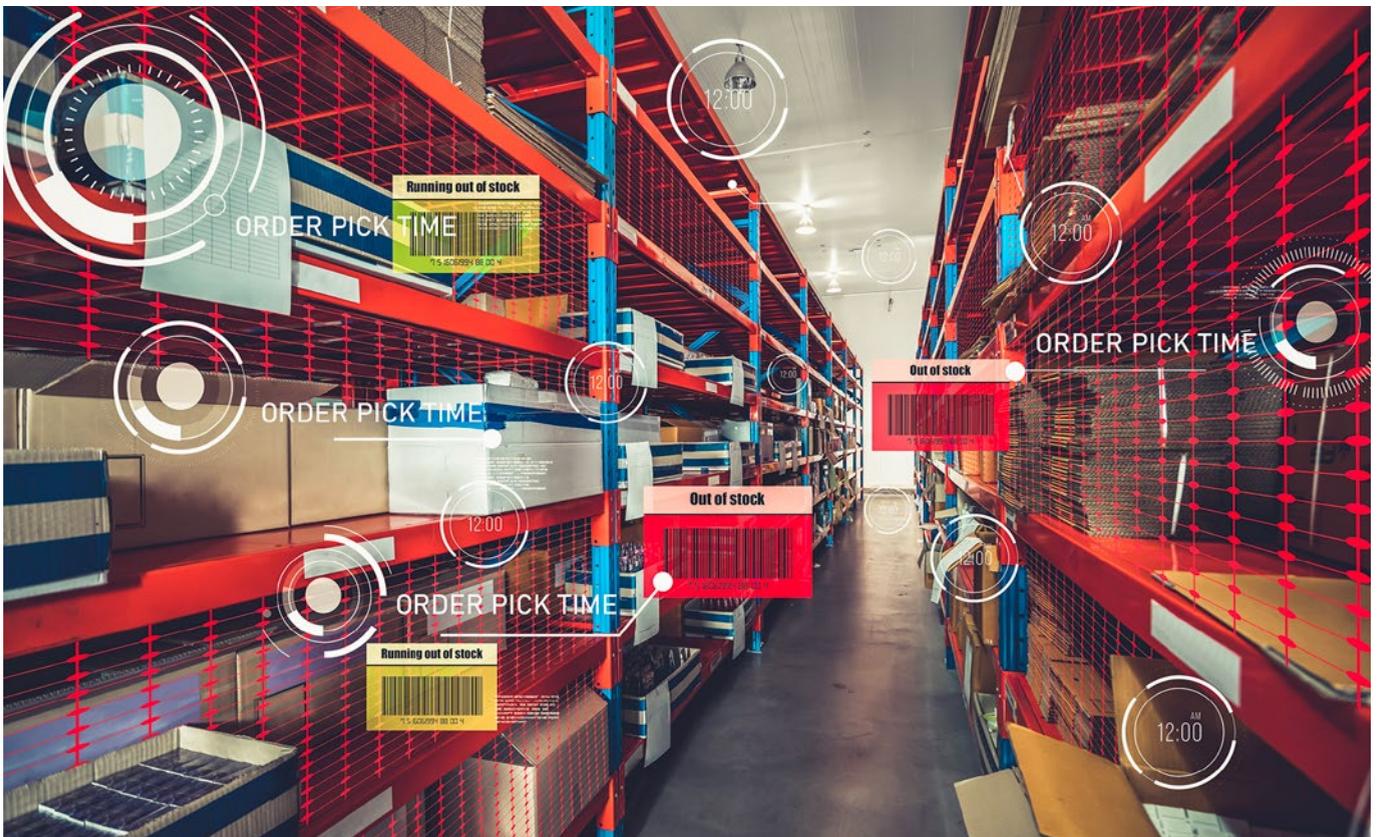
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# Modern Inventory Management **Secrets**

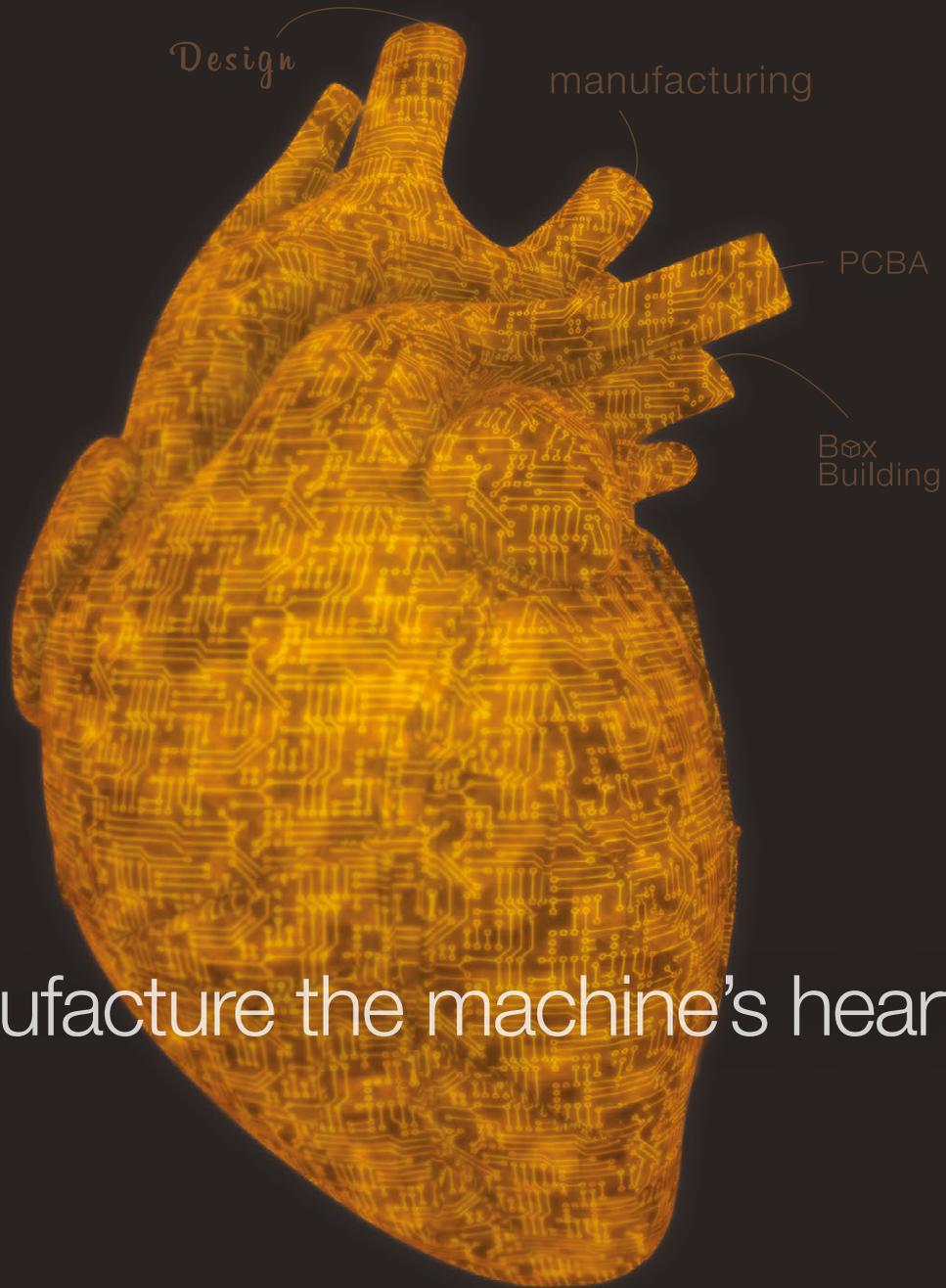
Feature Article by Michael Ford  
AEGIS SOFTWARE

Inventory management should be simple; after all, it is how many of us learned to count. ERP solutions have become complex yet cannot solve our immediate supply-chain and manufacturing challenges unaided. It's time to unfold the root-causes behind key issues and reveal the secrets for success in modern inventory management which have a significant impact on any manufacturing business.

To understand modern inventory management, we should start at the beginning, which is actually at the end. The aim of the manufacturer is to get rid of completed products as soon as possible. Whether it's an OEM or EMS company, the customer has agreed on price, so it's time to get paid and free up that warehouse space. Customers of completed products were once eager to take them into their distribu-

tion chain, turning their investment into cash while completing the journey to the final customer. However, once there, products generally depreciate over time, value-wise, whilst still accumulating costs associated with logistics and storage throughout the distribution chain. While this is shorter, it's an altogether significant threat to profitability.

