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Seeing the Light

Our September issue examines the wider set of challenges currently in the supply chain. Managing one’s suppliers takes extra work and attention right now, but there are methods and solutions available. There is light at the end of the tunnel, so to speak. The question is, are you taking advantage of as many of these methods and solutions as you should?

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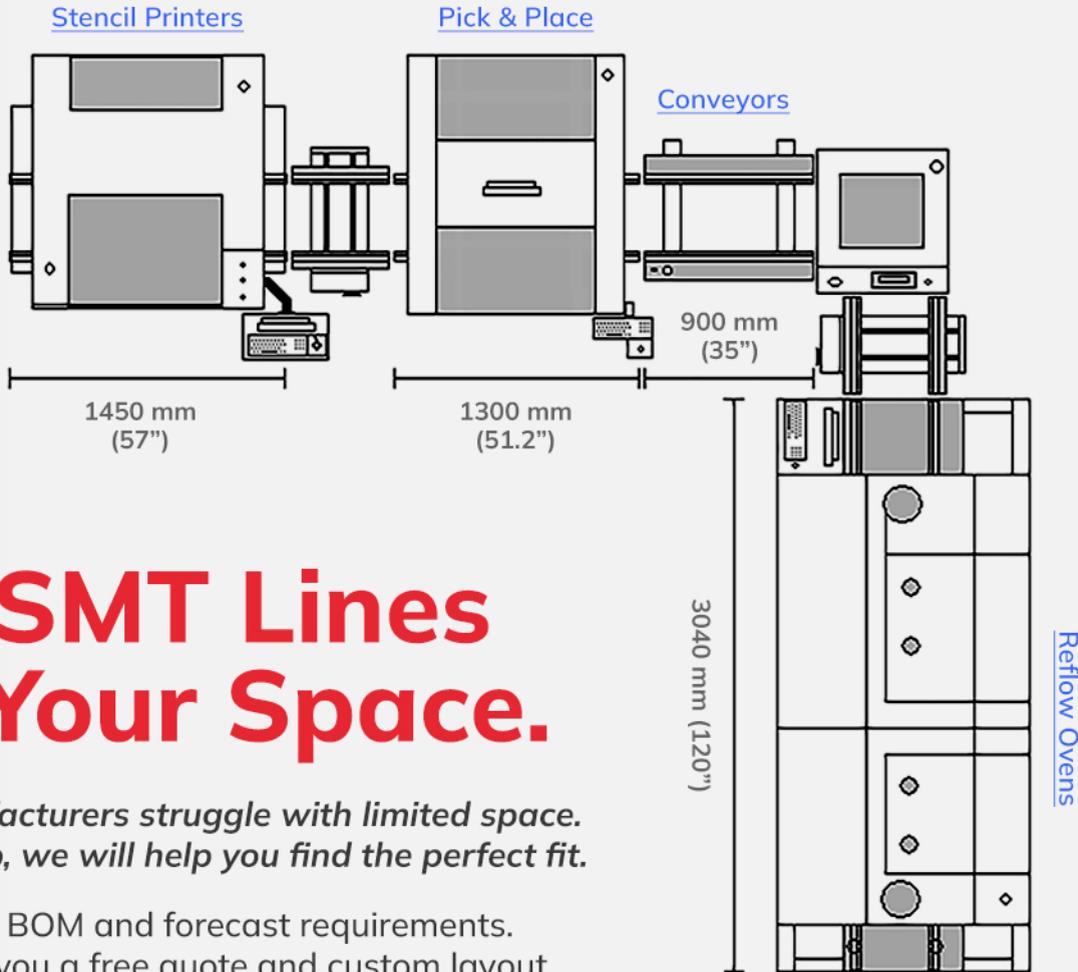
by Michael Ford



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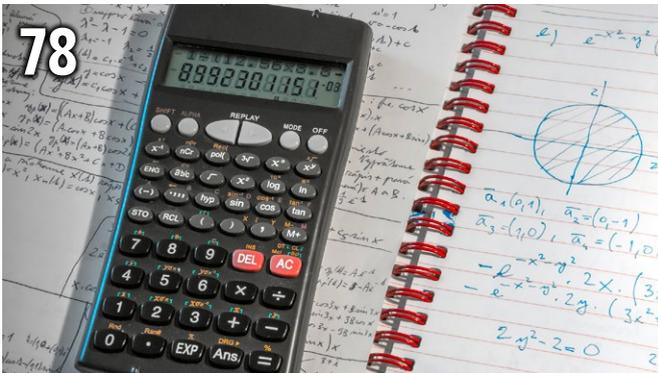


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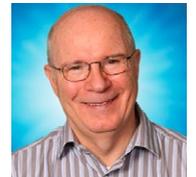
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Light at the End of the Tunnel

Nolan's Notes

by Nolan Johnson, I-CONNECT007

Developing one issue of *SMT007 Magazine* takes two to four months of planning, research, content gathering, editing, and production. Under normal conditions (are they ever normal?), the stories we identify at the start of the planning process remain accurate and timely when the magazine is published. We move fast in this industry, but sometimes, just like the rest of our industry, things evolve.

Supply chain challenges, though, look to be here for the long haul. So, the questions we asked centered on how EMS companies should adapt their processes and equipment. It feels as if the component sourcing teams at EMS providers are as overworked and stressed-out

as the emergency room nurses were in our hospitals one to two years ago. Look at the similarities: constantly changing situations, facilities clogged with more work/patients than the staff can handle, shortages of critical supplies, new pressures from unexpected places, and each new pressure point causing cascading issues throughout the entire operation. In both cases, workers have expressed that it feels like a long, dark tunnel—or the bottom of a well.

Therefore, we chose Pozzo di San Patrizio, in Orvieto, Italy, for our cover. This well was built between 1527 and 1537, as requested by Pope Clement VII, who took refuge there while Rome was sacked in 1527. To reach water, the

well had to be dug 53 meters (174 feet) down. Faced with a huge challenge, Antonio da Sangallo the Younger, the well's mastermind, delivered a disruptive and innovative solution. He wrapped the perimeter of all 53 meters with two corkscrew ramps arranged in a double helix. These ramps—tunnels, really—allowed mules to haul water from the bottom of the well to the surface, guaranteeing a reliable source for water. While the climb to the top, to the light, could seem arduous, it was made possible because of the thought and practice behind its development. What is to be learned from this architectural feat?



Pozzo di San Patrizio, in Orvieto, Italy.
(Source: Wikimedia Commons, Fantasy)

When we look at component sourcing, it seems that not all the components are easing back into distribution at the same rate. Every EMS company spokesperson I've talked to recently seems to have stories of customer jobs with high part counts ready to go, except for a single missing critical component. Inventory is simply sitting idle, tying up company funds as they wait for the critical part—one that used to be sourced as easily as the common passives. While many parts are becoming easier and more reliable to source, there are still enough elusive key parts to extend the headaches for procurement. This is the climb through the proverbial well.

That might be changing little by little, making it easier on the procurement teams. Just recently, we've heard that supply chain pressures seem to be improving. Truthfully, we have been dealing with supply chain pressures since 2019, but it was the spike in 2020 due to COVID ramifications, that sent us reeling. So, it's big news to hear that supply is improving somewhat. At the top of our well, it is important to remember that when we emerge from our supply chain "tunnel," we're not back where we started; it's a different landscape.

For instance, buyers are increasingly making use of new tools to track part availability. In fact, I believe that software assistance for procurement is an emerging and disruptive sector. While there have been players in this space for a while, new players with new approaches are emerging. Think about it: Tracking parts availability and sending alerts to the team when action is needed is exactly the kind of work that computers do best. Why shouldn't the purchasing team benefit from as much automation as the CAM department or the manufacturing floor?

Our September issue examines this wider set of challenges. Managing suppliers takes extra work and attention right now, but there are methods and solutions available. Are you taking advantage of as many as you should? How are you managing your sourcing? Do you see

it as a tunnel? A well? A chance to engineer a new, disruptive process?

To help answer these questions, we sought out experts to share their findings. We have three fresh-off-the-boat interviews: Shawn DuBravac, chief economist at IPC; Chris Lentz and Joe Garcia at Emerald EMS; and the team at Epoch, including CEO Foad Ghalili. These conversations provide insight into what's under way, what's pressuring our supply chain, how EMS companies and the industry are adapting, mitigating risk, and finding ways to thrive under the new conditions.

To augment the interviews, we have perspective from military specialist, Axiom, where Michael Schindele discusses the challenge of finding military parts, which often adds a whole new set of challenges, and how his company has used innovative methods to overcome their specific challenges.

As ever, our columnists weigh in on key topics, including Michael Ford on machine intelligence; Bob Wettermann on how to open a trace on a PCB surface; Chris Ellis on overcoming today's SMT challenges; Ron Lasky on teaching basic SMT skills; and a link to a column by Zac Elliott of Siemens about the manufacturing metaverse.

Finally, I want to recognize the recent work to help government representatives across North America and Europe better understand how the pieces of the electronics hardware industry fit together in a robust and resilient supply chain. Legislation in the U.S. and European Union intends to build that foundation that will carry this industry forward. This tunnel is a bit longer and more strategic. I've been told to expect a 10-year process. But we're in motion and that's a good thing. **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](#).



Finally, Some **Good News** About Supply Chain

Feature Interview by Nolan Johnson

I-CONNECT007

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. It doesn't seem we'll be seeing any across-the-board relief for some time to come, but Shawn's higher-altitude perspective brings insight to your daily planning.

Nolan Johnson: Shawn, while things may be easing up in the component supply chain, it's still spotty.

Shawn DuBravac: Yes. There are still broad shortages in the market. We aren't seeing a rapid reduction in lead times, but there are

variables that point in the direction of healthier supply chains. For example, we've seen costs come down quite significantly, even falling rapidly, though they also rose rapidly. Shipping costs, for example, for a 40-foot container from Shanghai to Los Angeles are off about 32% over the last year. They shot up significantly, and now we're seeing them come back down.

Johnson: I'm guessing that 32% decrease is not back to what it once was.

DuBravac: Correct. We're not back to pre-pandemic levels yet, but we are getting there and that will continue. We have data through the end of June for motor vehicle assemblies, and this tells us about domestic production in the

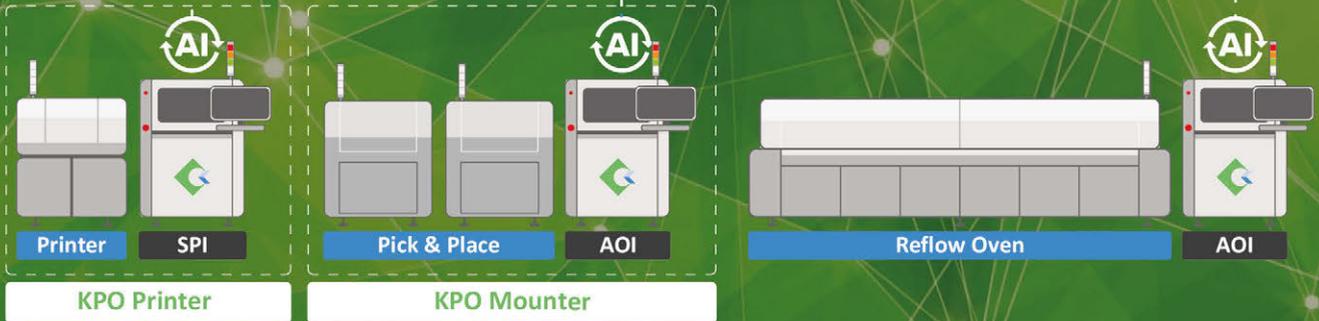
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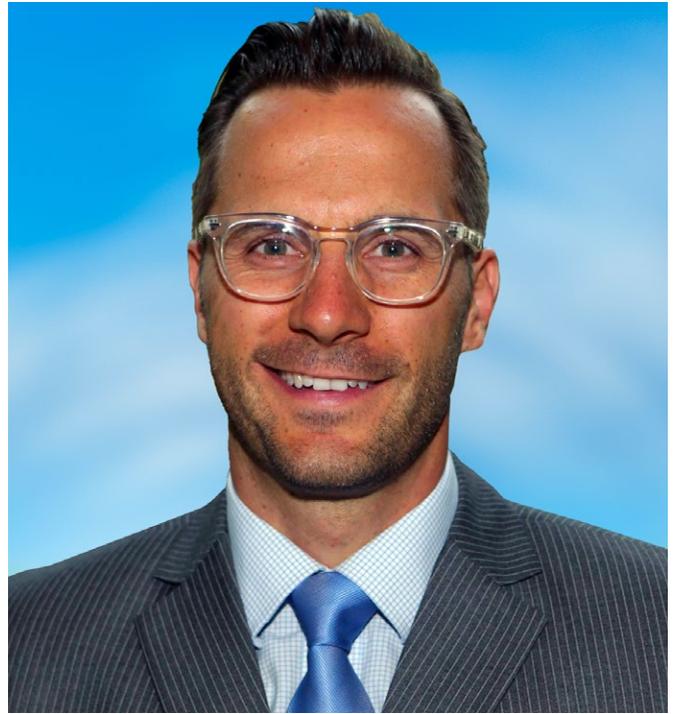
United States. In the last three months, we've had an annualized rate for auto production of over 10 million units. We're not back to pre-pandemic levels, but we're about a million to a million-and-a-half units higher than the beginning of the year. At the low point in September 2021, we assembled just about seven and a half million units on an annualized basis.

We are 30% up from September 2021, and there are several contributing factors. We saw in the most recent GDP report—which wasn't very good—that both consumer demand for goods, and business investment and equipment, were all down. Anytime you see demand easing, it provides some breathing room for the supply chain to recover. Now, it isn't necessarily great that demand is waning—these are two sides of the same coin. There is risk, but these factors contribute to the improvement of supply chain dynamics.

Johnson: How does this relate to semiconductors? If the supply chain is easing, that's good. But I have recently spoken with a number of EMS companies and each one has shared some flavor of, "We can get most of the parts, but all it takes is one part that we can't get and we're stuck; the availability is not consistent." What insight does IPC have about component availability?

DuBravac: You're right, all it takes is one part to be out of stock or one part to have an inaccurate delivery date. EMS providers have been dealing with that for two years now. They place an order, think they have an accurate delivery date, and it ends up delayed two, four, eight weeks, or more. It will take some time for that to heal and for us to see those types of delays become less severe.

I know everyone wonders about the timing, but you must see it as a process—something that will continue through 2022. Will we see these issues next year? Definitely, in some instances. Certain components will still have low stock availability. There will be prolonged



Shawn DuBravac

lead times. Some companies will try to work around that. For example, we hear of OEMs that have engineered out some of these components when they can.

Johnson: What other coping strategies have you heard about?

DuBravac: It's many of the normal ones you would expect. I mentioned engineering out components that are in short supply, but it's also stockpiling, or ordering based on anticipated needs, not just what you need today. Some companies have at times been able to find other sources as well.

However, we don't get the sense there has been a lot of stockpiling. We don't get the sense that there is excess inventory sitting out there which could come back to haunt the industry later. If you have excess inventory and your company decides to get rid of that, then you could see excess availability and prices dropping. In this environment, we probably won't see that. Certainly, companies that were holding onto any excess inventory would have been selling it into the market when prices were

elevated, so I think most people were holding stock for things they wanted and needed to use.

Again, we can use the automobile industry as an example. From the data, we see production levels improving, but there are very low inventory levels for new vehicles. Until we get those inventory levels closer to historically normal levels—and as we head toward a recession—companies probably won't bring their inventories back to pre-pandemic levels for now. They'll keep them at what they consider a healthy manageable level. But we're still very far from either of those two levels. We're certainly very far from pre-pandemic levels. We're even very far from a more normal, manageable, healthy type of range.

Until you see inventories come up for finished goods, you're likely to have spot shortages, longer lead times, that type of thing.

Until you see inventories come up for finished goods, you're likely to have spot shortages, longer lead times, that type of thing. In many instances, OEMs have been reporting strong bookings, and order flow that's outpacing their deliveries; this suggests some backlog. With that type of environment, where OEMs are facing backlogs, you will have pressure on the supply chain. In 2021, there was much pressure on the supply chain with extremely high transportation costs, political uncertainties, and very strong demand. But these pressures have lessened, and demand is slowing.

As well, transportation networks are getting better, and costs are coming down. Forces that had been working in one direction are now working in the opposite direction. Over time, this will bring down costs, improve availability,

and shorten lead times. I see improvement in these areas. Let's look at the forces pushing up lead times. You had ships sitting off the coast, waiting to get to a berth so they could unload. They sat there waiting for three extra weeks. That directly led to three weeks on your lead time when the stock you needed was sitting on a boat. Now, we don't have ships just continually sitting outside the port. They pretty much come in, get a berth, and unload.

Johnson: It seems things are improving, but it's still a long tail to recovery.

DuBravac: That's true. I've had conversations with companies that were sourcing from Russia or other parts of the world. Once any of that stock is depleted, it will put pressure in that particular part of the market. So, those types of segments could have long tails. But other things could improve rapidly because some manufacturing shifted to make other products.

The classic COVID example is toilet paper. When you looked at production, roughly half the market was industrial grade, and the other half was commercial. When everyone started working from home, most of the demand shifted to home consumption, and manufacturers couldn't shift quickly enough to just producing consumer-grade toilet paper. Consumer toilet paper is a different product; it tends to have a lot more paper pulp than commercial grade. The demand for paper pulp shot up in the pandemic which drove the price up for paper pulp. There are these knock-on effects that happen. What could happen in several areas is suddenly there will be available supply that wasn't there before, because manufacturers will go back to making the products like before the pandemic.

That shift is still taking place. That piece is the long tail. It will take companies a while to shift back to the other markets they hadn't focused on in the past 18 months.

Let's look at semiconductors, which shifted away from categories like autos when the auto-



is a good sign the supply chain is healing when those shipments pick up. Each month, I look closely at EMS company data and how shipments look relative to orders from the prior month with the presumption that you've got a two- to four-week lag between when the order comes in and when the product is shipping out.

When supply chains were very tight, you saw that shipments were weak relative to the prior month's orders. That relationship has improved and the numbers are healthier. The book-to-bill is still quite strong in EMS providers. It's a positive sign.

Johnson: It's likely a factor in the easing of the supply chain for components.

DuBravac: Definitely. Semiconductors got all the headlines, but I spoke with a company recently, and was essentially told, "Normally when we might be placing an order for a hundred parts, one will pop up with a price change, or a change in the availability, which leads to a delay. Now it's 50% or 60% of the components popping up with warnings that the price has changed, there's a stockout, or a lead time change." One of the unspoken strains on companies was that suddenly it was a multi-person, full-time job just to keep on top of what's stocked out, how prices change, the lead times, and other places to find a product. There's been a very big strain on staff within all electronics manufacturing. It's a strain on their bandwidth and staff time.

But it's improving. It will never get to where we want it to be, but supply chains are designed to handle disruptions. We saw more disruption than ever in the past 18 months, but supply chains are resilient and adaptive; they adjust. It doesn't mean there wasn't stress, but companies that are making products, given the headwinds they've experienced, have been unsung heroes in the past two years with respect to their ability to continue sourcing components, building products, and shipping them out.

makers stopped placing orders early in the pandemic. At the same time, orders from everyone else picked up, and semiconductor fabs started satisfying those other orders. Now that demand for other durable and consumer goods is slowing, they can say, "We now have capacity, we can go back to serving some of these markets that we were serving in the past." I see that shuffle taking place. That's why I talked transportation and the port situation because they are signs that everything is shuffling back to where it was.

Johnson: What numbers does IPC track for semiconductors and components? How much market insight do we have through IPC data into how the semiconductor products are flowing?

DuBravac: When it comes to other components, we're working on gathering data for lead times. We haven't historically tracked semiconductors because other associations are doing that, like the Semiconductor Industry Association (SIA). At IPC, we have good visibility into PCB and EMS data, and the orders there.

As you look at the book-to-bill for PCBs, we've seen that come down somewhat. It's still tracking at around one, meaning shipments are matching orders. We still have good order flow there, but you see shipments accelerate, which

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Johnson: EMS companies tell me they are moving toward software tools that help them automate their processes. These tools look at the pricing updates, do a periodic check on pricing and availability, and send alerts. I see it emerging in procurement and it seems poised to stay. I have also heard about EMS companies starting to work together collaboratively to share their inventory.

DuBravac: I like your point about software because ultimately, that's a key piece to the Factory of the Future. As much as people talk about automation in manufacturing, it will show up in software-enabled capabilities that augment the human. When it comes to procurement, software can play a vital role. If my distributors are all using a software program, I can be talking to them nonstop. Automation enables a greater flow of information. Rather than doing inventory checks with my distributor only when I need to place an order, if we had a list of everything I've ever ordered, I could be checking against their system at near constant intervals.

It could say, "You haven't ordered this lately, but you have ordered this before. It's out of stock or it's got a longer lead time." Some of that already happens. For the larger OEMs, something that exacerbated the supply chain dynamics was having projects built into this ERP system, then you want to build a product.

Let's say you're 16 weeks out from starting it. If you get an alert that tells you the lead time on a component for the project went from 14 to 18 weeks, you will place that order right away.

For a big company with a lot of projects, their ERP systems are probably talking to each other. As soon as one person gets an alert about a change in lead time, the system pulls orders forward because it triggers everybody's ERP system about the changes. It helps other projects to know when to place orders. That dynamic exacerbated the supply chain constraints when shortages triggered a flood of orders.

When inventory is tight, you want everyone to stop ordering. But it works in the reverse—when they hear there's tightness, they all jump forward. Eventually, you catch up with your lead times, you reach a more even flow of orders. The software piece will be crucial, especially if we have a direct connection to our distributors and other companies that we're sourcing from. Those ERP systems can communicate directly and augment what the human is doing.

Johnson: It could be said that it's a higher priority to automate those planning roles in the process rather than the manufacturing floor.

DuBravac: I agree. It's the flow of information that will improve the productivity of facilities and, ultimately, of their workers. For an EMS company, their profitability is based on the value-add of the labor, the value-add of that person. If they can improve when components are showing up, how soon they can start to build products, how quickly they can move through the manufacturing process, and ship them out, all that improves the value-add of those employees and improves the profitability of the organization. It all comes down to logistics.



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Johnson: Cash flow becomes an issue. When you have to buy inventory and hold onto it, you tie up cash you might otherwise need for other operating expenses. How does an EMS company handle that right now? What's the best strategy for them?

DuBravac: I think it's vital that EMS companies—really all manufacturers—have very good relationships with their banks and that they understand their lending channels well. EMS companies that I've spoken with tend to have very good relationships with their banks. They're typically grabbing that line of credit to pay for the inventory, which turns into product. They don't typically get paid for it immediately but rather they get paid on terms which are often, plus-30, plus-60, plus-90, or perhaps something else entirely.

There is this period where they need to bridge the finance. This was a big problem in 2006–09, during that recession when banks were facing much stricter asset and deposit requirements. I heard from manufacturers during that time that companies were making all their payments and doing everything the way they were supposed to but suddenly not getting their balloon loans renewed on their warehouses or their facilities because the banks were not in

a position to do it. They were forced to either sell it or find some other way to finance.

Those financial channels are very important. My read on that environment is that we aren't anywhere near the type of situation that we were back then. But EMS companies should communicate frequently with their bank and understand the strains their banks might be under. Diversifying your lending and banking is a wise strategy as well.

Johnson: We're learning all about resilience everywhere, aren't we?

DuBravac: Just as much as ever. Dual sourcing is the holy grail that's often unachievable for any number of reasons. It's often hard to do that, but many seek it. There's probably an equivalent when it comes to banking. It's dual finance, not relying on a single financial channel, but having a multitude of channels, even if it's just two regional banks or two local banks that you can turn to for credit when you need it that will bridge the gap between paying for your components and then shipping out your product. That line of finance is extremely important. Yes, the cash flow is extremely important.

EMS companies are probably facing or will face higher rates because of the rate increases. I think EMS companies must ensure they factor the higher operating costs into their quotes to make sure that they are pricing in a higher operating cost. It's showing up everywhere. This is something they're all facing. Orders are good, demand still looks good. It's holding up for the most part in many sectors. It's slowing, but we're not seeing it drop off a cliff. At the same time, though, labor and finance costs are rising. Companies need to adjust, or they'll find themselves in a situation where orders are good, but profitability isn't. That's the catch.

Johnson: Shawn, as ever, thank you.

DuBravac: Always happy to chat. SMT007



Is there light at the end of the tunnel?



INFLATION EASES

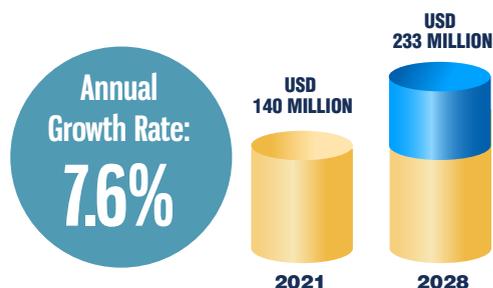
Inflation slows in 2023 and 2024, settling near 2%



Source: US Bureau of Labor Statistics, Tradingeconomics.com

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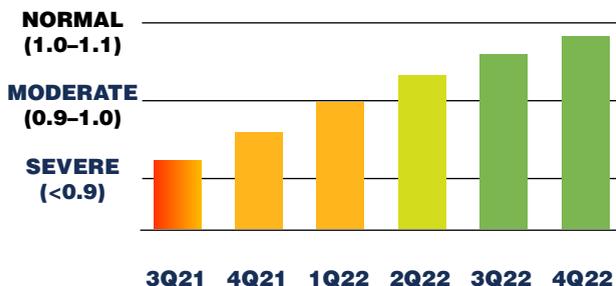
Rapid growth and adoption reduces costs



Source: Automation.com

SEMICONDUCTOR INVENTORY

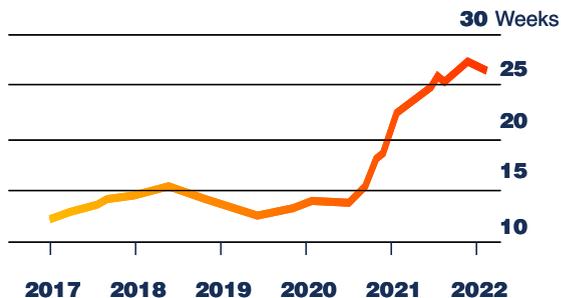
Inventory levels are returning to normal



Source: Gartner

THE WAIT FOR CHIPS

Lead times for semiconductors fell in July



Source: Susquehanna Financial Group

The Progress of Machine Intelligence

Smart Factory Insights

Feature Column by Michael Ford, AEGIS SOFTWARE

Adversity drives focus, realization, and 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 or adaptability. This oversight has persisted into automation projects and digital transformation initiatives. Innovators today realize there is no way back, that we must embrace the intelligence we all should have learned.

We're now seeing the true fragility of our business world after a decade or two of relative calm. When nothing untoward happens for a while, risks get downplayed in favor of short-term results, and complacency takes hold. The enduring focus of automation within manufacturing has been predominantly stuck with

Industry 3.0—that is, the automation of physical tasks once performed by humans. Recently, however, automation of human thought (aligning with Industry 4.0) has become the origin of true digital transformation. Unfortunately, for many this started at a time of relative calm in the industry, focusing again on short-term profits rather than long-term resilience. But it's not too late to change.

It's a Human Resource Issue

The recent trilogy of challenges—COVID-19, political instability in several regions, and a restless climate—have led to known fundamental effects, including shortages, inflation, and human resource issues. It is taking a significant toll. Existing software automation has revealed its true limitations in many cases.



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Relatively simple automation of operations, optimized to meet short-term goals without real consideration of long-term challenges, has proven to be near-useless. It was left to good, old human intelligence to respond to recent extraordinary events, make quick decisions, and navigate through obstacles, as well as look for opportunities. Lack of investment in flexibility, the acceptance of dependencies on materials and products made in remote locations, as well as reliance on key people in the organization where only one person knows or can perform certain tasks, have led to extreme challenges for many.

In our continuously changing world, we seek to avoid things over which we have little or no control. Local sourcing of key materials, security of operations and data, and automation choices that provide flexibility with a vast range of simultaneous operational and business models, should top the “to do” list, as manufacturing embraces the world’s uncertain future.

In our continuously changing world, we seek to avoid things over which we have little or no control.

The most unexpected and interesting challenge, however, is that during such volatility, we found we could not even rely on human intelligence. We are now experiencing economic patterns of inflation and potential recession, which seem familiar to those old enough to remember the 1980s. Legacy economic tools to deal with these issues, however, seem inappropriate as, unlike previous cases, employment levels are very high—exactly the opposite of previous scenarios. While companies were focused on business challenges, people were also making their own private changes, as they decided (or were forced) to seek a “better

life,” moving from roles that were just acceptable to ones that stimulate them. This turbulence in the labor market can be regarded as good news from the digital transformation perspective.

So, Let the Machines Do the Talking

The technology behind automation of physical work continues to evolve considerably. There are more choices of hardware automation solutions than ever before. The priority between flexibility and optimization, however, is now under serious review. Rather than having a person or an automation dedicated to a specific role, we have learned that such resources should be flexible, allowing them to be dynamic across a whole selection of prioritized tasks. Humans have the physical dexterity to be flexible; automation is also making progress.