Distribution chains have now become shorter, designed to cope only with any expected fluctuations in supply and demand. With rampant inflation in many markets—fueled in part by the perceived shortage of products and materials, as well as changing customer demand patterns in many cases—the value of finished goods is appreciating. This is an extremely dangerous condition, as competing vendors now choose their timing



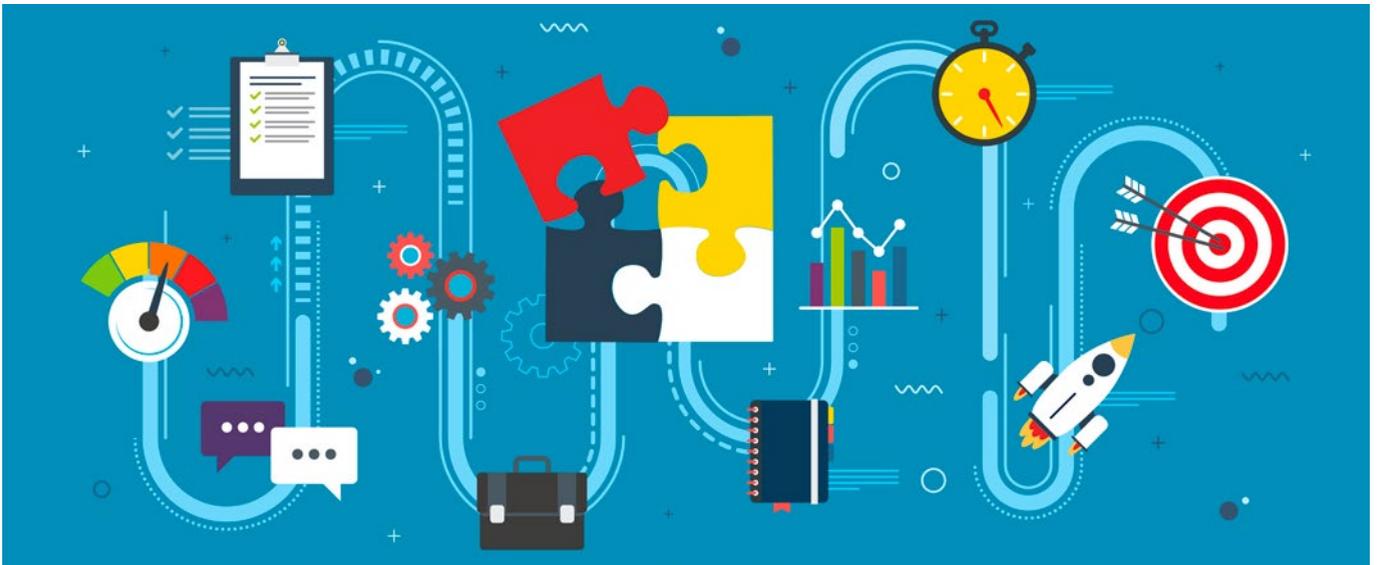
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for release of product supply based on where and when the pricing is most favorable. On the other hand, prices may suddenly crash as demand falls, confidence fades, and a flood of products come into the market that aim to stay ahead of the trends. Though this is normal practice in the industry, the effects scale considerably with turbulence in the supply-chain.

As usual, the manufacturer is bearing the brunt of this activity, alongside all the other market challenges they face. They are being asked to hold stock and not be paid, without the clear understanding of their customer's business strategies. Within the manufacturing domain, that is their scope of investment responsibility, inventory cannot be allowed to build up. Production schedules are therefore more often revisited, and quickly adjusted. A production quantity boom-and-bust pattern emerges, with sudden demand, then suddenly, nothing. Though this pattern may be subtle in many cases, it causes a whip-like effect throughout the supply chain. With a keen eye on the level of finished goods, inventory costs, and capacities, production schedules are most effectively optimized on the fly, often using simple, intelligent visual tools to fulfill commitments, but not waste money on unnecessary semi-finished or finished product stock.

The strengthening of the whip-effect is next seen as the need for raw materials becomes a

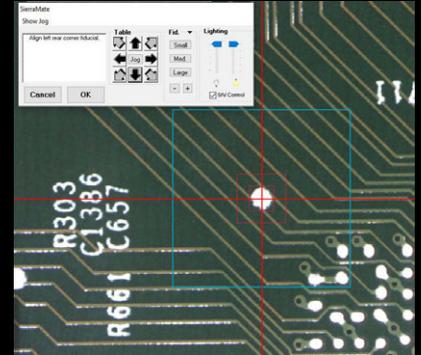
lot more variable and volatile as compared to original ERP forecasts. This is driven by the need to reduce inventory investment costs and storage space of materials, as well as the risk of obsolescence. It may be driven by the manufacturer's direct purchasing policy, or from the customer where materials are consigned. In either case, the party with the investment responsibility has the same motivation. As with finished goods, the value of materials would normally depreciate over time, as well as face the risk of obsolescence toward the end-of-life of products and physical degradation during storage. Recently, however, some materials have been appreciating in value, whether due to scarcity or inflation.

The decision on the appropriate levels of raw material inventory to maintain at any time has become a very complex process. With short-term commitments made on shipping dates and rates of finished goods completion, materials need to be in place just in case, but to keep inventory investment levels reasonable, a trusted "just in time" approach is preferred over carrying excess stock. Cases where shortages of materials occur present a serious risk to the business. Even one missing material prevents the start of new work orders, the cut-short of work orders already under way, and the potential for delayed availability for the customer. Extreme efforts to source materi-

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als in short supply result in increased quality risks, where compromise may have been made in terms of physical and operational specifications, including the potential for counterfeit ingress. Alternative choices of materials need business and engineering approval in many cases, introducing more delays—that is, where rules are followed. On the other hand, having an excess of materials brings storage issues and costs, effects of aging, volatility in value, and increased investment costs. It is often difficult to re-assign or sell unneeded materials back on the grey market, especially those that are bespoke for a specific product.

Just two years ago, inventory management methods using ERP that were anywhere from completely dependable, to at least acceptable, are now clearly inadequate. A lot more human effort now must be utilized, tweaking the purchasing settings based on availability risk, material value, potential effects of inflation, and approvals. Complex decisions can only be effectively made if there is a clear visibility of any problem or opportunity.

Visibility of accurate physical material inventory levels on the shop floor has always been a challenge. Without it, there have been many cases of work orders not starting due to the incorrect perception that there are not enough materials, and of work orders that are cut short due to expected materials not physically being there when they are needed. At the same time, ironically, there are significant amounts of obsolete materials on the shop floor accruing storage costs and aging. The effects of inaccu-

rate material inventory can be seen and felt at the time of a periodic physical stock check.

Relying on ERP in isolation, it is quite normal for there to be significant discrepancies found when comparing the physical stock levels with those recorded

in ERP, which can run into millions of dollars of value in terms of both expected materials not being present, and physical materials being found that were no longer recorded by ERP. It is ridiculous to think that ERP can perform its role effectively if it does not have the true picture of the actual internal inventory on hand. This is a more significant challenge with complex bills of materials (BOMs), with potential use of approved substitute or alternative materials, approved and non-approved vendors, variations in products, materials that are used in fractional quantities that age, expire, or need periodic test, inspection, and re-work. The accurate measurement of such inventory usage, spoilage, shrinkage, and managing stock lifecycles, is essential.

The secret behind great inventory management is very simple. It must be possible to effectively account for every individual piece of material continuously across the whole of manufacturing, with direct feedback of changes and results to ERP. It is a fact of manufacturing life that the sum of materials consumed on any job cannot be exactly calculated by simply multiplying ERP BOM quantities by the number of units produced. It is also nonsense to assume that deviations to the ERP plan will be effectively communicated back to ERP manually. Manufacturing operators are otherwise focused. Counting unused materials at the end of every work order is also not practical, other than perhaps for a small number of critical materials. Expected spoilage losses, for whatever reason, are normally addressed

through a small allowance made by ERP on a general basis. Practically however, the accumulation of spoilage can quickly exceed control limits, making such allowances only a short-term buffer.

The practical way to prevent the accrual of stock level inaccuracies between physical stock and ERP inventory levels, requires gathering data about any material-related actions as they are being performed in an automated way. Specific material consumption from machines or operator tasks must be set into context with any last-minute selections of alternative or substitute materials allowed in the BOM.

The modern MES solution, with built-in unique-ID-based material management support, gathers and contextualizes all material information in a way that other solutions and manual efforts cannot. Each individual material or carrier of materials is uniquely identified, which is used to manage every aspect of the material's journey and usage throughout the factory. The location and status of each material is always known in a far more comprehensive way than ERP, including designated warehouses, point-of-use stores on the shop-floor, or being loaded onto or near a manufacturing process.

Both production and materials operators must be trained to understand the value and importance of the disciplines needed behind day-to-day physical material management. For example, materials must not be trivially discarded, used in a different application than intended, or, if compromised in any way during logistics, etc., issues must not go unreported. As part of their operation, following paperless work instructions, any spoilage or other losses should be easily reported as part of their normal role.