The real challenge, in both cases, is to provide the continuous step-by-step guidance as to how to perform and complete each task. Humans are then not dependent on niche, rarely used training, nor on specialist knowledge. People receive information in the form of electronic work instructions, and deliver to automation through IIoT-based commands and data exchanges. This innovation brings the need for a holistic view of operations, sourced from the domain of MES, which already provides the central control and management of operations. Standards-based “plug and play” interoperability across the shopfloor, for example with IPC-CFX, is proving its worth, and differentiation from older data exchange mechanisms, as it provides any machine or solution a secure protocol and fully defined unambiguous language.

An extension of this MES intelligence is to automate the decision-making processes that drive operational events. Human intelligence is no longer motivated, or interested in, searching for data and using it to make mindless routine decisions. Retaining sustainable human intelligence will be for those who derive



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job satisfaction from making complex decisions in an easy and timely way, based on the availability of immediate, accurate, and contextualized knowledge. The intelligence within MES is based on internal complex data models, created from many years of experience, where data is contextualized across many factors. This enables software to take routine decisions and action them, such as the best timing and selection of a material replenishment. This enhances the human contribution in manufacturing to work at a higher level of responsibility and provides for more job satisfaction.

Here is where we see the benefits. As an inherent part of digital transformation, software-based automation that is intelligent and flexible helps resolve both day-to-day business operations, and supports challenging exceptions. It starts with the respect for human intelligence, a change that we have begun to take seriously, and is potentially the most fundamental challenge of anything we've faced so far. It may come as a bit of a surprise, though the signs have been there for a while. People want to be more evolved, to get their hands dirty through their chosen hobbies, rather than daily obligations. As humans have left manufacturing operations for whatever reasons, it took out their wealth of skills, knowledge, and intelligence, which perhaps was often taken for granted. It has been especially noticeable during the pandemic when many business-critical exceptions needed to be dealt with. Intelligent software built into automation and machines, and especially modern MES solutions, will fill the gaps. The key requirement is a rich and mature internal data model:

- Representing knowledge about every aspect of the manufacturing operation
- Making and executing routine decisions, with significant flexibility
- Providing key intel to humans with which their intelligence results in real business differentiation



Conclusion

As we move forward, we need to revisit our business practices. Operational risk and dependencies in the supply chain as well as inefficiencies in terms of environmental impact and energy use are sure to be top of mind. We must revisit our strategies behind digital transformation, not just to help automate and optimize existing, fixed operations, but to provide flexibility, to relieve humans from the distractions of data gathering and trivial decision-making, and to create a sustainable and resilient environment.

In between challenges, we will be tempted to revert and focus too intently on short-term goals. Such a strategy helps business for only a short term, while cannibalizing future potential. Let's seize the benefits that this silver lining has presented and be prepared for any future challenges when they come. By doing so, we increase the quality of life for our human teams that are essential to meet sustainable business objectives. **SMT007**



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

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Demand

STEM
Education

Greater Supply
Independence

Inflation

Four Silver Linings in the Stormy Clouds of Pandemic, Supply Chain, and Inflation

Feature Article by Dr. Ronald C. Lasky

INDIUM CORPORATION

It may be difficult to see any bright spots in the current economic situation. We have all experienced the devastation of the pandemic, supply chain issues, and most recently, inflation. However, as a senior technologist for an international materials supplier (Indium Corporation) and a professor of engineering at an Ivy League research university (Dartmouth College), I offer these four silver linings for those of us in the electronics industry.

Silver Lining 1: Demand

Because of the pandemic and supply chain issues, there exists an insatiable demand for electronics. Nearly all industries are dependent on electronics. For example, many automobiles are structurally assembled, but are

awaiting electronics installation. For example, I'm currently waiting on a Volvo that was ordered in May and is not expected until October; the hold-up is the lack of electronics.

Silver Lining 2: Greater Supply Independence

The shortages during the pandemic and more recent supply chain issues are driving a sense that countries like the United States must be more independent for supply from unstable countries and regions. Most notable, action to support this concern is the recent passage of the CHIPS and Science Act. As in Silver Lining 1, this bill, although controversial in many aspects, will almost certainly lead to more jobs in electronics.

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I think we will see this independent drive go beyond electronics to pharmaceuticals, machine tools, rare earth metals, and other critical materials and finished products.

Silver Lining 3: STEM Education

Not only will the United States need more engineers and technicians to develop and manufacture semiconductors and other high technology products like electrical vehicles, but the world has also seen how much supply chain challenges affect our lives. More scientists and engineers will be needed to improve the operations, transportation, and final delivery of the goods we all need to prosper in the 21st century.

All these needs will be a boon to STEM education.

Silver Lining 4: Inflation

We have all suffered from inflation, mild at first and rampant now. It appears that much of the inflation is driven by the cost of fossil fuels. These high costs drive not just transportation, but fertilizer prices, food, construction—almost everything. This is where electronics

can come to the rescue. Electronics are one of the few consumer products we purchase that historically come down in price. I was recently shopping and saw a 70-inch flat panel TV for less than \$700. Just a few years ago, that TV would have cost about \$2,000.

Conclusion

The United States and the rest of the world still have multiple challenges ahead, including supply and staff shortages, wars, and unrest. But with the near insatiable need for ever-increasing high-performing electronics, those of us in this vital industry are blessed indeed. **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, and an I-Connect007 columnist.

To read past columns, [click here](#).

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Lean Digital Thread

The Manufacturing Metaverse Revisited

By **Zac Elliott**

In my May column, I talked about the hype around the metaverse and looked at how the technology may be leveraged by manufacturers in the future. Because the metaverse is only starting to be built, the topic was a bit abstract, but the recent announcement of a partnership between Siemens and NVIDIA brings the industrial metaverse one big step closer to (virtual) reality. In this column, I will discuss the new partnership, the technology each party brings to the table, and how manufacturers can benefit from the collaboration.

The Partnership

The collaboration between Siemens and NVIDIA brings together two technology platforms to sup-

port an industrial metaverse—the digital business platform, Siemens Xcelerator, and the NVIDIA open world platform, NVIDIA Omniverse. The goal is to reach the next level of industrial automation by leveraging AI-driven digital twin technology. This will provide companies of any size with new ways to collaborate, innovate, and improve their performance.

“Photorealistic, physics-based digital twins embedded in the industrial metaverse offer enormous potential to transform our economies and industries by providing a virtual world where people can interact and collaborate to solve real-world problems.”

To read this entire column, [click here](#).



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Breathing Room in Parts Supply

Feature Interview by Nolan Johnson

I-CONNECT007

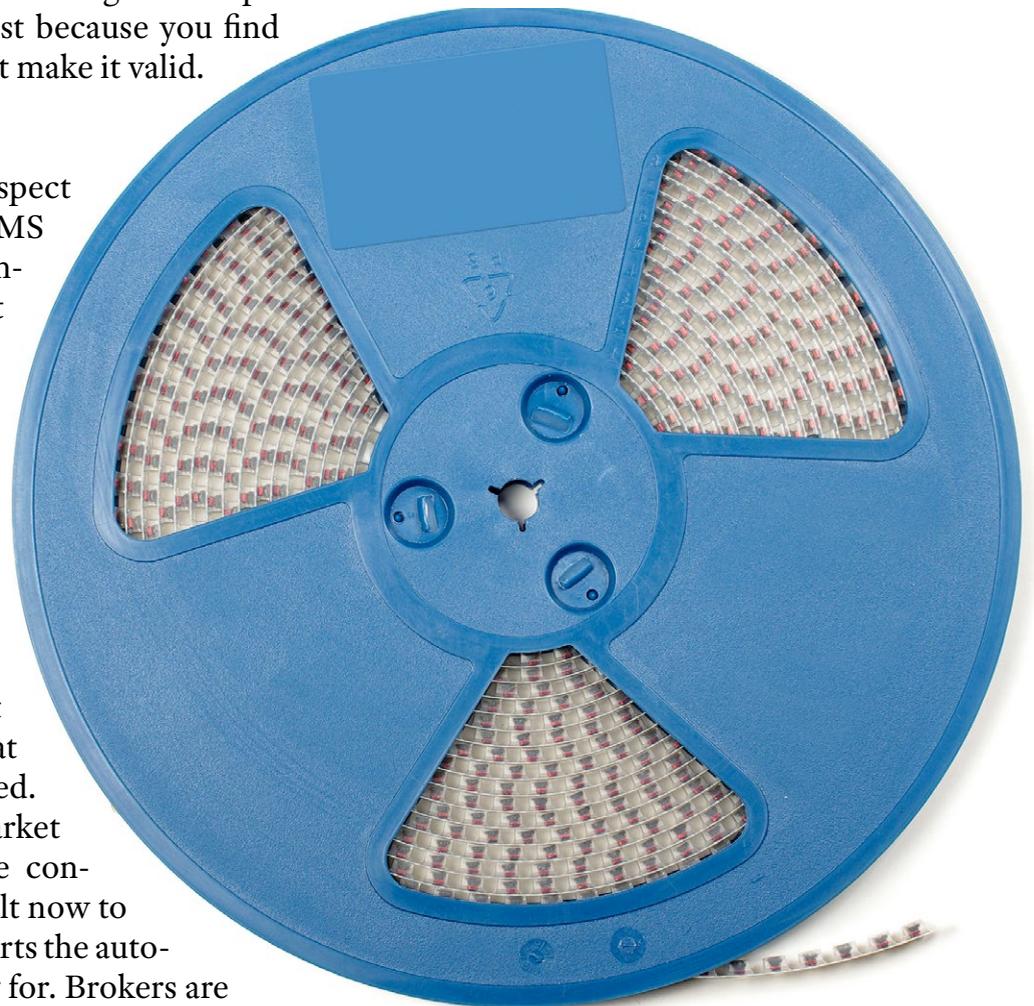
Electronics manufacturers like Emerald EMS are finding that as the consumer markets experience a slowdown, and supply chain woes are lightening, challenges persist. Chris Lentz, vice president of supply chain logistics, and Joe Garcia, vice president of sales and marketing, break down the issues their company has faced over the past two years in working with vetted sources, not backing down in the face of adversity, and most importantly, forging better relationships with customers. One thing they've learned is how to be creative in finding parts while maintaining their reputation with customers. Just because you find it cheaper online doesn't make it valid. Chris and Joe explain.

Nolan Johnson: With respect to being a responsive EMS supplier to your customers, what are the biggest challenges you're facing right now?

Chris Lentz: Last year, we had to use non-franchise suppliers more than ever—more than I would ever like to, more than I have in my history. We restrict it to three or four that we've vetted and audited. But this year, as the market has become even more constrained, it's very difficult now to find some of the same parts the automotive guys are looking for. Brokers are

springing up out of the woodwork with unbelievable pricing, sometimes 50 times, if they have it, of the normal cost. That makes this year a little bit tougher.

We see some break as the consumer markets are slowing, with cellphone demand, and other products. We get dribs and drabs of parts we weren't expecting to see for six months. For example, we may need a shipment of 10,000, but we'll get a reel of 3,000. I have a lot of direct, high-level contacts with manufacturers, and while they won't say there's a



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consistent market downturn right now, they know people are a little scared about the possibility of a recession, so some orders are getting pushed out or canceled. That's to our benefit, but we still have so many we are chasing right now.

For the teams at our sites, our priority is working the relationships with our suppliers, leveraging our customer relationships, and doing anything we can to resolve these shortages.

We are asking our customers for an extended forecast, where we can obviously get the pipeline out there. Most of our customers are well educated now. Many of them have brought in supply chain experts, often from the EMS supplier industry, so they understand what's going on and the reason we need to forecast. We do anything to help, including long lead BOMs, safety stock, and others.

Johnson: Are you getting better forecasts from your customers?

Lentz: Some of them. Some are still hesitant to hedge on their demand, which is understandable.

Joe Garcia: We're getting more visibility in the forecast, but whether they're actually better, we don't know. Some things we assume to be true (and may not be) are that customers might be double ordering, or they may be giving signals to excite the supply chain—they may think that it is going to create more action around getting parts. We're getting more visibility by way of forecast; I just don't know if they're more accurate yet.

Johnson: When I was visiting your facility recently, I asked whether customers' behaviors were changing. Were they, for example, sending more kitted parts? Are you seeing behav-



Chris Lentz

ior changes from your customers? For example, trying to take more control over sourcing the parts themselves in this environment?

Lentz: At the NPI center we've seen more consigned kits, but not that many more from a production level. Are customers trying to pipeline more? Yes, some. When Joe brings in a new customer and he says, "They've been pipelining the long lead

time components," there's nothing better than that. We are seeing a little bit of change in behavior in that, but we're still the victims of a lack of forecast where we have a 52-week quote, the order comes in at 15 weeks, then the load and chase begins.

Johnson: It must be an order of magnitude that is more complex right now?

Lentz: I've been in the business 35 years, in supply chain for 32 years, and it's by far the most challenging set of circumstances I have ever seen. There are so many things at play. We must be careful what we're bringing in, but you can't just push everything out. With the market the way it is now, if you have a 52-week part you can't push parts out to line up with that, or you'll risk going to the back of the line; distributors and the manufacturers will shift them to someone. We must be savvy.

Obviously, there's pressure to push out inventory, and if it is very high dollars, we will look to partner with our customers to help us cover the inventory costs, to pay for it and let us put it in consignment. We've had some good reactions from our customers on that. As we further educate them, they understand that we can't just push it out. But we also don't want to bring in millions of dollars in parts if one part keeps us from shipping. We're trying many different avenues to resolve those, including

working with our customers for alternates when they're available so they can design them in quickly. We're also using brokers where we needed.

If you talk to anyone in my position, I'm sure they've told you the same. It's an everyday battle to solve shortages. You get de-commits. As I've told my customers, you don't have the parts until they're on your dock. There are heavyweight guys that have a lot of pull, so we make the strategic decision where there are parts that we know are high risk. We're working with our customers to help us cover where we need them to, but we won't make silly decisions and jeopardize our customers' requirements. We're very visible and vocal with our customers.

Johnson: With all that complexity, did you have to start doing your job differently or use some different procedures?

Lentz: Yes, in some cases. We have business intelligence, for example, to create some tools and reporting for us, streamlining our system reporting to get out to our suppliers. We use CalcuQuote as our quoting tool to check components at least six times a day. They run our shortage list for us, looking for part availability. Our systems can't currently do that; we do not have an automated way. If you went back about five to seven years ago, it would be a buyer's full-time job, checking everyday availability. Now we're using some of our distributors to do that who can check it daily as an automated practice. CalcuQuote daily searches our global corporate preferred approved brokers.

Johnson: How has that software changed your procurement? You're getting more global visibility, but what does that visibility mean for you when it comes to getting those parts?



Joe Garcia

Lentz: It's almost like when a house goes on the market, and a day later it's sold. Parts become available, and the next day (or sooner) they're gone. We get a four-hour, six times a day check, all to my team in China. We want as much global coverage as possible, so we have the ability to grab stock as soon as it's available. Eventually, we will work the APIs with them so that, hopefully, we can do some ERP integration here within Emer-

ald. I'm hoping we can soon take advantage of their API capabilities with ShopCQ and some of the other things they offer.

We use WatchCQ, and CalcuQuote to help us move our excess. It gives the conglomerate EMS providers and some OEMs the ability to look at availability of inventory and hopefully get some hits.

I like CalcuQuote because they are very fluid as we suggest changes. For example, when WatchCQ was originally set up, you could only import one part at a time. I met with Chintan Sutaria, president of CalcuQuote, and said, "It would be nice if we could upload a list." The next day, we had the ability to upload a list and we put 150 parts up in a couple minutes. Historically, it was a more difficult to get real-time changes with the quoting partners I had. This has been a huge help to us and we've had some good hits on those parts. There were probably close to 20 parts hits on the list we had. It might not sound like a lot, but each one is huge for us. It could be revenue from a hundred thousand, to a million, or even \$5 million.

We're trying to get pre-approvals from our customers: If the price is up to 20% higher, we have their approval to buy it. Sometimes it would take customers up to two weeks to give us approvals. By that point, the parts are gone. Most of them now are good at 24 to 48 hours approval.



You talked about working with customers to do redesigns around particularly troublesome parts. How has that changed at Emerald?

Lentz: That's true. We have tried to become much more proactive. We use a third-party software tool as the in-house tool at all our sites. With our customers, we want to express the urgency, as well as give them as much information as we can. Silicon Expert allows you to have the part on the AVL. We have a component engineering team that will look at the alternate, and then you can do an exact comparison between two of the

deltas. With our customers, we have found that all their engineering resources are strained, but if we give them the information they need up front, we get resolution much quicker. It tends to go to the top of their pile if they don't have to do the digging.

We have some supply chain initiatives right now. One of them is to further streamline the alternatives process. It will engage our customers, but what other information could we give them? Our tools do a wonderful job looking at obsolescence and providing proactive feedback to our customers. They have realized the strain it puts on their engineering resources, and they had to focus more attention on it. We never vary from the customer AVL because we have no design authority. They must update their AVL.

Johnson: Is this analysis and feedback process you're just describing something you proactively do for OEM customers? Is there a trigger or a threshold where you bring that in, or is that only by customer request? How does that process initiate?

Lentz: We do as many as we can proactively. Many times, they don't come up in a quarterly business review (QBR) or just in a regular business discussion.

Johnson: Earlier, you mentioned adding some new vendor suppliers. Now that you've gone through the process, and as the parts supply starts to ease, is it your intent to keep those suppliers? Have you found value in having a wider, more distributed supplier network?

Lentz: Yes I have, but it will be a mix. Franchises, as you know, are different in North America than they are in Europe or Asia. Some of the franchise suppliers we have activated are new to us, whether they're in Europe or in Asia. Our division in China was probably dealing with them directly; we didn't have them set up domestically, but now we do. Will we use them in the future when it eases? Yes, certainly, but they may not be the first option. I will look to limit the brokers or the non-franchises as we have our corporate preferred list; I like to keep it to three or four. With that being said, we realized that with the ones we had, Europe was not their strong point, so we picked up a very highly respected, accredited, non-franchised supplier in Europe that has done some great work for us.

Johnson: As I think through using software tools more often, it stands that if you've only got two suppliers, what the software can report back to you is very limited.



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Once you get the data, the customer will ask, “What are the available alternates?” That digging creates a little bit more work. Our partner does do it, for a cost. Some customers have taken advantage of that by looking at BOM scrubs for their products. We can do a quick scrub for new customers. If they want to give us a BOM, we can give them a life cycle analysis. It won’t give them all the alternates, but it will tell which parts are at risk, either end of life, or going end of life in the next year.

Manufacturers are end of life-ing parts much quicker now. We see that.

Johnson: So far, we’ve been talking about finding the parts, but once they come into the receiving dock, how do you verify them? Has that changed?

Lentz: It’s standard to require the marking on the reels. Some of the parts are scanned in, based on the reel marks so it matches what’s in the system. With other parts, we fully inspect. Some customers have different requirements for inspection. We have a very good VMI program with some major distributors. We specify and make sure the label matches exactly. Every part brought in from a non-franchised supplier is looked at, whether in an automated way or under manual inspection.

Johnson: Is this an external inspection or do you run an X-ray?

Lentz: Some require X-ray, but we don’t run X-ray onsite. Some non-franchise suppliers will do it as a matter of business for us, which is our preferred, but some of our major customers require third-party testing. We have to send it to a GETS or one of the other testing houses.

Johnson: Would you say X-ray testing seems to be on the increase?

Lentz: Yes, absolutely. We’ve had situations where we’ve had our preferred brokers stop parts. We’ve had GETS catch one part. This year we’re reaching the bottom of the barrel of the stock. We’re very leery of using brokers that we don’t know. If it’s someone that our customer directs us to use, we require them to sign up for that buy or take liability for it.

Johnson: Do you find this happening where, once you get into the assembly process, and you find a problem mid-process or something actually escaped, now you’ve got bad parts on a board for a customer? I ask as a measure of counterfeits, not your build quality.

Lentz: I’ll tell customers, even with the third-party testing, it’s not foolproof. My concern is that even with the third-party testing, like for an issue like timing, in dealing with our component engineering there is still that small bit of concern.

Our brokers are very good; if anything looks questionable, they will stop it. That’s why I use them. Obviously, we don’t want to use a broker that isn’t at least an ERAI, that doesn’t have the certifications that we’re looking for. When a customer directs us to one that we have no history with, I’m very leery of using them. If our guys can’t find the parts and these guys just happen to come up with those parts—and it does happen—I’m a little nervous. We need to make sure that we’re not putting our customer or ourselves at risk.

We had one incident where a customer had a part that somebody had pulled out of the



woodwork. It was a \$50 part, we confirmed with the manufacturer that they had never sold them for less than \$47 or \$48, yet the broker had them for \$6. They wanted money wired up front. There were red flags everywhere so we obviously didn't proceed with that buy.

Johnson: You talked earlier about working with customers to put parts on consignment because otherwise you're being everybody's bank to the tune of millions of dollars.

Lentz: You're right. I always say my best friend is finance. This is where we really need the customers to partner with us. We're working with our suppliers, we have great relationships with the major distributors, direct relationships with manufacturers, who will work with us where they can, to hold inventory a little bit longer for us. They've been good about it, they really have. This is like nothing I've ever seen. In the past, you've had your tantalum caps, DRAM, and PCB material shortages, but nothing like this. At any point, something can go from a 12- to 40-week lead time.

Johnson: Right now, the value-add of being an EMS company is in helping your customer keep their manufacturing and their forecast on track. With all these issues, you're on a treasure hunt to find the parts, to keep their schedule on track. How do you differentiate yourself against your competition in that regard and how do you monetize this value-add?

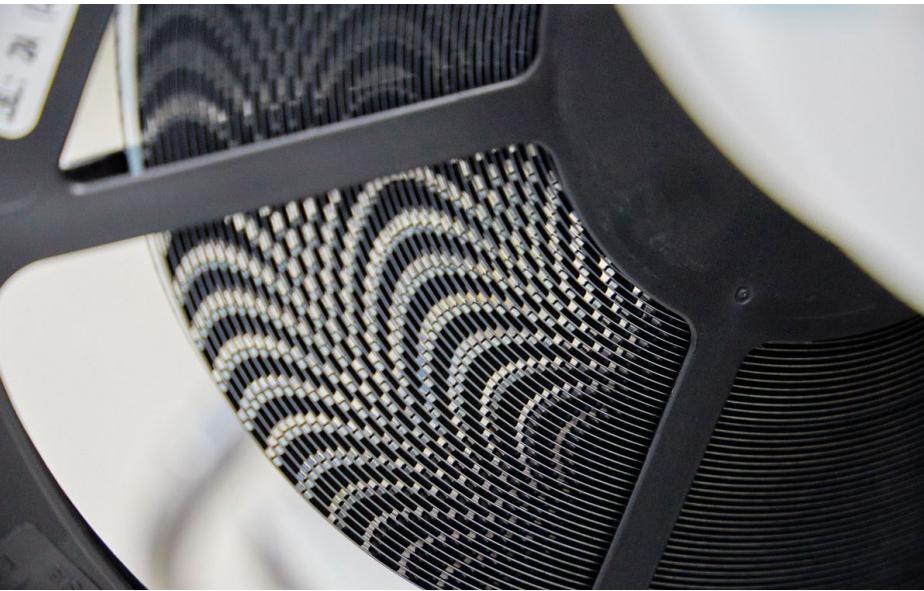
Lentz: Here's what we do. We quickly identify the problem and solve it. Obviously, the engagement with our customers is so critical. What are their drop dead requirements? What will get them through? If they need 20,000, I'm working with Analog and Ford's chasing the same part, but if I can get 2,000, that will get them through their gap. That's how closely we're working with our customers. We find tremendous value in getting our customers engaged right away as part of the escala-



tion. We're not embarrassed to tell them that we have an issue.

We want to get our customers involved right away as partners. It differentiates us from some of our larger competitors that we want them to understand, and we both learn from it. We tell them, "We should have a long lead BOM, we should do some risk buys," and then we point out, "Remember this is the part that came up a few months ago." They're more welcoming and they really appreciate it. They understand we aren't penny pinching with them. That was always the concern, that your customers would think you're trying to get them to put in consignment just to help. No, this market is real. There are really big players outside our industry using the same parts.

When I look at our sites, I'm amazed at the relationships we have with our customers and how tied in we are with them. These guys are down on the ground, making weekly even daily calls, working shortages. I know the customers appreciate that, so that's one big change over the past two years; it is a partnership. I tell our customers, "Our suppliers want to be able to invoice us. We want to be able to invoice you." We all want to solve these as quickly as we can and to satisfy them. We're very passionate about it, believe me.



Johnson: Chris and Joe, any final thoughts?

Lentz: I want to emphasize that we are expanding on the relationships we have with our suppliers—our distributors—on the programs we’re setting up with them to get material in BOM, to get material on VMI. We’re trying to go direct on everything. We’re working with our suppliers—our customers—to set up programs that will help us ensure supply.

Garcia: I think an organization like ours exists to solve problems, be creative, and not just stick to a cookie-cutter approach. That tailored solutions approach has really helped us be as nimble as anybody in this crazy time. It’s not to say we haven’t been bitten. Our inventory has swelled a bit, but it’s to the benefit of our customer. There are millions of dollars in product that we could ship if we can just get those last parts in. We fully expect that will happen. Our approach has always been to be responsive, flexible, and open-minded, and we’ll continue to look for ways to solve these problems creatively.

Johnson: What’s your advice to your EMS compatriots?

Lentz: I had a meeting earlier with a major manufacturer and their local rep. They told

me a story about one of our other New England partners, a smaller CM, that actually went to their major customer for a loan to stay in business. All I can say is that you must engage with your customers and partner with them. When you identify those long lead time components, don’t make it a surprise to them. Engage them early. You know, I feel for these guys. I spent a couple years at a tier four, as a family-owned EMS provider. You must be open with your customers, get the relationship with your distributor as

strong as you can. Don’t be afraid.

When I talk to some of the manufacturers, they say the CM is almost begging them to improve on a 52-week part that they need in 10 weeks, yet they haven’t told their customer. They don’t want to go to their customer with that news. You’ve got to do it. It’s not seen as a weakness. If it is, shame on the customer. It is what it is. For the smaller guys, when I heard about them asking for a loan, it was the first time I’d heard that, but their customer actually gave them the loan to keep them in business. That was amazing to me.

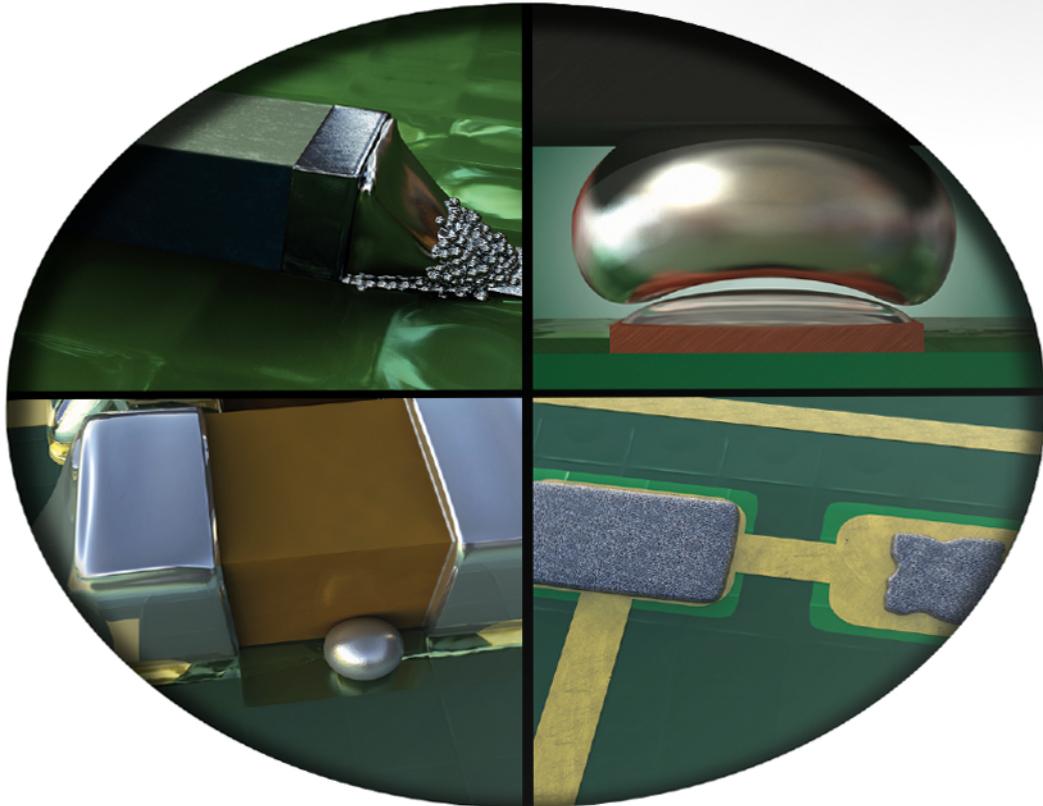
It’s about relationships. The relationships with your customers and your suppliers. It’s one of the things I have loved about Emerald, after coming from a tier one, where suppliers were looked at as the other side. Here, it’s about relationships and taking advantage of the programs offered by our distribution partners. I loved it. It’s not all roses, I’m not saying that, but we’ve been able to solve some issues we’re very proud of, and our customers are very happy.