The exchange of information between MES and ERP is essential, such that ERP can replace unexpectedly spoiled materials where necessary. ERP performs more effectively, accurately differentiating materials that are freely available, allocated, partly used, or may require

testing and inspection prior to further use. Operational risk can only be managed effectively by ERP knowing the situation related to real physical inventory levels.

In summary, there are some easy and established routes towards great inventory management, which should not be kept secret:

- **A good ERP solution:**

- > The ability to set rules for purchasing against individual material part numbers
- > The capability to handle complex BOMs
- > Management of local purchasing decisions with engineering approvals
- > Great communication with MES

- **A great MES solution:**

- > Complete, continuous visibility of exact material quantities, locations, history, and status
- > Automated gathering of material consumption, spoilage, and other data, including scrapped materials and products, from automated machine processes as well as from manual operations

There are many other functions that manufacturers may like to see from their ERP and MES solutions, though these can be a distraction from ensuring that the very basic requirements, without which the modern manufacturing operation, based on the evolved “random” business logic of customers, will find it very hard to be successful. The secret is to never compromise on inventory accuracy. **SMT007**



**Michael Ford** is the senior director of emerging industry strategy for Aegis Software and an I-Connect007 columnist. To read past columns, [click here](#).



# Advanced Packaging Symposium 2022

**Special Coverage by Nolan Johnson**

Photography © John Harrington

## Introduction

IPC took a visionary step in October by hosting a two-day Advanced Packaging Symposium. Held at the Kimpton Hotel Monaco in Washington, D.C., the event brought together industry experts, government representatives, advocacy groups, and manufacturers to discuss the strategic need for packaging capability, both advanced and traditional, outside the Asian region.

Opening day speakers included keynotes from TechSearch's Jan Vardaman, and Intel's Tom Rucker. Additional speakers throughout the day represented DoD, NIST, the European Union, Western Digital, IBM, AMD, Northrup Grumman, and BAE Systems. The second day's agenda included: SRC, SkyWater, Amkor, Integra, Samsung, AT&S, AGC Tactonic, OKUNO, and Lam Research. A lively mid-morning panel was comprised



of representatives from Averatek, Calumet, GreenSource Fabrication, Sanmina, and TTM.

A recurring theme was the urgent need for in-region capabilities. Each speaker, in their own way, made the argument that the U.S. and EU need to ramp up these capabilities. During her Q&A session, for example, Kim Eilert of BAE Systems was asked when BAE would need to have this capability available to them. Her answer was, “Today.” It was clear that she meant that quite literally.

Another common theme was that significant investment will be needed. For example, during one panel discussion, it was suggested that an advanced packaging facility will require two orders of magnitude more clean room

area than a current traditional PCB fab, and that it will likely cost a minimum of 2X that of a traditional PCB fab to construct.

This symposium succeeded in exposing the urgency and the magnitude of the need to support advanced packaging in all regions of the globe. What needs to happen next is ongoing work to focus the efforts, educate manufacturers and legislators, use government funding wisely, and to look at this as an ongoing process for as much as 10 years.

I-Connect007 attended the event and gathered a series of key interviews from the 26 presenters.

The following five interviews aim to provide you with a feel for what happened, what’s important, and what’s to come.



# Advanced Packaging Symposium Recap: A Real Conversation Starter

Matt Kelly had the vision and Jan Vardaman set the tone for the IPC Advanced Packaging Symposium, Oct. 11–13, in Washington, D.C. So, did they accomplish their goals? What were the real takeaways from the event, and what can we expect to see next? Spoiler alert: Matt and Jan came away impressed in more ways than one.

**Nolan Johnson:** Matt and Jan, now that the symposium has closed, what are your thoughts? How did it go?

**Jan Vardaman:** We've had a lot of great discussions. Many met for the first time, and when you're trying to make changes, it's important to bring people together, talk about the problem and the solutions we can develop. That's exactly what happened.

**Johnson:** About a year ago, Jan, we did an interview and I asked what we needed to do to move forward. You said, "We need a summit," and here we are.

**Vardaman:** That's right. It's been very successful because people were having great discussions outside the planned sessions. We've heard those in the hallways here, so putting this together to get something done is very important. That's what's been accomplished out of this meeting.

**Johnson:** Matt, as the architect for this event, what are your thoughts?

**Matt Kelly:** While this was about awareness and education, one of the biggest takeaways was in the number of people who were talking,



Jan Vardaman



Matt Kelly



exchanging business cards, and having their meetings. Jokingly, I had said that if the groups didn't like the content of the slides at least they could meet new colleagues and start the work on their own. So, I'm most happy about the level of engagement.

I'm also impressed by the attentiveness of the attendees. We had a completely packed room for two full days and that shows the need and the desire to learn more. They wanted to take this information back with them and begin to make sense of it.

**Johnson:** Will the presentation materials be distributed to the registered attendees?

**Kelly:** Yes, it will be part of the compendium which we'll put together when we get back.

**Johnson:** This can't certainly be the end. What's next?

**Vardaman:** We certainly need to see what will come out of this, but I believe we plan to have another event at IPC APEX EXPO where we can continue the discussion. We'll be closer to the time that things start coming out and we'll see people picking their dance partners, so to speak.

**Johnson:** One big piece of news was Frank Gayle from NIST announcing that PCB ecosystem projects could be submitted under the CHIPS Act. That was confirmed in other conversations I've had with those who were at the Capitol talking to congressional and senate staff. That's a good sign for ongoing work with government legislation, isn't it?



Frank Gayle

**Kelly:** Yes, it is, and we heard it this afternoon as well. We keep hearing about the lines blurring, but printed circuit board technologies to a level with IC substrates are coming together. There are absolutely differences, but there's also synergy. The one thing I really like about this—if we can get all the way there—is this reversal of commodity. That word commodity is a bad word.

The commoditization of printed circuit work, the commoditization of IC substrates is a bad thing. We need to continue that effort to show how complex they are and how much work is needed.

**Johnson:** Part of the message was that it's time to stop talking and start acting. Will there be more symposia in the future?

**Kelly:** We had multiple requests for similar events in different geographic locations. There's a request to do one in Europe. There was a request for a more defense-based agenda. Part of what Jan does at TechSearch International, and what IPC is doing, is to keep that community vibrant. You need to know who needs to work together. That will be a continued function.

But as you know, post-event, we must continue driving more substantive types of execution. That means building these communities, starting to list exactly what is needed, and get beyond talking.

**Johnson:** Well, congratulations. Job well done.

**Kelly:** Thank you.

**Vardaman:** Thank you.



# The ‘Intel’ on Advanced Packaging Options

Dr. Tom Rucker is vice president in technology development at Intel and was a keynote speaker at the IPC Advanced Packaging Symposium, which helped set the table for the rest of the agenda. Tom understands this “radical and seismic” shift in terms of technology and breaks down what it means for the semiconductor and PCB fab industries. There’s absolutely a place at the table for PCB fabricators, but what are the first steps?

**Nolan Johnson:** Tom, thanks for taking a moment to speak with me

**Tom Rucker:** My pleasure.

**Johnson:** You just finished your keynote. What was the message?

**Rucker:** My key message is that packaging is undergoing a very radical and seismic shift in terms of technology and driving the requirements to ensure that our customers, the whole industry, and the ecosystem can really support the computing changes happening across the industry. If you look at it from a compute perspective, there’s more data getting collected that needs to get stored and moved. It needs to

get analyzed and decisions made. That drives a very large change in the capabilities that products need to deliver—more functions and performance. The key to enabling that technology is advanced packaging where you can take multiple different die and components, put them together in a very compact form factor, get that performance, and then give the consumer, the end user, what they need.

**Johnson:** In your keynote, you referred to a disaggregated implementation vs. the old-style monolithic approach. Your presentation included the discussion of several techniques for putting advanced packaging together. Is there room for these methods or will we see some of these shake out and consolidate?

**Rucker:** That’s a great question. Historically over many years, usually you had one silicon die—a monolithic piece of silicon—in one package. Now, there are many use cases for products which drive multiple die in one package. Some use cases may need more compute capability than graphics. Maybe some need two compute environments—one for massive calculations and one for simple data transformations or data aggregation. Machine learning, advanced artificial intelligence, with different architectures for different functions, need to be combined with more traditional general purpose computing architectures in one package.

With so many different use cases, putting all those on one die means the die would be enormous, and you wouldn’t have the optimized solution because you, the architect, cannot use different technologies and designs optimized for specific workloads and applications. With advanced packaging or disaggregated tech-



Tom Rucker

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nology, it allows the architect to say, “Let me take this function and make it on this technology node, and this other function on a different technology node.” Then I can put those all into one small unit. For the end user it looks as one unit, but as we manufacture it, it’s internally, four or five different blocks. That’s a benefit of disaggregation. Higher performance in a small form factor.