Johnson: Chris and Joe, it’s been a pleasure. Thank you for your insight.

Lentz: You’re very welcome. Thanks. SMT007

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Axiom Inspired by Industry Challenges

Feature Article by Michael Schindele

AXIOM

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.

Supplier Issues

Unlike past periods of extreme allocations, we now have delivery commitments that cannot be trusted, making it very difficult to plan and meet our business commitments. For example, due to ongoing material availability fluctuations, "committed" purchase order delivery dates are moving targets; changes are

happening real-time, and materials that you expected to be delivered by the committed date are now weeks or even months out. This leaves both us and our customers with stranded inventory, waiting for a few parts before we can start, complete, and ship a job from our factory.

Conversely, we have seen the opposite happen: We were given a commit date two years out and even after the customer assisted in discussions with the manufacturer, we were faced with placing a premium priced NCNR order with an independent distributor only to have the manufacturer come back weeks later and give us the "great news" that the parts will be shipping in 30 days.

We are seeing price increases not only at the time of PO placement, but up to and including the actual ship date as the materials are ready to ship. How do you explain this sudden



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change in plans to management, your board of directors, and/or your shareholders? In the past, when you received a committed date or price, you may not have liked it, but you knew that you could count on it. Those days feel like they are long gone—at least for now.

It feels like the perfect storm with this global event taking place; not just a regional or manufacturer specific event, but the added burden of other dependencies such as logistics, downstream suppliers, raw materials, outside processes, and more, that impacts our daily lives.

With many of our customers in mil/aero we add “degrees of difficulty” to our supply chain processes. Because so many of our customers cannot provide forecasts for various reasons, we struggle with being able to pass forecasts along to our suppliers. The positive news is that some of our customers now understand the situation due to their own experiences in the supply chain. They are now providing POs to us out into 2024. While we have manufacturers/suppliers requesting our 2024 forecasts/orders now they will not support us, there are still suppliers who will not accept orders for delivery in 2024 due to the unknowns about the future. They are not willing to commit.

As I did when I worked for an OEM, I now manage our EMS provider relationships. Customers rely on their EMS partners to own the relationships with suppliers and to have the skills and capabilities in place to manage the customer’s supply chain. The challenge is that, as an EMS provider, we have little leverage with the original component manufacturers (OCMs). During the design/NPI process the customer works with these manufacturers and/or distributors on the design of their products, negotiating terms such volumes, pricing, and lead times. As such, they have the leverage. I had one OCM make it perfectly clear to me, “We own the customer.” In the OEM world, I had to make it very clear to our OCMs and distributors that when one of our EMS partners contacted them they were speaking on our behalf, so respond accordingly.

Workforce Challenges

Some of the workforce challenges that we have been faced with include a greater than expected impact on our suppliers and manufacturers, and growth of our company. To the first point, we have seen:

- The “great resignation” is in full effect
- COVID impacts to workforce availability caused by shutdowns and social distancing
- Reduced service levels to customers, including longer lead times for products, longer response time for inquiries, processing quotes, providing commitments, etc.

As to the growth at Axiom, we see the challenges of having more positions to fill as employees have moved on, getting more people to apply for open positions, and finding the desired skill set to fill our open positions.

What Are the Silver Linings?

Despite these challenges, there is much to be learned and appreciated from the past two years. We are now implementing long-term improvements as we’ve learned from these obstacles and challenges. Here are just a few:

- Because of the extended and unreliable lead times, customers are more open to the independent/broker/alternative markets; even mil/aero companies are now interested in looking at options such as:
 - › Stock availability within our Axiom “qualified” independent distribution partners
 - › Using BOM tools such as Z2Data, Silicon Expert or IHS; looking at alternate manufacturers, functional equivalents, etc.
 - › Using EMS Alliances through tools such as StockCQ and WatchCQ from CalcuQuote to see what inventory may be available outside of the franchised or independent distribution markets.

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- We are working to create better transparency between the Axiom and customer supply chain teams. We are not afraid to ask for help including:
 - › We have a very short internal escalation process where we get our customers involved early in the shortage process. It is better to get them involved to help us get a solution sooner, rather than when it is too late.
 - › Asking the customer to help us by leveraging their relationships with MFRs and suppliers on our behalf.
- Increasing the need for digitalization of the supply chain. We are utilizing customer self-service capabilities on our supplier's websites.
 - › This allows our buyers to see availability, pricing, lead times, and alternates; review our open PO reports for completeness; validate commit dates, all in real time.
- We are incorporating the use of application programming interfaces (API) for real time M2M (machine-to-machine) data exchanges, used in place of or to complement the use of the traditional EDI or B2B.
 - › Purchase order management: The ability to pull directly into our ERP system the appropriate data that the buyers are currently doing “manually” through emails, or the supplier's portal. This could include line item requested date, line item commit date, line item pricing (to see if any changes were made), etc.
 - › Provide a validation that all POs and line items are acknowledged. (How many times have you had a supplier say, “We do not have that PO, can you send it to me?”)
 - › Provide real time inventory status/availability, LT, and other critical attributes directly to the buyers and/or our ERP system
 - › Provide a means for online order placement directly from our ERP system to the supplier, and the results back into our ERP (with human review).
 - › Provide any changed/updated commit date back into our ERP system.
 - › Provide ship notification of materials directly back into our ERP system for review by planning, receiving, etc.
- Axiom workforce challenges
 - › Our Axiom HR team is busy attending career fairs.
 - › We have turned the labor market constraints into the opportunity to promote from within. We recently promoted two long-term Axiom team members into supply chain roles. They are both working out very well and it was definitely the right action to take.

Conclusion

Look at your own supply chain operations and see what has been transpiring over the past two years. You will most likely see that you have new pinch points in your supply chain and the way you used to do business may no longer apply in today's world. I challenge you to look at how technology can help you with the daily changes that affect you, and what can be done to help. You will be surprised at what your suppliers can do for you. They are faced with the same issues we are faced with and many of them may already have solutions that will help—but you may not know unless you ask them. **SMT007**



Michael Schindele is director of supply chain at Axiom Electronics.

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Supplier Highlights



Maggie Benson's Journey: Breaking Down the Math ▶

In this column, Ivy Benson employees Andy and Sue continue to quiz one on another on algebraic equations that they need to know in PCB assembly. While Andy feels outwitted by Sue, his own knowledge is improving. Will they make a good team?

Dymax to Support Parylene Coating Through Exclusive Partnership ▶

Dymax, a leading manufacturer of rapid and light-curing materials and equipment, announces its collaboration with Electronic Coating Technologies (ECT) to provide a one-stop-shop for Parylene conformal coating services to its current aerospace, defense, and automotive customers.

Saki Announces Global Sales Management Team Changes ▶

Saki Corporation, an innovator in the field of automated optical and X-ray inspection equipment, is delighted to announce two new sales and business development leadership promotions.

Standard of Excellence: The New Age of Cooperative Partnerships in North America ▶

For the past few years, I have written frequently about being partners with our suppliers and our customers. Now I thought it might be time to talk about being partners with each other. By each other, I mean the whole North American PCB industry—PCB and PCBA shops, engineers, designers, and of course, our customers and suppliers.

ViTrox Partnering with Compmaq in Introducing SMT PCBA Vision Inspection Solutions to Brazilian Market ▶

ViTrox Technologies is delighted to announce Compmaq (Subsidiaries of Interbras Group), as ViTrox's Sales Channel Partner (SCP) for Brazil region starting June 1, 2022.

CyberOptics Announces Agreement to be Acquired by Nordson Corporation ▶

CyberOptics Corporation announced that its Board of Directors has unanimously approved a definitive agreement pursuant to which Nordson Corporation will acquire CyberOptics for \$54 per share in cash for each outstanding share of common stock held.

The Test Connection Achieves ISO 9001-2015 Certification ▶

The Test Connection Inc. (TTCI), a U.S.-based technology company focused on providing production test solutions for the electronics manufacturing industry, announced that the company has earned ISO 9001:2015 certification for its quality management system.

MacDermid Alpha Launches ALPHA HiTech AD13-9910B Ultra-Low Temperature Adhesive ▶

MacDermid Alpha Electronics Solutions, a global supplier of integrated solutions from our Circuitry, Assembly and Semiconductor divisions, announces the launch of ALPHA HiTech AD13-9910B ultra-low temperature adhesive, designed to mitigate defects on very temperature sensitive parts and substrates.



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The **Critical Balance** of Supply and Inventory Control

Feature Interview by the I-Connect007 Editorial Team

Can you still design a product and expect to see validation by the next week? The Epoch International Enterprises team of Meghan Zou, Foad Ghalili, Lillian Lin, and Crystal Zhang provide insight into what their distributors have up against over the past two years as they seek to source and validate parts. Often, it means finding alternatives, redesigning the project, and worst of all, sitting and waiting.

Nolan Johnson: With the current global component supply challenges, we want to better understand how your firm manages the validation of inbound inventory. With so many shortages and additional vendors, it is more

possible that counterfeits slide in. How do you handle that?

Meghan Zou: The situation has worsened since last year. We are trying to build some inventory as safety stock. On the other hand, we want to manage the inventory and secure a stable supply chain.

We are classifying our components to various risk levels and managing them accordingly. If the supply situation looks risky, we will tag it in our system and keep our stock levels a little higher on those components. We must make sure that all components are real, otherwise it will impact the quality we sell to customers.

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Meghan Zou

First, we ensure the components come from our regular established distributors, who help validate the parts. But one distributor might not have enough of what we need, so we are trying to diversify, not put all our eggs in one basket. We have identified several key distributors globally, but even those distributors might be having supply issues.

We support procurement in our facilities, both in Dalian, China, and in Fremont, California. Over the past 20 years, we have established our own purchasing network. We use reliable suppliers on even small batch components. First, we verify by the data code (DC). If the DC is too old, we go through an inspection process to test the components, verifying whether the component can be used in our assembly.

Even for small suppliers, we choose the reliable ones. All the component purchases come from an authorized vendor list (AVL), which has been certified and validated by both our purchasing and SQM teams. Every component goes through component validation by quality, engineering, process engineers, and production before it is used.

Johnson: Meghan, are you testing every component?

Zou: Every lot, especially if the DC is over two years old, needs to be verified as to whether it can work. It also depends on our procurement rules, especially for brand new vendors.

Lillian Lin: We have validation for those new vendor situations.

Zou: When we have a purchase from a new vendor, we go through a sample evaluation process.

Johnson: Do you get samples for validation before you get it from them? How does it happen?

Zou: Actually, we confirm it through two processes. First, the vendors bring in a small lot, and do the test themselves. They need to give us their certificate, the guarantee letter stating we can use it without any quality issues. Second, when we have the goods in hand, we test it in our own factory. That is our double confirmation.

Johnson: What are the methodologies you use for testing?

Crystal Zhang: Our incoming inspection will check the parts' solderability and electrical characteristics. With integrated circuits (ICs), they check more than solderability. They track the lot number and the manufacturer ID. Sometimes we find that someone has tried to copy the manufacturer logo, so we check the logo and markings on the components.

Foad Ghalili: On the ICs, they check the markings. It's critical to ensure that the marking is legit and valid, as it's coming through.

Zhang: They test the tolerance and the resistance value on the resistant capacitor.

Johnson: You have a certificate from the distributor vouching for the parts as being tested and confirmed when they left the distributor.

Ghalili: Exactly.

Johnson: You mentioned that you're trying to work with your normal distributors. But you're also diversifying and adding new distributors for more sourcing. Talk me through the process of qualifying a new distributor.

Zou: This is an AVL validation of the vendors. Two documents need to be done internally: purchasing certification and supplier quality assurance certification. We also do a survey on suppliers' capability and financial status. Besides requesting certificates, such as ISO, we ask for environment certifications like ROHS and REACH as part of the standard process. Those documents are prepared, archived, and audited yearly. The SQM team will do an onsite audit at the factory or the distributor to determine whether this is a qualified vendor.

Once the vendor is set up in the AVL, and we begin to purchase, we do monthly performance evaluations focusing on on-time delivery (OTD) and IQC rejection rate. Every quarter we evaluate each AVL vendor on five factors: price, OTD, IQC, responsibility, and risk. This score card helps us determine whether the vendor meets the AVL standard, or whether we need to carry out an improvement plan.

Barry Matties: I'm curious what changes or shifts you have seen from your customers' perspective as it relates to component sourcing and requirements from the OEMs or the customers.

Zou: Customers are even more nervous than we are about supply issues. They push us very hard to know all the available options for sourcing components. Sometimes customers will give us sources and ask us to determine their reliability. For critical components, we may do the



Foad Ghalili

sourcing together, where we do some sourcing, and the customer checks their own resources. Sometimes customers find a source online and give us the link, but usually we cannot use that information. Basically, they rely on us to judge whether this is a reliable supplier.

Matties: What I'm hearing is that customers will say, "Here's a source we would like you to explore, and we trust your judgment."

Zou: Yes, and the cost might increase for some small quantity purchase. This is a global issue, not just for us. In one case, the original price was only several dollars, but with the small quantity, the price is more than a thousand.

Ghalili: We had a European customer who was extremely frustrated when we said the component was not available. He kept saying, "No, I can find it. I know I can source it." He found a source and sent it to us, but Meghan and the team checked into it. Meghan told him, "This is not a real source." So, you have that dynamic with some customers who want to find sources, but we can't verify them.

I remember about a year ago, a couple of those online sources told us, “Give us the funds and we will transfer the component to you.” That has become their mode of operation. Immediately, if a supplier insists on getting the funds first, we know something is wrong because a reputable supplier wouldn’t do that.

Matties: Are you seeing more customers get involved in the sourcing process?

Ghalili: They are frustrated because they need parts, and when we give them a delivery time of 14 to 18 weeks, they go online and maybe find a two-week source. But at the end of the day, I haven’t seen one that was reliable and could deliver in two weeks.

Zou: More customers are starting to accept the fact about long lead times.

Matties: You’re right. There’s a level of frustration that we’ve never seen before in the supply chain. OEMs must rely on their EMS contract manufacturer (CM) suppliers to validate. Consequently, you’re putting more energy and effort into the front end: sourcing and validation. Do you have to increase your pricing to offset that? They’re paying for the service, right? You’re really providing a sourcing service beyond what the normal business would have been without the supply chain crisis.

Ghalili: The way we set up our price structure accommodates that into our system. Let’s say we had a component that had been priced at 5 cents, now it’s 20 cents, and they wanted it within three weeks. We tell them, “There is a price raise on this one component.” But the validating process is built into the quoting process. We do it early on.