Now the question was whether there’s one solution or multiple. I believe there will be many different solutions. Different use cases—whether to build personal computers, servers for data centers, products for aerospace, automotive, medical devices, communications—will require variants of packaging technology.

They have different functionality and requirements, so it will require slightly different building blocks and technologies that come together. The key part of the CHIPS Act is whether we can set up a pipeline to allow for innovation on the front end, and then be able to pull that through into manufacturing, using a mix and match of those different technologies. These process steps could be panel, wafer or unit based, or combinations thereof.

**Johnson:** Many of our readers are PCB fabricators and assemblers. Do you see a future for them in advanced packaging?

**Rucker:** Yes, absolutely. As advanced packaging becomes more fab-like, some key challenges are line width, improving cleanliness requirements, and developing new material. Anyone who looks at this and says, “I just want to take my current equipment, convert it, and run advanced substrates,” will probably have a very difficult challenge.

They should look at the opportunities to adapt and evolve their business model. Are there radical new technologies where they can



develop innovation to deliver value to the customer? Those packages still go onto a board that eventually goes into the system. Now what that board looks like obviously depends upon the end use. The same way that the silicon technology nodes keep on scaling with Moore’s Law, now packaging is following at Moore’s Law. The question is whether PCB fabricators and assemblers can scale and deliver new capabilities and functionality. Can they develop innovative thermal solutions? Can they accelerate that development? Can you take the board industry and economically scale it?

**Johnson:** Isn’t that bringing the board fab industry into the process of maintaining Moore’s Law?

**Rucker:** Yes.

**Johnson:** Can one go that far?

**Rucker:** I would say so. If you step back as a consumer, we want more performance, a smaller form factor, faster, and at a lower cost. Can the board industry accelerate and move at almost the same pace? It’s very challenging from an economic perspective, but that’s what makes it interesting.

**Johnson:** Well, there’s the call to action right there. Thank you, Tom.



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# Working on the Hill to **Build a Future**

The message can't be emphasized enough: Producing IC substrates overseas weakens America's position and national security. In this frank discussion with Will Marsh, president of PCBAA, he talks about his efforts to educate government policymakers on the dire need to consider the entire microelectronics ecosystem. There's power in numbers, Will says, and he sees the association's efforts making a difference.



Will Marsh

**Nolan Johnson:** Will, we're gathered at the Advanced Packaging Symposium, but you have been spending most of your time on Capitol Hill doing work for PCBAA and TTM. What is the atmosphere there?

**Will Marsh:** Right now, the Hill is very quiet because Congress is in recess and they aren't

back in session until after the election. While D.C. is quieter without the members of Congress, legislative staff are still doing the day-to-day work on behalf of their constituencies. In our meetings with staff about the printed circuit board industry and the IC substrate opportunities, we're finding an appetite to learn and talk more about strategies and

policies that address the other parts of the electronics ecosystem that were not addressed directly in the CHIPS Act.

From the Senate side, they are adamant that the CHIPS Act covers the ecosystem, but as you read the bill, that's hard to determine. We're reinforcing the messages that while it's a noble cause to advance the CHIPS Act and the \$52 billion investment, it's the first of many steps. We are encouraged that staff recognize that the microelectronics ecosystem,





the reshoring debate, and having a domestic, secure, resilient supply chain for the ecosystem are absolutely being met with open arms.

It's an encouraging piece of news, but it's something we wouldn't know about unless we were on the Hill talking about it. That's why this IPC event, with 150 really smart people talking about advanced packaging definitions, needs, and requirements, is really important. We can take some of these messages back to the Hill to reinforce the messages that the Printed Circuit Board Association of America, IPC, and USPAE are telling that story. As we know, Washington is all about creating a sense of debate and having discussions. Government is not the speed of business, and this is a slow-moving train, so we must stay in front of the right people and drumbeat our message.

**Johnson:** How does the industry participate in this process? Government moves at the pace of government, but pressure can be applied.

**Marsh:** Absolutely. Strength in numbers wins every day in Washington, D.C., and in politics.

The speed of government might be slow, but the larger your megaphone the quicker we get to a solution. We need more companies involved in the message that the domestic microelectronics ecosystem is relatively broken. You can write your representatives or write op-eds. As associations, we can use our social media platforms to bring more awareness. The more people participating in getting that message out, the quicker it will lead to a solution.

**Johnson:** As we've listened to the speakers this week, we realized that it takes a large amount of capital to implement advanced packaging. It's understandable that you need volume, customers, or both, to make it a viable business model. This points back to continued, ongoing discussions with government to put that infrastructure in place.

**Marsh:** You're spot on. It's not just having those conversations either, all of which are going well. The other part is educating them about where the holes in the yard are. Oftentimes, elected officials and decisionmakers in commerce or defense are unaware that there are





holes in their yard because they're not responsible for that part of the yard. Our job is to educate, advocate, and legislate. There's an educational component, we are defining the true national and economic security issues and problems, whereby 97% of IC substrates are built in Asia. Less than 1% are built in America, and I'd be hard pressed to even say it's 0.5%.

Substrates aren't domestically produced, and when you think about the major weapons system prime contractors and OEMs that are waiting up to 52 weeks for a foreign substrate to put on a category one ITAR weapon system, that's a problem. Remember: any time a contract is awarded, the contractor is responsible for the schedule. If you tell your program manager, "I can't deliver your weapon system for another 52 weeks because I'm waiting for a piece of electronics from Asia," that just means America is not positioning itself properly at the policy or financial level for investing in these capabilities to be domestically secure.

**Johnson:** Just moments ago, a presenter said the U.S. is a technology and R&D leader globally, and yet the manufacturing capability amounts to about 2% in the U.S. They called that gap ridiculous.



**Marsh:** They would know the numbers better than I would. We are, as a country, caught up in statistics all the time. The reality is, America is not investing in—or at even low- or mid-volume—producing IC substrates. We are wholly dependent at a national security level on a foreign supply chain and that is a problem. That's why I continue on the Hill with IPC, USPAE, and the PCBAA on behalf of a group of companies and the industry. This is more powerful than just a couple companies where it could be misconstrued as strictly a parochial argument you're trying to make.

It will directly benefit you, not your peers, competitors, or your "competimates." We believe this is a great opportunity not only to listen, learn, interact, and build relationships with professionals from multiple different sectors, but it's important to transform, transmit, and relay this information to Capitol Hill. They might get a bad rap, and the approval rate of Congress is low, but at the end of the day, they're still making policy. They're responsible for laws that affect our companies and our lives, and it's important to educate them before they legislate. We are taking advantage of the brain power and the professionals in D.C., making sure Congress is aware this is happening.

**Johnson:** That argument just points right back to strength in numbers, as much help as you can get.

**Marsh:** Absolutely agree. Always wins, every day in D.C.

**Johnson:** Will, thanks for taking the time to talk about this. Thank you for the work that you do.

**Marsh:** Thank you, Nolan.

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# Trailblazing Substrates in PCB Fabrication

Todd Brassard, vice president and COO at Calumet Electronics, participated not only in the IPC Advanced Packaging Symposium in Washington, D.C., Oct. 11-13, but also met with congressional staffers at the Capitol during his visit. Todd does not back down from a challenge, and the one in front of him is no different. It's why his company is at the forefront of the conversation, and he plans to keep it that way.



Todd Brassard

ologies right down to the fundamentals, and the messaging is consistent: We need to do it in the U.S., and we need to do it fast. There are potentially imminent threats developing, and we must be capable of producing the technologies that keep the country safe and keep the country competitive.

**Johnson:** It seems like the motivation is strong to ask Calumet how this works and how to get there. You are blazing a trail.

**Nolan Johnson:** Calumet is showing up repeatedly in the conversation around advanced packaging; you're established as a company at the forefront. Meredith LaBeau, your chief technology officer, was mentioned and sat on a panel here. You've been talking to Senate staff on the Hill as well. That's a lot of activity. What's your takeaway?

**Todd Brassard:** This is the first time IPC has done a microelectronics symposium; today was a new venture for them. There seems to be more than 100 companies here. I am pleasantly surprised and encouraged by the conversations, the depth of the information and the insights that are being shared, and the uniformity of the problem. We've seen discussion from the most advanced technol-

**Brassard:** If you listen to the dialogue, you hear a variety of "PCB shops can participate or PCB shops can't participate. They should; they shouldn't." We feel that maybe it's not for every PCB shop, but it's certainly not out of the bounds for those PCB shops that want to advance. Where substrates are today, that's where PCBs will be a decade from now. Miniaturization will continue. Things will get smaller.