Matties: Are you finding that other companies are calling to find out whether you have surplus inventory you’re willing to sell?

Zou: Some customers have other projects that don’t use us, but they still ask us for help, so we try to give them information. Because of the supply chain issues, everyone in the network tries to help each other. One of our bigger customers, even though pretty influential, will still sometimes ask us for help. There’s mutual support.

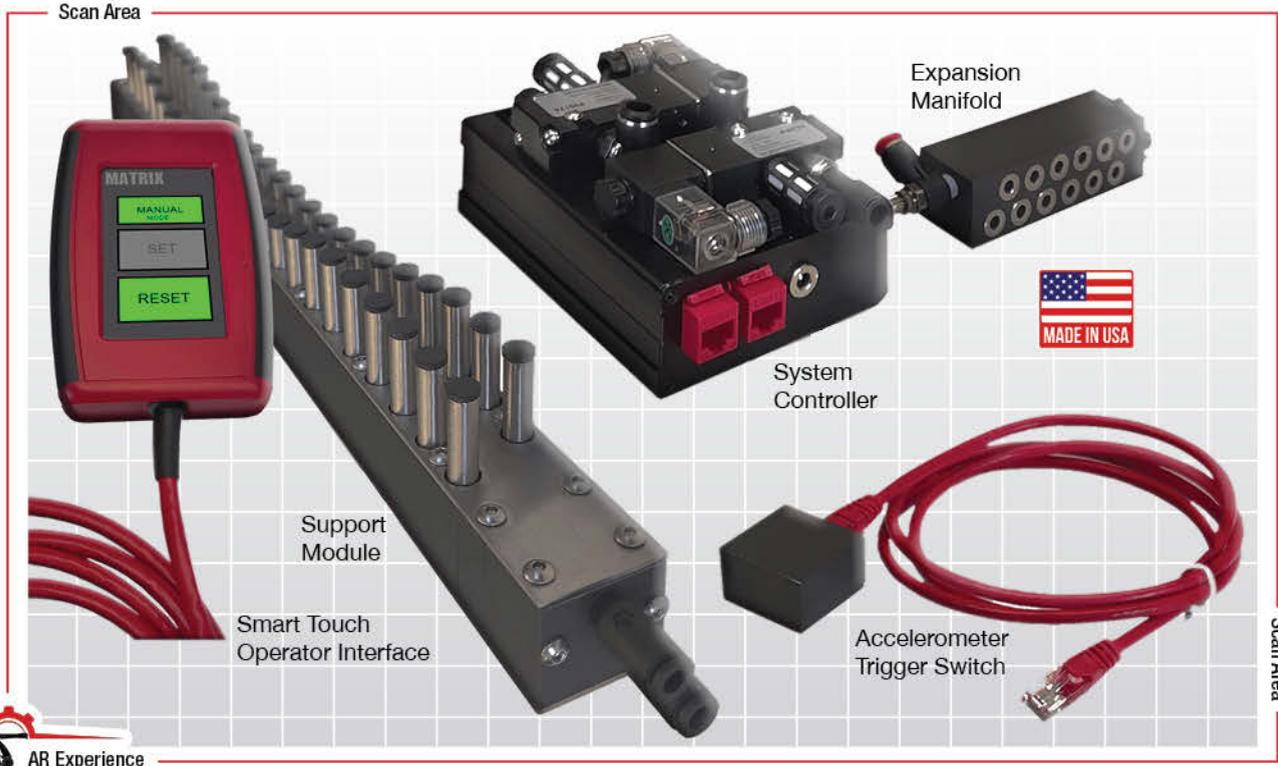
Ghalili: I have some good examples of this. A few smaller EMS providers here in Fremont have reached out and said, “Can you source this product for us? We’re struggling.” I hand those requests to Meghan, and we have sourced it for them. I’m seeing more of this situation. In addition to Meghan’s example, we had a customer last year that had completely shut down. They were working with a much bigger EMS provider that had shut down because of an issue getting an LED product. We were able to source that LED product



and get it out to them. Now they’re looking to move their EMS manufacturing to us because of the service we offered. They see more value-add with us than they did before, when they primarily saw us as just an assembly house. They are looking for that value-add.

Matties: Do you find that OEMs are talking to you before they actually design their products and that there is more collaborative manufacturing going on?

Ghalili: There was some element of that happening prior; they are working with our design teams in the early stages, and we are working



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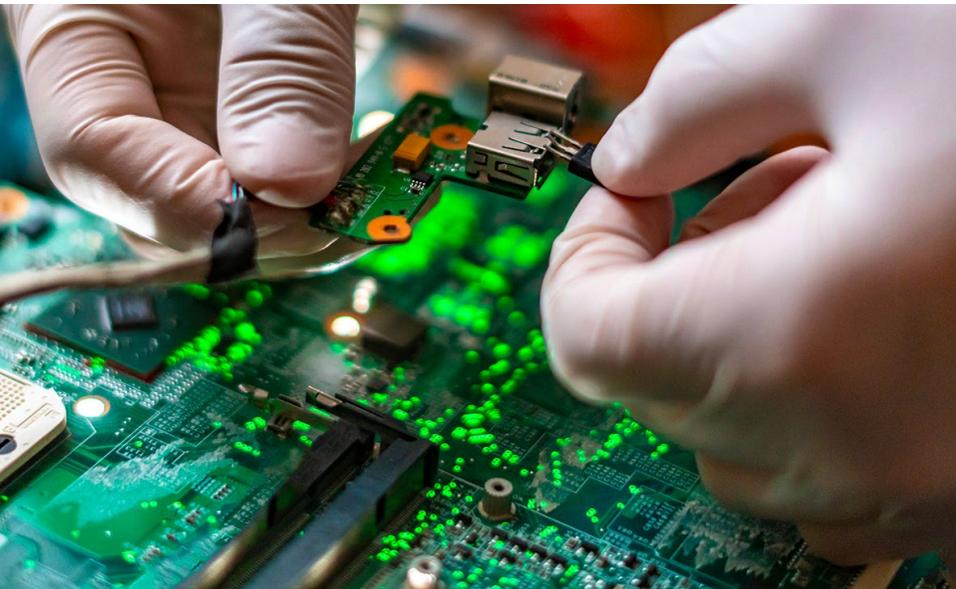
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and in this marketplace, that's important. How do you market and sell that capability?

Ghalili: It has made my life a lot easier because I talk to the customer. I'm talking to one customer that asks, "How can you do it?" I say, "I can assure you, we can do it." This has been a major advantage for us, and it's helping our growth right now. But then Meghan has a very extensive team. She has quite a few people who are always online and have established

relationships with some of these vendors going back 10 to 20 years.

with them on the DFM system. Once you're involved with DFM, our engineers are bringing Meghan into the discussion. Is this a component that you can get early? If not, they trigger that way in advance. I see this happening quite a bit more, especially with purchasing, letting us know this component may have a long lead time and that you might need to consider something else. That's where I see the collaboration but it's more intense now.

Matties: Do you think those projects tend to be more successful?

Ghalili: Definitely. If that level of involvement is there, then the project is much more successful.

Johnson: Are you seeing an increase in customers that want to send you parts kits, source their own, and just send over a kit?

Ghalili: No. I haven't seen any of that. The major struggle with a lot of the customers is getting the component. If they're able to get that from their EMS provider, they would love to see that provider do all the sourcing for them.

Johnson: Your ability to source parts is a value-add. That seems like a competitive advantage,

relationships with some of these vendors going back 10 to 20 years.

Matties: Have you come across jobs where you haven't been able to find the sources or the components needed?

Zou: Yes, that has happened.

Matties: What does the customer do in that case?

Zou: These are situations where we could not meet a promised schedule on critical components. Once we are both convinced there is no potential source, we look for a pin-to-pin alternative. If one is found, we run it through our ECN process to validate and get approval to use the part. If we cannot find a pin-to-pin alternative, then we work with the customer to do a Gerber change in the fab to accommodate the new part.

However, if a customer does not want to go through the BOM and Gerber changes, we try to reach out directly to the original manufacturer to get a partial release. We find in many instances the component is in an "allocation" situation. In that case, we need to work with the customer and manufacturer to get partial parts released.

Matties: Are you seeing any changes in order habits? Are people making larger orders to build inventory?

Zou: Yes. Comparing last year to this year, one of the key reasons why there is large demand for the IC components is factories are doing a “panic buy.” They know there will be future shortages, so they are building up their inventory.

Matties: When do you think it will ease and the supplies will be easier to locate? What’s your estimate?

Zou: Some line cards have gradually improved, but not all of them. Demand has changed a lot this year, and some demand has even dropped. You might see in the news that demand has dropped for some consumables, like mobile phones, so that has an impact. Also, IC fab manufacturers have increased their production over the past year. Our expectation is that it will continue to get better, but maybe not as soon as we hope.

Matties: What components are the most challenging to locate right now?

Zou: It’s still the IC components.

Johnson: Meghan, you mentioned alternative parts and that might mean a redesign. How does Epoch work with the customer when a redesign is required?

Zou: First, when we have a new project, we look at the BOM list and identify the most critical component because we don’t want the product to go to mass production (MP) and suddenly there’s no supply. So, before the trial run, they ask us to identify the critical components. They might also ask us to do some redesign or suggest an alternative. That is the one of the key steps we are taking now.

Next, if there’s a product we’ve been supplying for a long time, but we can’t source a component, our engineering teams may initiate a conversation, giving the customer alternative options. Ultimately, the customer must approve whether that will work.

When there is no pin-to-pin alternative then we need to revert to the PCB board. That means a revision change to the board. In most cases, we can find some samples of an alternative part to use for testing, so we can give the customer the data they need on testing and verification.

Ghalili: Not too long ago, we were having a similar discussion. When you want to use an alternate, it’s not only the electrical modifications, but you have to modify the firmware. That’s something we offer if the customer is okay with it. We see it’s an area where the customer is always struggling besides having the physical Gerber change that will change the path; there’s a firmware change that comes in as well. We have people on our team who write the firm version in different languages.

Johnson: How many people do you have doing that for you?

Ghalili: On the engineering team, we have about 15–20 electrical, mechanical, and software designers. Our business model has always been heavy on the value-add to our manufacturing, rather than just the hardcore EMS that runs products.

Matties: Are the requirements for the Fremont facility different than what you’re seeing in China?

Ghalili: Right now, a lot of the engineering support for Fremont is coming out of China. When we work with customers locally, the engineers in China also get involved to verify from a DFM perspective and they are supporting the team here.



Lillian Lin

Matties: For the Fremont facility, do you rely on U.S. sourcing or is it mostly on international?

Ghalili: For Fremont, Meghan's team sources mostly from the United States, but they do the sourcing for China from the U.S. source. They work with the suppliers and distributors in the U.S. They source it for them, but from a U.S. source.

Matties: What advice would you have for OEMs that are struggling with the supply chain right now?

Zou: We are still having challenges with how to reach a balance with supply and inventory control. One of the key issues is on the BOM completion rate. There are cases where we have all the components for the whole BOM, except one critical item. So, we sit on an entire inventory just waiting for one critical part; to identify those critical parts well in advance would be essential.

Johnson: What can the OEM do to help?

Ghalili: In the last year, we have automated much of our ERP system to highlight these issues. For example, leads and lagging of the components.

Lin: We always try to balance the inventory here. Sometimes we only look at critical components, but the challenge is how well our team can control the inventory, and handle delivery.

We have developed an automated clear-to-build (CTB), which runs daily. It can help check the supply and demand, and clearly see the exact timeline for the product available to promise (ATP) to ensure we meet customer delivery.

This year, we upgraded our CTB. Like Meghan mentioned earlier, we assigned different risk levels for the components—red, yellow, and green—to track each component and its individual gating situation. We have a lot of common parts amongst our customers. For example, one component may be used in more than 20 projects, which makes it very difficult to manage manually. The automated system can monitor the components and then we balance production, delivery, and the inventory.

Zou: Each project could have hundreds of components, so overall, we are managing thousands of components. The system helps us understand the overall project inventory and supply status level. Without this control, maybe only one or two gating items can cause the project to get stuck. That causes the whole inventory to build up. This kind of system can help us to identify the gating items to the project.

Ghalili: We have done a lot of customization on the Oracle ERP. You have these systems that are basically like the CTB that we've been describing. It goes through the whole system, identifies the parts that are gating, at what point and how they need to be identified. When you have a common part, the same rules used with 20 different parts, a gated situation can cause a lot of delays.

Lin: We have a team dedicated to this process. Once a week we meet and review the gating parts. We decide how to balance the production with our purchasing, inventory, and delivery.

Matties: How do you make sure your yield is high enough so that we are not wasting resources?

Zhang: We use 100% of our inspection equipment like SPI, AOI, X-ray and flying probe so we can catch the yield in the process.

Ghalili: More in-process inspection, more in-process testing. We also have an extensive DFM system at the NPI level, which initially looks at the process. They have developed certain tools and use them to ensure the processes are tightly controlled before we release it to MP. It's an active team that meets weekly, looks at the details in the process, and identifies what needs to be cleared up before it hits the MP stage.

Johnson: Does that mean you are testing more of the components as they go through the line to the point where we're testing all of them or did you need to add new testing into the line?

Ghalili: We are utilizing the in-line testing a lot more now, as some of the pick-and-place machines have LCR meters on them as well. We rely on the SPI, AOI, and X-ray machines. We may have done more sample tests in the past, but now we are running 100% on products.

Matties: Does this slow down your process?

Ghalili: Yes, somewhat, but in the long run, it doesn't because you are reducing the load on your rework station.

Matties: Do you have any final thoughts?



Crystal Zhang

Ghalili: For the customers, I recommend doing the design far in advance. We have customers that are designing one day, and they want the product the next day. That's a challenge. They need to be getting the components into their design and implementation phase, and that takes more time. In the old days, you could design it and want validation by the next week. But not anymore.

Zou: From my point of view, I hope customers can allow longer lead times with more accurate demands. For example, many of the IC components have lead times extended to over 50 weeks. A full year forecast is needed. If we cannot get that information from customers, we will do our own rough estimate demand forecast to make sure we can get at least some of the components.

Matties: We appreciate your time and input today.

Zou: Thank you.

Lin: Thank you. SMT007

ICT Webinar: Your Journey to a Smart Factory

Presented by Happy Holden

Happy Holden understands—getting started can be the hardest part. For the past 55 years, he has followed his passion for automation and computers by writing books and white papers, and engineering and managing projects. Each one has always meant one thing: finding the right place to start.

In an upcoming ICT series of eight online sessions, Happy will introduce the topic of “Automation and the Journey to Your Smart Factory,” by breaking down the elements this type of journey requires, addressing the five W’s, and encouraging study on your own.

Each session is approximately 60 minutes, and is offered at 4:00 p.m. Wednesdays, Sept. 7 to Oct. 26. The webinars are based on Happy’s books: *24 Essential Skills for Engineers* and *Automation and Advanced Procedures in PCB Fabrication*. Happy Holden is a retired electronics manufacturing technologist, contributing technical editor for I-Connect007, and a member of ICT.

“The hardest step is getting started,” Happy says of his past experiences. “I know; I have done this many times. I have designed and built nearly nine automated PCB factories and a dozen more process factories in my career, all automated by computers and the software that drives them.”

What he’s learned is that your journey to building a Smart factory must focus on who will design it, what they need to learn, how to analyze and plan the automation, how long it should take, when is the right time, and how much it will cost.

“There are seven major topics to be addressed, with the primary one being to meet your company’s business objectives,” Happy says, adding that can be achieved by the following:

- Company business objectives
- Zero waste
- Internet of Things sensors
- Predictive analysis
- Zero-defect manufacturing
- Driving zero downtime
- Create solution templates

“Once you have the ‘who,’ then you need to give them time to learn some of the new tools and skills that will be required,” Happy says. This is where he includes the two books he has written, as well as other book titles from I-Connect007, NIST, Siemens, and more.

Once a company has decided to start a Smart factory, Happy says implementing it requires a focus on three things:

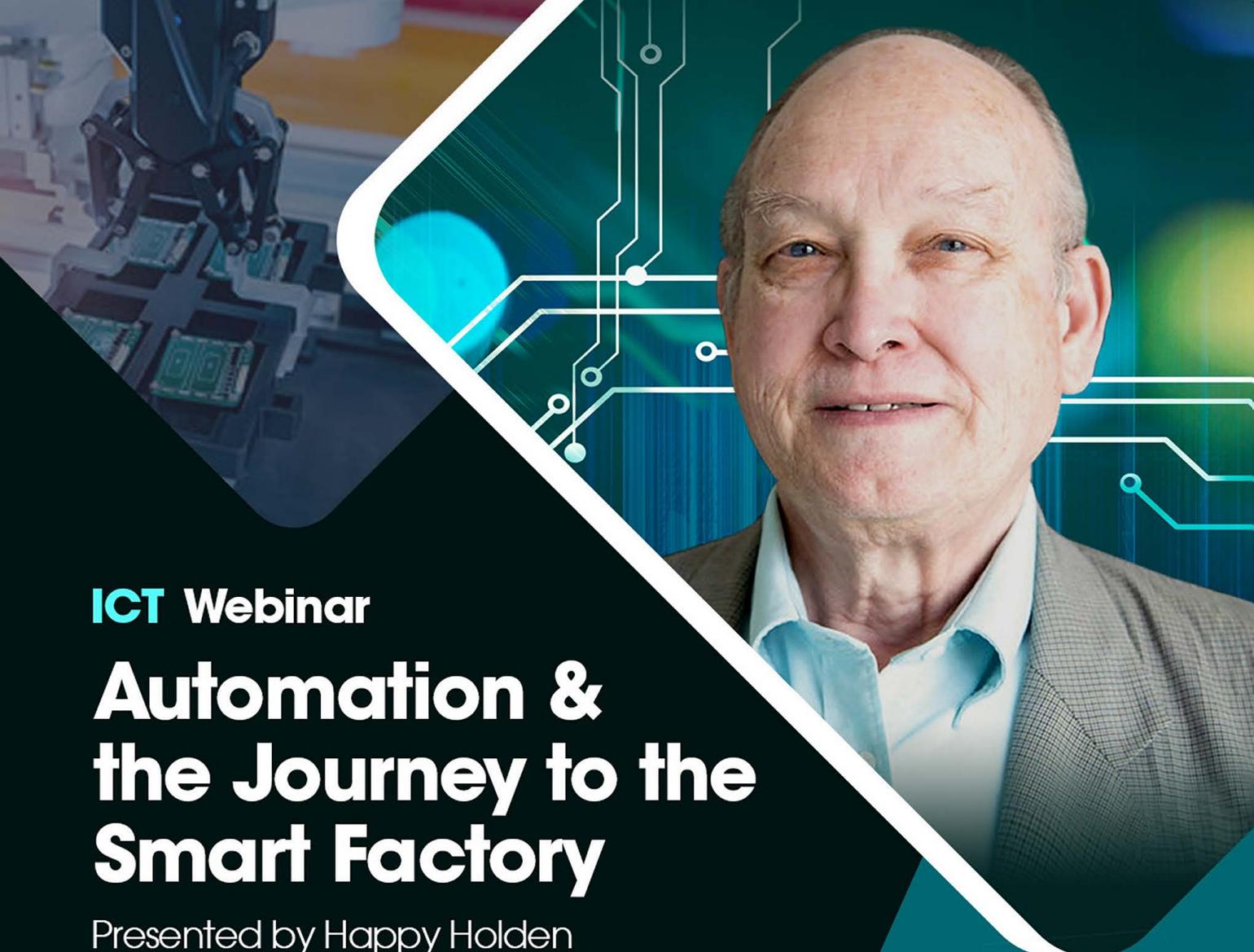
- 1. Sensing:** Collecting the data in real time
- 2. Connecting:** Uniting different and unique data sources
- 3. Predicting:** Using models to use the data for predicting the outcome of machine/process events for alerting operators, to predicting machine downtime for maintenance, to improving processes for high controlled impedance performance

The ultimate goal of all this work, Happy says, is customer satisfaction and business success. He suggests first looking at predictive analytics, which will drive you to zero downtime and your quality to zero defects. This can be done by improving overall equipment effectiveness by 5 to 10% gains, and lowering costs through improvement in labor productivity by 10 to 25%.

Traditional methods of statistical process control, process monitoring, and OEE can be replaced with predictive process monitoring and control, providing benefits that improve overall performance and the bottom line, he says.

To register for the webinar, sponsored by the Institute of Circuit Technology, visit instct.org or send an email to info@instct.org.

This series of webinars is offered at no charge. You can register at any time during the eight weeks, and lectures will be available on-demand after each one is presented, for those who are registered. **SMT007**



ICT Webinar

Automation & the Journey to the Smart Factory

Presented by Happy Holden

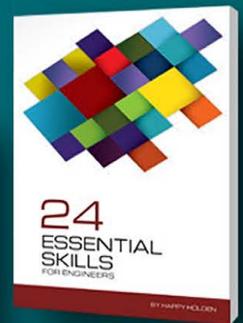
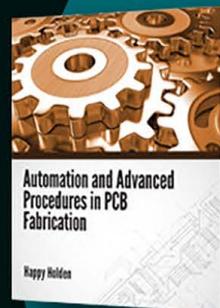


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Tips for Today's SMT Challenges

The Manifest

by Chris Ellis, MANNCORP

As the supply challenges continue, we see a trend in taking control of manufacturing. Many companies that have been contracting out their assemblies are battling both the supply and labor shortages by buying their own components and acquiring SMT lines to bring manufacturing in-house. Companies already doing assembly in-house are now updating their production lines to reduce labor hours needed and investing in tools to get the most out of their inventory.

Tightening Inventory Control

Preserving parts is critical to secure SMT production. If you don't account for and protect your company's investment in components, you can lose any advantage you hoped to gain.

Pro Tip 1: Track your components throughout your production cycle.

Don't guess; use a component counter to provide an accurate accounting of your reeled parts. Inventory should be taken at incoming inspection and again in the stockroom for spot checks of ongoing inventory.

It's recommended to use a component counter with pocket check verification to ensure there are no missing components in the middle of the reels. Pocket check verification also guarantees the counter will stop when it reaches the empty pockets at the end of the reels, giving a 100% accurate count.

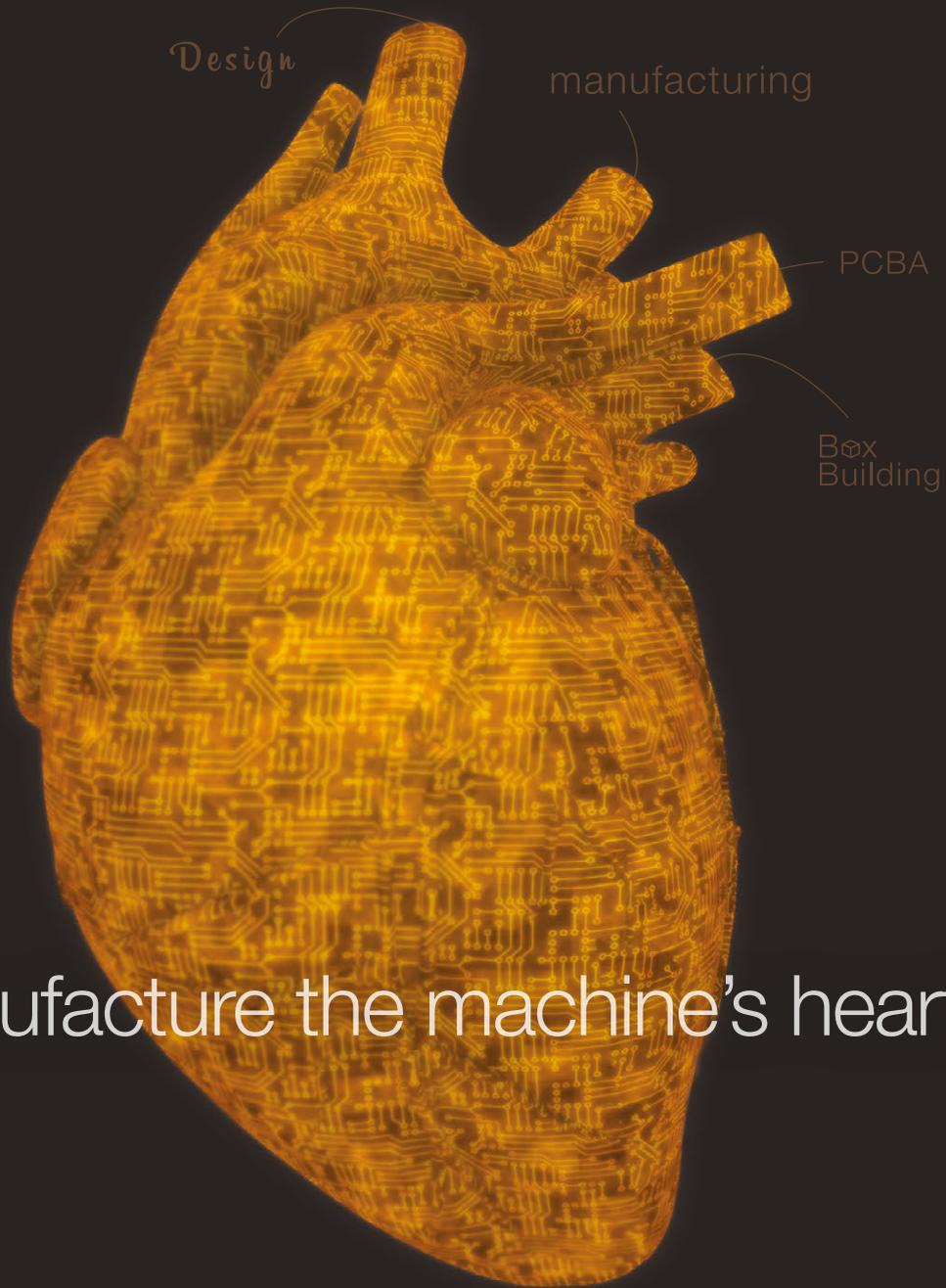


Figure 1: Component counter with pocket check.

Component counters are also available with bar code readers and label printers to make the job more efficient.

Pro Tip 2: Protect your moisture-sensitive components from moisture damage. When moisture-damaged components are exposed to reflow oven temperatures, the moisture trapped inside the component expands, causing internal damage that can lead to early product failure in the field.

To prevent this outcome and save your company money in warranty repairs, you simply need a dry box or cabinet that meets J-STD-033 standards. With an IPC-Standard dry box, your components are safely stored below 5%



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Figure 2: 1490V dry box.

relative humidity to make sure the components are not susceptible to moisture.

What if you're reading this after your moisture-sensitive devices have already been exposed? No need to eat those costs. You can restore those components using a baking dry box that conforms to the J-STD-033B standard for floor-life restoration and storage. These dry boxes bake at a safe 40°C to reset the shelf life of the component. For the required time, check Table 4.1 of the J-STD-033B standards.

Pro Tip 3: Rework, reclaim, reuse. Problems happen. Don't just toss bad boards in the trash. Investing in a rework station is the best way to rework boards in need of repair and to reclaim good components to be reused on new boards. This is especially beneficial for hard-to-find components or components that have a

Package Body	Level	Bake @ 125°C		Bake @ 90°C ≤5% RH		Bake @ 40°C ≤5% RH	
		Exceeding Floor Life by >72 h	Exceeding Floor Life by ≤72 h	Exceeding Floor Life by >72 h	Exceeding Floor Life by ≤72 h	Exceeding Floor Life by >72 h	Exceeding Floor Life by ≤72 h
Thickness ≤1.4 mm	2	5 hours	3 hours	17 hours	11 hours	8 days	5 days
	2a	7 hours	5 hours	23 hours	13 hours	9 days	7 days
	3	9 hours	7 hours	33 hours	23 hours	13 days	9 days
	4	11 hours	7 hours	37 hours	23 hours	15 days	9 days
	5	12 hours	7 hours	41 hours	24 hours	17 days	10 days
Thickness >1.4 mm ≤2.0 mm	2	18 hours	15 hours	63 hours	2 days	25days	20 days
	2a	21 hours	16 hours	3 days	2 days	29 days	22 days
	3	27 hours	17 hours	4 days	2 days	37 days	23 days
	4	34 hours	20 hours	5 days	3 days	47 days	28 days
	5	40 hours	25 hours	6 days	4 days	57 days	35 days
Thickness >2.0 mm ≤4.5 mm	2	48 hours	48 hours	10 days	7 days	79 days	67 days
	2a	48 hours	48 hours	10 days	7 days	79 days	67 days
	3	48 hours	48 hours	10 days	8 days	79 days	67 days
	4	48 hours	48 hours	10 days	10 days	79 days	67 days
	5	48 hours	48 hours	10 days	10 days	79 days	67 days
BGA package >17 mm x 17 mm or any stacked die package (See Note 2)	2-6	96 hours	As above per package thickness and moisture level	Not applicable	As above per package thickness and moisture level	Not applicable	As above per package thickness and moisture level

Note 1: Table 4-1 is based on worst-case molded lead frame SMD packages. Users may reduce the actual bake time if technically justified (e.g., absorption/desorption data, etc.). In most cases it is applicable to other nonhermetic surface mount SMD packages.