Maybe someday the substrate won't be the interposer, but the PCB will be the interposer. Because everything is built at the microelectronic scale and the PCB just scales it up to interface with the system. There are many reasons for a PCB shop to explore what they're interested in.

**Johnson:** Excellent. Thanks.

**Brassard:** Thank you, Nolan.

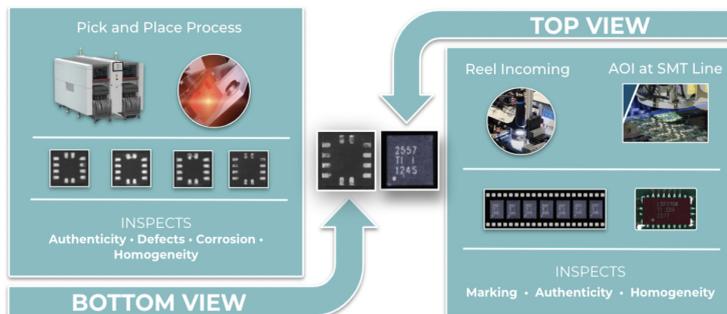
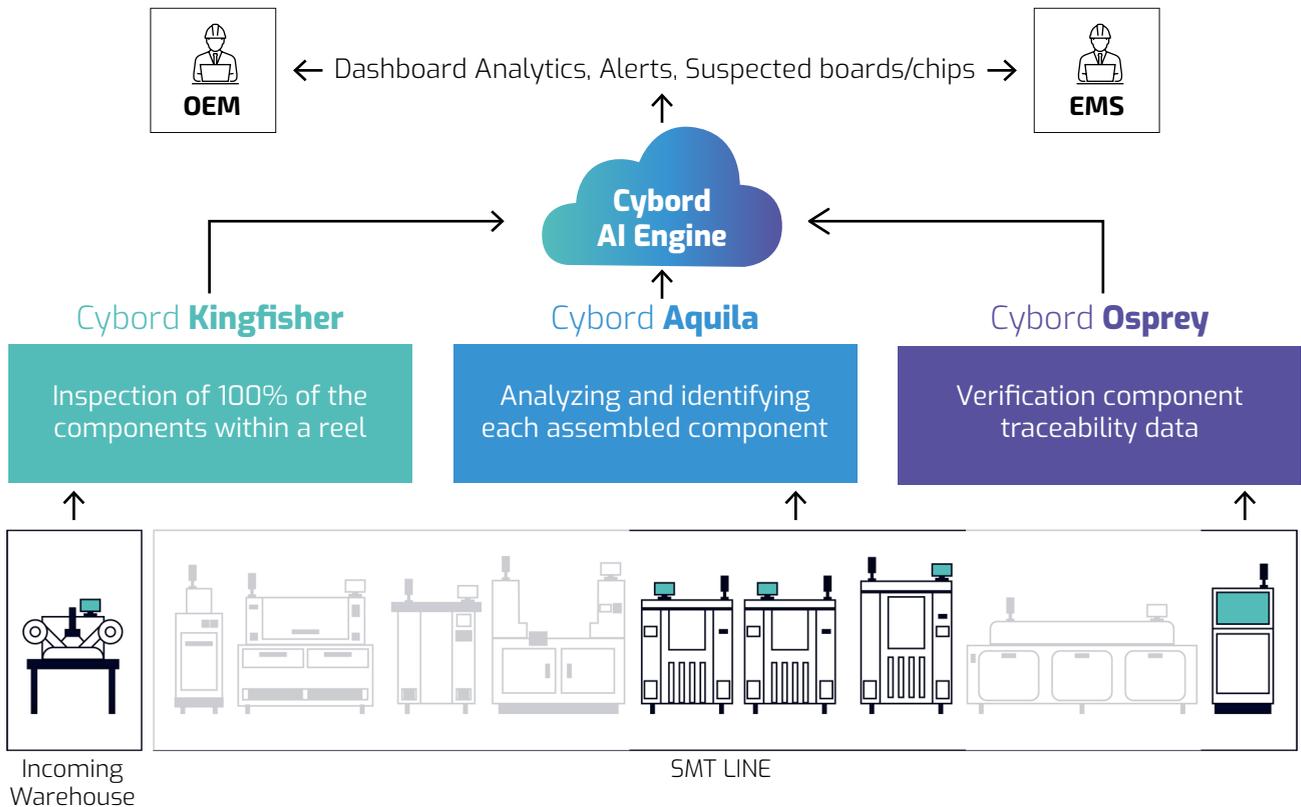


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# The Critical Nature of High-performance Computing

Dale McHerron is senior manager at IBM Research and oversees heterogeneous integration research. In his presentation, Dale spoke about the need to architect the next generation of AI systems, and what it means to the infrastructure to run AI systems at this high level of technology.

**Nolan Johnson:** Dale, you just finished your presentation and I'd love to get a quick summary.

**Dale McHerron:** Sure. My focus is on high performance computing, with a special interest in AI and AI workloads, and how we need to architect next generation systems to support what we see happening in AI. I talked about where we are today from a traditional IBM high performance computing standpoint, and some of the aspects of our z Systems® (zHPF) mainframe. Then I started talking about the emerging confluence of the need for much more compute power, while simultaneously silicon scaling is starting to slow down. There is the need for

architecting for new workloads, which drives a huge amount of memory. How do you bring all that together? That all has an impact on what we will need going forward from the packaging.

**Johnson:** You had an interesting statistic that AI compute power requirements are doubling every three and a half months. Can you talk about that?

**McHerron:** The algorithms are getting so sophisticated. As you can see, AI is raising some eyebrows. People are really doing things with it. Those algorithms are getting so complex, and so computationally complex in terms of training, which is much more complex than inferencing. Training is how you train the model; inferencing is actually using it in the real world. You look at the training requirements for these very sophisticated algorithms, and they need to double the amount of compute every three and a half months because they're getting so complex. Our friends in the software and algorithm worlds are really making a lot of leaps and gains in terms of the complexity and the ability of these new algorithms.

**Johnson:** That just feels like a pace well more than what you'd expect from Moore's Law. That's driving the hardware even harder than we traditionally think—even at a time where some people are saying Moore's Law is broken.

**McHerron:** It is. There's been a lot in the industry lately about how much energy data centers use. I read that something like 3% of the



Dale McHerron



world's energy gets directed toward data centers because we're not as efficient as we need to be for managing these new workloads.

**Johnson:** You talked about the constraints that are holding this computational development back—power among them. But what was interesting to me from a packaging point of view was that you also discussed the resurgence of a multichip module (MCM). The MCM was something we saw 20 to 25 years ago and then it faded away. What's bringing it back?

**McHerron:** With scaling slowing, you're not getting as many transistors on a piece of silicon with each new generation as we did in the past. As computation workloads increase, you need more and more transistors. The system architects will ask, "How can you get me more acres of silicon into my package to make this work?" We're already at the limits of reticle sizes, as I mentioned, the next generation of lithography for silicon, which will probably be online for manufacturing before the end of the decade; the reticle size will drop in half. Now, to get the hardware needed to enable the compute intensity required, you must put more silicon in each volume. You can't have it spread out across the board. It will drive your power requirements through the roof. So, the more you can bring these things together, the more silicon you can get in each volume. You're not getting it from transistor scaling like we used to, so it must come down to the packaging.

**Johnson:** Compare the difference between a multichip module, what we're seeing in chiplets, and the heterogeneous integration type packaging.

**McHerron:** In the past, MCMs were largely just putting more of the same chip into a package.



The chiplet architectures, each one of these pieces of silicon, will now have its own function and own personality. You must bring the package to interconnect all these different functions in a very efficient way, so you get good performance and energy efficiency.

**Johnson:** Great. Thanks for the clarification on that, and thanks for your time.

**McHerron:** Sure. SMT007



## Book Excerpt: *The Electronics Industry's Guide to... The Evolving PCB NPI Process*

*The Electronics Industry's Guide to... The Evolving PCB NPI Process* is the first book in I-Connect007's new The Electronics Industry's Guide to... technical series. This valuable resource is for all segments of the electronics interconnect industry. What follows is an excerpt from Chapter 1: How the NPI Process Has Changed and Where We're Going.

## CHIPS Act Implementation Requires Strong Focus on 'Advanced Packaging,' Industry Leaders Say

Leaders of top semiconductor, microelectronic, IC-Substrate, PCB, EMS, and OSAT companies along with the U.S. government and European Commission gathered in Washington, D.C. last month to discuss "the next big thing" in CHIPS Act implementation: expanding "advanced packaging" capacities and capabilities to go along with expanding production of semiconductor chips.



## Smart Factory Insights: The Progress of Machine Intelligence

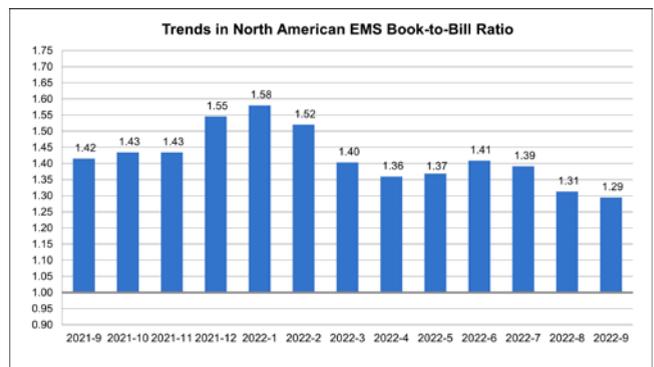
Adversity drives focus, realization, and then innovation. This is especially true in manufacturing, which has felt the effects of recent challenges. For decades, manufacturing has been overly focused on short-term business objectives, with little regard for risk and adaptability. Innovators today realize that there is no way back, that we must embrace the intelligence that we must have learned.



## North American EMS Industry Up 15.5 Percent in September

IPC Releases EMS Industry Results for September 2022

BANNOCKBURN, Ill., USA, October 27, 2022 — IPC announced today the September 2022 findings from its North American Electronics Manufacturing Services (EMS) Statistical Program. The book-to-bill ratio stands at 1.29.



## Neways Announces Hans Büthker as New CEO



Hans Büthker

The Supervisory Board of Neways Electronics International N.V. announces the intended appointment of Hans Büthker as new Chief Executive Officer (CEO) and member of the Executive Board of Neways as per 1 October 2022 to lead Neways through its next stages of growth.

## Koh Young KPO Printer Technology Wins Best Process Control Software at SMTA Guadalajara

Koh Young Technology, an industry-leader in True 3D measurement-based inspection solutions, is proud to announce its KPO Printer technology earned the Mexico Technology Award for Process Control Software from Mexico EMS.

## Finally, Some Good News About Supply Chain



In this follow-up to his recent interview on the Q4 2022 outlook, Shawn DuBravac, IPC chief economist, provides an update on the incoming supply chain for EMS providers. Naturally, this conversation centers on component availability, where the supply crunch is easing, and by how much.

## Knocking Down the Bone Pile: Opening a Trace on the Surface of a PCB

Because of PCB layout problems or required circuit modifications, at times a trace on the surface of a PCB needs to be severed. In this procedure a small section of the trace is removed, thereby forming a “break” in the circuit.



## Axiom Inspired by Industry Challenges

After living through more than two years of the pandemic, we are very aware of the issues facing the electronics industry. We have witnessed months of factory shutdowns, labor disruptions due to a reduced workforce, and country, regional, and citywide COVID regulations and shutdowns. I will describe some of the issues we've been facing, and then explain how we learned to be creative and look for the silver linings in these disruptions.

## MacDermid Alpha Electronics Solutions Takes the Double at Mexico Technology Awards



MacDermid Alpha Electronics Solutions announced it received two Mexico Technology Awards in the category of for the category Solder Paste, with ALPHA's OM-565 HRL3 low temperature solder paste, and in the category Conformal Coatings, for Electrolube's UVCLX UV Curable Polyurethane coating.

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GOOD FOR THE INDUSTRY



# Career Opportunities



## Technical Sales Representative

We are an established distributor that represents manufacturing equipment and specialty consumables for the PCB manufacturing industry as well as other markets. All4-PCB represents products from suppliers in both Asia and Europe.

The objective of the position is to maintain and further develop the manufacturing consumable product business in the PCB industry. Excellent and well-organized communication flow between our principles and the customer base is required. We are looking for a dynamic, results-orientated sales personality with a technical background, capable of understanding the technical applications of the products.

A generous commission structure is available on top of solid base salary.

### Responsibilities

- Grow existing accounts by maintaining relationships with clients
- Manage operation of accounts through responding to customers, forecasting, inventory management
- Generate new leads and tackle existing leads to contribute to business growth
- Attend trade shows and relevant conferences
- Supporting sales network in North America. Travel is required.

### Qualifications

- A technical background in chemistry or engineering is beneficial. Min. 2-year degree.
- Proficient in Microsoft Office
- Strong organizational, communication and analytical skills
- Strong understanding of full sales process
- Experience utilizing customer relationship management software
- US citizenship or green card is needed and a valid driver's license

Apply to: [Torsten.Reckert@all4-pcb.us](mailto:Torsten.Reckert@all4-pcb.us).

[apply now](#)



## Application Engineer

Flexible Circuit Technologies (FCT) is a global supplier providing design, prototyping and production of flexible circuits, rigid flex circuits, flexible heaters and full assembly services.

### Responsibilities

- Gain understanding for customer/specific project requirements
- Review customer files, analyze - application, design, stack up, materials, mechanical requirements; develop cost-effective design to meet requirements
- Quote and follow-up to secure business
- Work with CAD: finalize files, attain customer approval prior to build
- Track timeline/provide customers with updates
- Follow up on prototype, assist with design changes (if needed), and push forward to production
- Work as the lead technician/program manager or as part of FCT team working with an assigned application engineer
- Help customer understand FCT's assembly, testing, and box build services
- Understand manufacturing and build process for flexible and rigid-flex circuits

### Qualifications

- Demonstrated experience: flex circuit/rigid-flex design including design rules, IPC; flex heater design +
- Ability to work in fast-paced environment, broad range of projects, maintain sense of urgency
- Ability to work as a team player
- Excellent written and verbal communication skills
- Willing to travel for sales support and customer support activities if needed

Competitive salary, bonus program, and benefits package. Preferred location Minneapolis, MN area.

[apply now](#)

# Career Opportunities



## Electrical Engineer

Located in State College, Pennsylvania, Chemcut, a world leader in wet processing equipment for the manufacture of printed circuit boards and chemical etching of various metals, is seeking an electrical engineer.

### Objectives:

The electrical/controls engineer will not only work with other engineers, but interface with all departments (manufacturing, sales, service, process, and purchasing). The engineer will design customer systems, creating electrical and control packages, while focusing on customer requirements.

### Responsibilities:

- Process customer orders (create schematics, BOMs, PLC programs, relay logic controls, etc.)
- Startup and debug customer equipment on production floor
- Interface with engineering colleagues and other departments, providing input & direction
- Provide electrical/control support to customer service
- May require occasional travel and overtime

### Qualifications:

- Bachelor's degree in electrical engineering or an EMET degree
- Machine control design experience a plus
- Good communication skills working in a team environment
- Strong ability to work independently with minimal supervision
- PLC and HMI experience a plus (ex. Studio 5000 Logix Designer, Factory Talk)
- Experience with AutoCAD, Microsoft Word, and Excel

Chemcut benefits include: Medical, dental and vision Insurance, life and disability insurance, paid vacation and holidays, sick leave accrual, and 401K with company match.

To apply, please submit a cover letter and resume to [hr@chemcut.net](mailto:hr@chemcut.net).

[apply now](#)



## Technical Marketing Engineer

EMA Design Automation, a leader in product development solutions, is in search of a detail-oriented individual who can apply their knowledge of electrical design and CAD software to assist marketing in the creation of videos, training materials, blog posts, and more. This Technical Marketing Engineer role is ideal for analytical problem-solvers who enjoy educating and teaching others.

### Requirements:

- Bachelor's degree in electrical engineering or related field with a basic understanding of engineering theories and terminology required
- Basic knowledge of schematic design, PCB design, and simulation with experience in OrCAD or Allegro preferred
- Candidates must possess excellent writing skills with an understanding of sentence structure and grammar
- Basic knowledge of video editing and experience using Camtasia or Adobe Premiere Pro is preferred but not required
- Must be able to collaborate well with others and have excellent written and verbal communication skills for this remote position

EMA Design Automation is a small, family-owned company that fosters a flexible, collaborative environment and promotes professional growth.

Send Resumes to: [resumes@ema-eda.com](mailto:resumes@ema-eda.com)

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# Career Opportunities



## Field Service Technician

Taiyo Circuit Automation designs and manufactures the world's finest dual sided soldermask coating and vertical drying equipment. Since 1981, we have served the printed circuit board industry with highly reliable innovative machinery, engineered to exceed.

### PRIMARY FUNCTION:

The Field Service Technician is responsible for troubleshooting and providing technical services on Taiyo Circuit Automation's mechanical and electro-mechanical products and systems.

### ESSENTIAL DUTIES:

1. Identify mechanical issues and implement process control solutions for process improvement and new projects
2. Consult with maintenance, operations, engineering, and management concerning process control and instrumentation
3. Specify, install, configure, calibrate, and maintain instrumentation, control system and electrical protection equipment

### QUALIFICATIONS/SKILLS:

1. 3 years of experience with equipment, preferably in PCB or related electronics industry
2. 3 years of experience in similar process industries with hands-on experience in operations, maintenance and project implementation—OMRON, Koyo, Allen Bradley experience preferred
3. Experience in installation and calibration of process control elements and electrical measurement devices
4. The ability to read and understand electrical, pneumatic diagrams and control systems

### REQUIRED EDUCATION/EXPERIENCE:

1. High school graduate
2. Associate degree in Industrial Engineering Technology, Mechanical or Electrical Engineering, preferred.
3. PLC experience

Email: [BobW@Taiyo-america.com](mailto:BobW@Taiyo-america.com) (Subject: "Application for Field Service Technician for TCA")

[apply now](#)



## DevOps Engineer

Altium is a publicly traded global company responsible for the most widely used PCB design software in the industry. Altium 365® is our cloud-based design and collaboration platform; it gives more power to every contributor in the electronics product chain, from the PCB designers to manufacturing. Our R&D teams are the driving force behind Altium 365 and all our technological accomplishments.

- The primary role of the DevOps Engineer is to help continue our transition to a cloud-based SaaS model as part of the production engineering team
- The team's top priorities are product reliability, security, feature delivery, and automation
- DevOps is responsible for the CI/CD process, streamlining automation for provisioning and deployment, scalable infrastructure, uninterrupted service, other DevOps activities

### Required Skills and Experience:

- Analysis, troubleshooting
- 4+ years' DevOps/SRE/ Linux/Windows
- AWS (EC2, RDS, S3, Storage, Route53, and network appliances
- Architecting and securing cloud networking

Altium offers a culture built and managed by engineers. We don't micromanage; we define the goals and give engineers the freedom and support to explore new ideas for delivering results. In doing so, we all have a hand in shaping the future of technology.

<https://careers.altium.com/>

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# Career Opportunities



## Supplier Quality Manager Headquarters, New Hartford, NY

### JOB SUMMARY:

The Supplier Quality Manager is responsible for maintaining and improving the quality of Indium Corporation's supplier base as well as compliance with identified quality standards and risk mitigation. This position will work cross-functionally with Supply Chain, Operations, and our suppliers. The role will ensure that the quality levels of all Indium Corporation suppliers and products meet customer requirements while supporting the company's growth, vision, and values.

### REQUIREMENTS:

- Bachelor's degree in business, supply chain or a science-based discipline
- Minimum 3 years in a supply chain role supporting or leading supplier quality
- Obtain and/or maintain International Automotive Task Force (IATF) auditor certification within first 3 months of employment
- Able to work independently or lead a team, as needed, to meet goals
- Excellent oral and written communication skills
- Knowledge of quality standards
- Proficiency in MS Office

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## Technical Service & Applications Engineer Full-Time – Midwest (WI, IL, MI)

Koh Young Technology, founded in 2002 in Seoul, South Korea, is the world leader in 3D measurement-based inspection technology for electronics manufacturing. Located in Duluth, GA, Koh Young America has been serving its partners since 2010 and is expanding the team with an Applications Engineer to provide helpdesk support by delivering guidance on operation, maintenance, and programming remotely or on-site.

### Responsibilities

- Provide support, preventive and corrective maintenance, process audits, and related services
- Train users on proper operation, maintenance, programming, and best practices
- Recommend and oversee operational, process, or other performance improvements
- Effectively troubleshoot and resolve machine, system, and process issues

### Skills and Qualifications

- Bachelor's in a technical discipline, relevant Associate's, or equivalent vocational or military training
- Knowledge of electronics manufacturing, robotics, PCB assembly, and/or AI; 2-4 years of experience
- SPI/AOI programming, operation, and maintenance experience preferred
- 75% domestic and international travel (valid U.S. or Canadian passport, required)
- Able to work effectively and independently with minimal supervision
- Able to readily understand and interpret detailed documents, drawings, and specifications

### Benefits

- Health/Dental/Vision/Life Insurance with no employee premium (including dependent coverage)
- 401K retirement plan
- Generous PTO and paid holidays

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# Career Opportunities



## Regional Manager Midwest Region

**General Summary:** Manages sales of the company's products and services, Electronics and Industrial, within the States of KS, MO, NE, and AR. Reports directly to Americas Manager. Collaborates with the Americas Manager to ensure consistent, profitable growth in sales revenues through positive planning, deployment and management of sales reps. Identifies objectives, strategies and action plans to improve short- and long-term sales and earnings for all product lines.

### DETAILS OF FUNCTION:

- Develops and maintains strategic partner relationships
- Manages and develops sales reps:
  - Reviews progress of sales performance
  - Provides quarterly results assessments of sales reps' performance
  - Works with sales reps to identify and contact decision-makers
  - Setting growth targets for sales reps
  - Educates sales reps by conducting programs/ seminars in the needed areas of knowledge
- Collects customer feedback and market research (products and competitors)
- Coordinates with other company departments to provide superior customer service

### QUALIFICATIONS:

- 5-7+ years of related experience in the manufacturing sector or equivalent combination of formal education and experience
- Excellent oral and written communication skills
- Business-to-business sales experience a plus
- Good working knowledge of Microsoft Office Suite and common smart phone apps
- Valid driver's license
- 75-80% regional travel required

To apply, please submit a COVER LETTER and RESUME to: Fernando Rueda, Americas Manager

fernando\_rueda@kyzen.com

apply now



## Field Service Engineer Location: West Coast, Midwest

Pluritec North America, Ltd., an innovative leader in drilling, routing, and automated inspection in the printed circuit board industry, is seeking a full-time field service engineer.

This individual will support service for North America in printed circuit board drill/routing and x-ray inspection equipment.

**Duties included:** Installation, training, maintenance, and repair. Must be able to troubleshoot electrical and mechanical issues in the field as well as calibrate products, perform modifications and retrofits. Diagnose effectively with customer via telephone support. Assist in optimization of machine operations.

A technical degree is preferred, along with strong verbal and written communication skills. Read and interpret schematics, collect data, write technical reports.

Valid driver's license is required, as well as a passport, and major credit card for travel.

**Must be able to travel extensively.**

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# Career Opportunities



## SMT Field Technician Hatboro, 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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ventec  
INTERNATIONAL GROUP  
騰輝電子

## European Product Manager Taiyo Inks, Germany

We are looking for a European product manager to serve as the primary point of contact for product technical sales activities specifically for Taiyo Inks in Europe.

### Duties include:

- Business development & sales growth in Europe
- Subject matter expert for Taiyo ink solutions
- Frequent travel to targeted strategic customers/OEMs in Europe
- Technical support to customers to solve application issues
- Liaising with operational and supply chain teams to support customer service

### Skills and abilities required:

- Extensive sales, product management, product application experience
- European citizenship (or authorization to work in Europe/Germany)
- Fluency in English language (spoken & written)
- Good written & verbal communications skills
- Printed circuit board industry experience an advantage
- Ability to work well both independently and as part of a team
- Good user knowledge of common Microsoft Office programs
- Full driving license essential

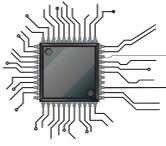
### What's on offer:

- Salary & sales commission--competitive and commensurate with experience
- Pension and health insurance following satisfactory probation
- Company car or car allowance

This is a fantastic opportunity to become part of a successful brand and leading team with excellent benefits. Please forward your resume to [jobs@ventec-europe.com](mailto:jobs@ventec-europe.com).

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# Career Opportunities



**MivaTek**

Global

## Field Service Technician

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

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

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

Do you have 3 years' experience working with direct imaging or capital equipment? Enjoy travel? Want to make a difference to our customers? Send your resume to [N.Hogan@MivaTek.Global](mailto:N.Hogan@MivaTek.Global) for consideration.

### More About Us

MivaTek Global is a distributor of Miva Technologies' imaging systems. We currently have 55 installations in the Americas and have machine installations in China, Singapore, Korea, and India.

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**INSULECTRO**



## Are You Our Next Superstar?!

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

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

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# Career Opportunities



## Rewarding Careers

Take advantage of the opportunities we are offering for careers with a growing test engineering firm. We currently have several openings at every stage of our operation.

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

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

## Associate Electronics Technician/Engineer (ATE-MD)

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

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

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## Test Engineer (TE-MD)

In this role, you will specialize in the development of in-circuit test (ICT) sets for Keysight 3070 (formerly HP) and/or Teradyne (formerly GenRad) TestStation/228X test systems.

- Candidates must have at least three years of experience with in-circuit test equipment. A candidate would develop and debug our test systems and install in-circuit test sets remotely online or at customer's manufactur-

ing locations nationwide.

- Candidates would also help support production testing and implement Engineering Change Orders and program enhancements, library model generation, perform testing and failure analysis of assembled boards, and other related tasks.
- Some travel required and these positions are available in the Hunt Valley, Md., office.

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## Sr. Test Engineer (STE-MD)

- Candidate would specialize in the development of in-circuit test (ICT) sets for Keysight 3070 (formerly Agilent & HP), Teradyne/GenRad, and Flying Probe test systems.
- Strong candidates will have more than five years of experience with in-circuit test equipment. Some experience with flying probe test equipment is preferred. A candidate would develop, and debug on our test systems and install in-circuit test sets remotely online or at customer's manufacturing locations nationwide.
- Proficient working knowledge of Flash/ISP programming, MAC Address and Boundary Scan required. The candidate would also help support production testing implementing Engineering Change Orders and program enhancements, library model generation, perform testing and failure analysis of assembled boards, and other related tasks. An understanding of stand-alone boundary scan and flying probe desired.
- Some travel required. Positions are available in the Hunt Valley, Md., office.

Contact us today to learn about the rewarding careers we are offering. Please email resumes with a short message describing your relevant experience and any questions to [careers@ttci.com](mailto:careers@ttci.com). Please, no phone calls.

We proudly serve customers nationwide and around the world.

TTCI is an ITAR registered and JCP DD2345 certified company that is NIST 800-171 compliant.

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# Career Opportunities



Arlon EMD, located in Rancho Cucamonga, California, is currently interviewing candidates for open positions in:

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

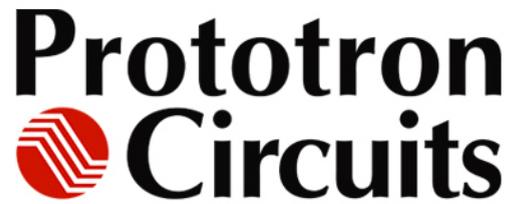
All interested candidates should contact Arlon's HR department at 909-987-9533 or email resumes to [careers.ranch@arlonemd.com](mailto:careers.ranch@arlonemd.com).

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

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

For additional information please visit our website at [www.arlonemd.com](http://www.arlonemd.com)

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## Sales Representatives

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

### Reasons you should work with Prototron:

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

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

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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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**BLACKFOX**  
Premier Training & Certification

## IPC Instructor Longmont, CO; Phoenix, AZ; U.S.-based remote

*Independent contractor,  
possible full-time employment*

### Job Description

This position is responsible for delivering effective electronics manufacturing training, including IPC Certification, to students from the electronics manufacturing industry. IPC instructors primarily train and certify operators, inspectors, engineers, and other trainers to one of six IPC Certification Programs: IPC-A-600, IPC-A-610, IPC/WHMA-A-620, IPC J-STD-001, IPC 7711/7721, and IPC-6012.

IPC instructors will conduct training at one of our public training centers or will travel directly to the customer's facility. A candidate's close proximity to Longmont, CO, or Phoenix, AZ, is a plus. Several IPC Certification Courses can be taught remotely and require no travel.

### Qualifications

Candidates must have a minimum of five years of electronics manufacturing experience. This experience can include printed circuit board fabrication, circuit board assembly, and/or wire and cable harness assembly. Soldering experience of through-hole and/or surface-mount components is highly preferred.

Candidate must have IPC training experience, either currently or in the past. A current and valid certified IPC trainer certificate holder is highly preferred.

Applicants must have the ability to work with little to no supervision and make appropriate and professional decisions.

Send resumes to Sharon Montana-Beard at  
[sharonm@blackfox.com](mailto:sharonm@blackfox.com).

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# Career Opportunities



**American Standard Circuits**

Creative Innovations In Flex, Digital & Microwave Circuits

## CAD/CAM Engineer

### Summary of Functions

The CAD/CAM engineer is responsible for reviewing customer supplied data and drawings, performing design rule checks and creating manufacturing data, programs, and tools required for the manufacture of PCB.

### Essential Duties and Responsibilities

- Import customer data into various CAM systems.
- Perform design rule checks and edit data to comply with manufacturing guidelines.
- Create array configurations, route, and test programs, penalization and output data for production use.
- Work with process engineers to evaluate and provide strategy for advanced processing as needed.
- Itemize and correspond to design issues with customers.
- Other duties as assigned.

### Organizational Relationship

Reports to the engineering manager. Coordinates activities with all departments, especially manufacturing.

### Qualifications

- A college degree or 5 years' experience is required. Good communication skills and the ability to work well with people is essential.
- Printed circuit board manufacturing knowledge.
- Experience using CAM tooling software, Orbotech GenFlex®.

### Physical Demands

Ability to communicate verbally with management and coworkers is crucial. Regular use of the telephone and e-mail for communication is essential. Sitting for extended periods is common. Hearing and vision within normal ranges is helpful for normal conversations, to receive ordinary information and to prepare documents.

[apply now](#)



**U.S. CIRCUIT**

## Plating Supervisor

Escondido, California-based PCB fabricator U.S. Circuit is now hiring for the position of plating supervisor. Candidate must have a minimum of five years' experience working in a wet process environment. Must have good communication skills, bilingual is a plus. Must have working knowledge of a plating lab and hands-on experience running an electrolytic plating line. Responsibilities include, but are not limited to, scheduling work, enforcing safety rules, scheduling/maintaining equipment and maintenance of records.

Competitive benefits package.

Pay will be commensurate with experience.

Mail to:  
[mfariba@uscircuit.com](mailto:mfariba@uscircuit.com)

[apply now](#)

# Career Opportunities



**APCT**  
Passion | Commitment | Trust

## 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](http://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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AD  
HERE

For information, please contact:  
BARB HOCKADAY  
[barb@iconnect007.com](mailto:barb@iconnect007.com)  
+1 916.365.1727 (PACIFIC)

**I-Connect007**  
GOOD FOR THE INDUSTRY



MEETINGS  
& COURSES Jan. 21-26

CONFERENCE  
& EXHIBITION Jan. 24-26

SAN DIEGO CONVENTION CENTER | CA

# ADVANCE IN A NEW ERA

## IPC EMS Leadership Summit

Monday | January 23 | 8:00 AM-5:00 PM  
6:00 PM Networking Dinner at Osteria Panevino

### EMS Leaders of Today and Tomorrow Helping Each Other and the Industry to Prosper

The IPC EMS Leadership Summit brings together current and future industry leaders to solve problems, build business networks, and share insights to doing business better. Focused on high level topics which drive business growth and financial success, leaders gather insights from experts and discuss their own and potential new best practices.

This meeting of minds inspires action and builds resources for participants, future leaders, and the greater EMS industry.

[IPCAPEXEXPO.ORG](http://IPCAPEXEXPO.ORG)

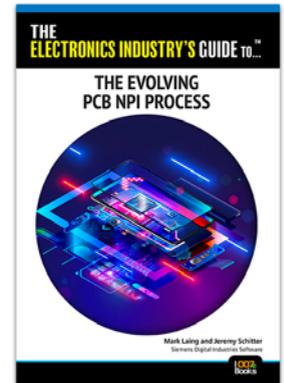
#IPCAPEXEXPO

**ALL EMS LEADERSHIP SUMMIT REGISTRANTS QUALIFY FOR ONE FREE LICENSE FOR IPC'S ELECTRONICS ASSEMBLY FOR ENGINEERS. ONCE REGISTERED OUR TEAM WILL CONTACT YOU TO PROVIDE ACCESS TO THE COURSE.**

# The Electronics Industry's Guide to... The Evolving PCB NPI Process

by Mark Laing and Jeremy Schitter, Siemens Digital Industries Software

In this book, the authors look at how market changes in the past 15 years, plus the slowdown of production and delivery of materials and components in recent years, have affected the process for new product introduction (NPI) in the global marketplace. As a result, we feel that PCB production companies need to adapt and take a new direction to navigate and thrive in an uncertain and rapidly evolving future.



I-007e  
Books

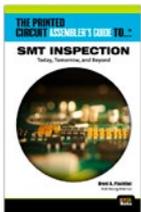
## The Printed Circuit Assembler's Guide to...



### Solder Defects

by Christopher Nash and Dr. Ronald C. Lasky, Indium Corporation

This book is specifically dedicated to educating the printed circuit board assembly sector and serves as a valuable resource for people seeking the most relevant information available.



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

by Brent Fischthal, Koh Young America

An in-depth insight into new and exciting true 3D inspection technology is provided in this book, along with a look into the future of leveraging big data management and autonomous manufacturing for a smarter factory.



### Smart Data: Using Data to Improve Manufacturing

by Sagi Reuven and Zac Elliott, Siemens Digital Industries Software

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



### Process Validation

by Graham K. Naisbitt, Gen3

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



### Advanced Manufacturing in the Digital Age

by Oren Manor, Siemens Digital Industries Software

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

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