Note 2: For BGA packages >17 mm x 17 mm, that do not have internal planes that block the moisture diffusion path in the substrate, may use bake times based on the thickness/moisture level portion of the table.

Note 3: If baking of packages >4.5 mm thick is required see appendix B.

Table 1: IPC J-STD-033B Standards Table 4-1, Reference Conditions for Drying Mounted or Unmounted SMD Packages (User Bake: Floor life begins counting at time = 0 after bake).



Figure 3: RW1500 rework station.

12-month lead time, and it minimizes the need to source new parts.

Recently, we've had customers inquire about reclaiming old parts off boards to start a business selling used components, so there's no reason why OEMs shouldn't do this with their own products.

Meeting Increased Demand With Less Labor

In addition to the parts shortages, companies have been struggling with labor shortages and keeping up with demand. To combat the labor shortages and meet higher demand, companies are turning toward machines that increase production volume without an increase in operators.

For instance, selective solder machines for mixed technology boards with through-hole parts are becoming more popular in the SMT industry. A selective solder machine can essentially do the volume of five to six hand solder technicians, with more consistent quality, all while needing only one operator. You may not have considered how easy it is

to justify the cost of a selective solder machine until you realize you are saving five to six additional salaries, or that you can reallocate technicians to another area and increase overall productivity.

OEMs have been pushing to bring SMT lines in-house to avoid many of the issues the markets are facing today. However, they often don't realize it doesn't need to be a difficult process, and connecting with the right people can make it even easier. It is wise to look for a manufacturer that sells full lines of SMT equipment to receive support on the entire process from one group of experts. Working with a one-stop-shop for an equipment provider avoids being tossed around, such as when a stencil printer company says the problem is related to the reflow oven company, while the reflow company puts the blame on your prints. Working with a manufacturer with expertise in full lines is the best way to get the support you need.

When choosing a manufacturer of SMT equipment to work with, make sure they are

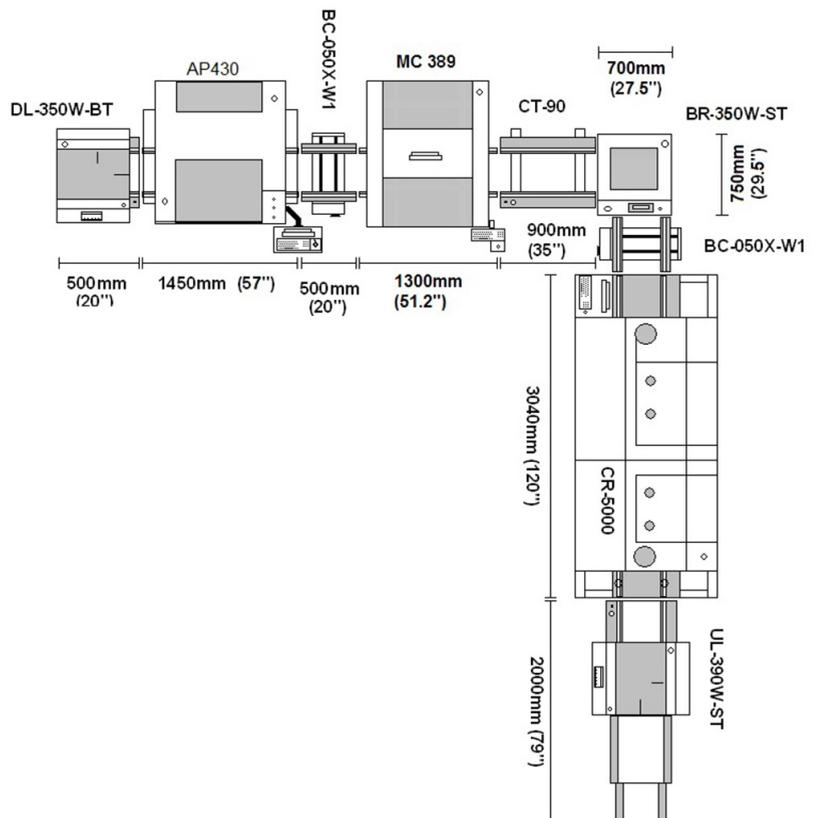


Figure 4: Line drawing example for tight space utilization.

responsive and attentive to your needs. Don't get stuck working with a company that waits weeks or months to send you a quote.

A company that offers extended support services will help you determine the volumes required, gather information about your products, and offer to review your BOMs to determine the equipment best suited for you now and in the future, based on projections. It is also vital that they ask about your area for the SMT line. The space you have available for a line has a big impact on which equipment makes the most sense. Once the equipment and configurations are decided on, your supplier should be willing to generate line drawings that show the equipment in line with dimensions, to give you the full visual of how much space it takes up. Some SMT lines cannot be laid out next to each other in a straight line due to space constraints, which is reflected in the line drawing.

A good supplier should be able to give you rough costs for budgeting purposes over the first quote request and get firm numbers to you within days of receiving the BOMs to analyze.

They should always have service technicians available. It's even better if they have a dedicated service number that is answered directly, so you don't need to jump through hoops just to get support.

As we continue to battle the supply issues and labor shortages, taking control of manufacturing and bringing SMT assembly in-house is becoming a more popular solution. Maximizing efficiency and keeping costs down by preserving existing parts, reworking placed parts, and beating the labor shortage issues are critical to maintaining increased productivity. Working with a responsive, qualified, equipment supplier reinforces these concepts and provides you with the support you need, every step of the way. **SMT007**



Chris Ellis is a sales manager/engineer for Manncorp Inc. To read past columns, [click here](#).

Book Excerpt:

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

Chapter 1: How the NPI Process Has Changed and Where We're Going

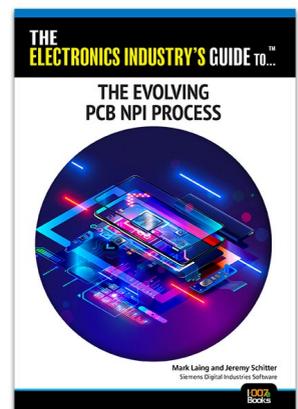
When forging into unknown territory or exploring new ground, it can help to look at where we've been so we can orient ourselves.

Just a few decades ago, electronics manufacturing companies were producing high volumes of few products. The efficiency of electronics manufacturing lines is measured by overall equipment effectiveness (OEE) and total effective equipment performance (TEEP). Back then, this meant optimizing the time it took to build a single board. If the time it took to build one board could be reduced by a few seconds, the savings would be multiplied by the number of boards being built. This could be in the

hundreds of thousands or millions of boards, with no changes in the line configuration. If it took a day to change over from one product to another, it didn't matter because the TEEP/OEE was driven by the time it took to build a board.

In today's high-mix, low-volume production environments, performance is further enhanced with line efficiency.

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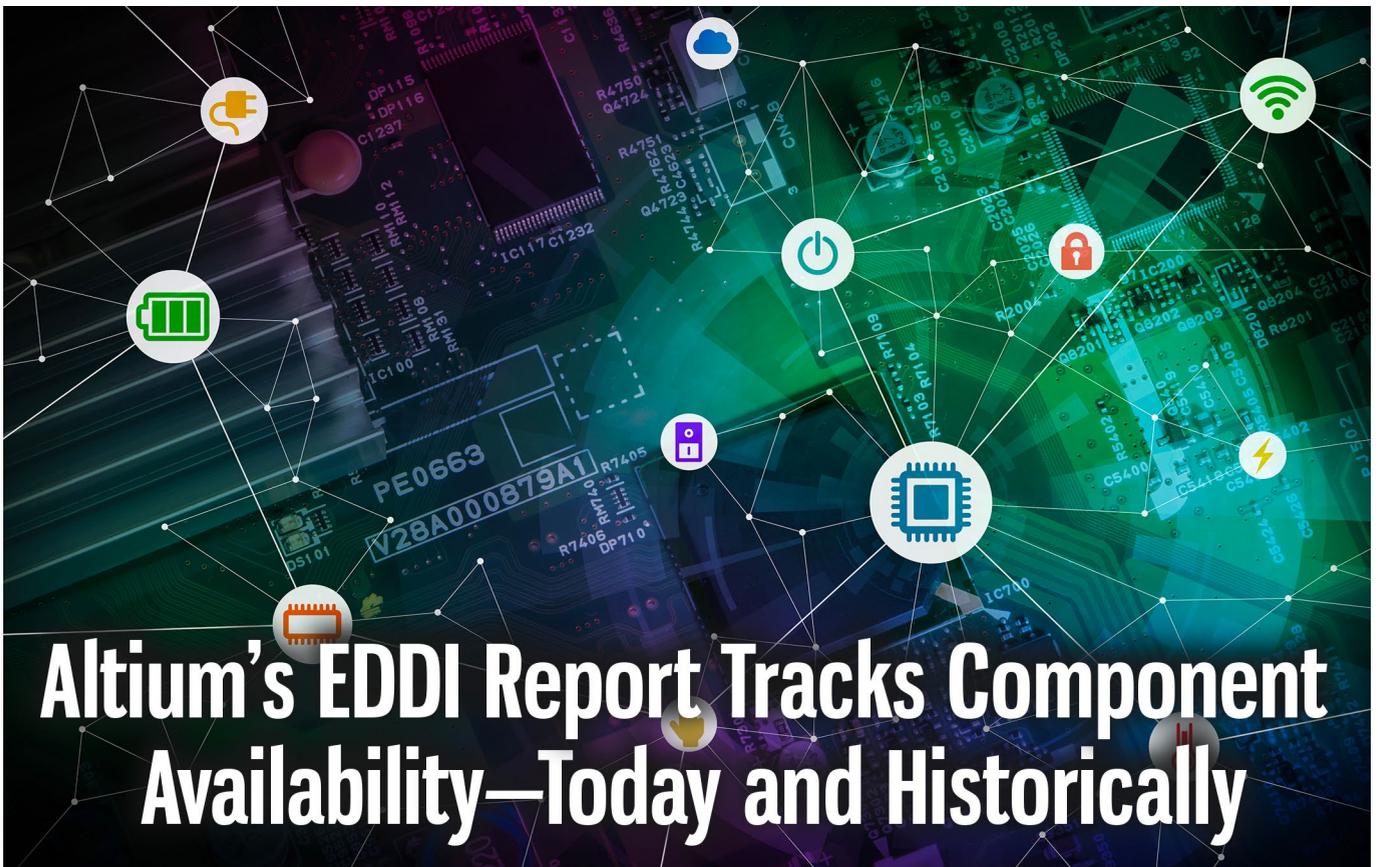
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Feature Interview by Andy Shaughnessy

I-CONNECT007

There's one lesson that all designers have learned over the past few years: Components might be here today and gone tomorrow, so tracking your parts is more important than ever. Any resources that help you keep tabs on your required parts are invaluable in these days of 40-week lead times.

Earlier this year, Altium released one such resource: the Electronic Design to Delivery Index (EDDI) report. Assembled from millions of bytes of data gleaned from the Octopart search engine and the Nexar platform, the monthly EDDI report provides part availability histories going back years, as well as a real-time snapshot of global inventories. It's free to download.

We asked Dan Schoenfelder, head of Nexar sales, to discuss the EDDI document and why PCB designers should take advantage of this handy report.

Andy Shaughnessy: Dan, welcome. You all have been talking about this EDDI report. I had the chance to review it, and it's pretty interesting. Would you walk me through it?

Dan Schoenfelder: Yes. Altium has a really interesting place in the market, where we have user experiences that span design, supply chain, and manufacturing workflows. Because of that, we have a lot of interesting data that we collect and which we mine to provide trends back to the electronics industry. Any stakeholder in the electronics space can benefit from this information. One of these products is the Electronic Design to Delivery Index, affectionately referred to as the EDDI.

We have two major signals: One is an industry supply signal and the other is an industry demand signal. They're both intended to give stakeholders a view of where the things stand

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today relative to history for availability of components and how challenging it might be to source components.

Shaughnessy: It was interesting to me that it had a running historical ledger of where parts were. How far back does it go? How granular can you get? Give us some details.

Schoenfelder: The report itself, and the indices that are a part of it, are pegged to a baseline of January 2020. We intentionally did that because it's pre-pandemic and probably the closest thing that any of us can remember to what was normal. The reports that we generate monthly show two years of history compared to January 2020.

In the EDDI, you'll find that we look at an aggregate signal for both demand and supply, but then we break it down further into key categories. These nine categories include integrated circuits, passives, and discrete semiconductors, among others.

Shaughnessy: That's really good. I'm curious where this idea came from.

We had this idea to give back to the industry some of the analytics that we're able to capture.

Schoenfelder: We had this idea to give back to the industry some of the analytics that we're able to capture. Under the Altium umbrella, we have design tools, a powerful API, and Octopart, the component search engine.

All these different user experiences have user interactions with data. The EDDI takes those interactions and signals of intent that data exhaust, and aggregates and normalizes that

into a product that shows trends in demand and supply relevant to stakeholders of the electronic component space.

Shaughnessy: I imagine a lot of this comes through Octopart, right?

Schoenfelder: Most definitely; portions of the EDDI are fortified by Octopart, such as inventory trends and search activity.

Shaughnessy: And Nexar also includes other search engines, so you've got a wide universe to cull this data from.

Schoenfelder: That's a good point. We like to talk about our signals as having both breadth and depth. Octopart itself sees several million unique visitors per month. The Nexar API receives about 15 million calls per week. So there's significant activity that provides us a broad but granular signal of what's happening in the industry. There's no question that market conditions have driven a lot of activity over the last 18 months or so.

Shaughnessy: And you're offering this free of charge?

Schoenfelder: Yes, the EDDI itself is a free report. You can subscribe at Nexar.com. It comes out monthly, usually around the middle of the month. We also have about 300 subcategories that go beyond what's in the free report. So, if users would like to see something that's not represented in the reports, we offer some bespoke reporting.

Shaughnessy: Now, you look at this information all the time. What trends do you see?

Schoenfelder: There are some distinct trends that you can see in the latest editions of the EDDI. Component availability is returning to normal for many product categories. We're seeing that across all passives, and we're see-



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ing some semiconductor products that are returning to normal as well.

But we also see some that are not. Microcontrollers is a great example of a subcategory that continues to have low availability in the market, with extremely long lead times and extremely high demand as a result. What we glean from this is that we're not in the same market conditions that we were in, say, nine months ago, but there are definitely categories that are normal with others showing signs of recovery.

Shaughnessy: Right. What we're hearing is that by Christmas, we may not be back to 100%, but the supply chain should be in much better shape by the end of the year.

Schoenfelder: Yes, I think the trend is that most categories that are not in the semiconductor space are operating at something that's close to normal lead time, and normal demand and supply. But semiconductors are just lagging now.

Shaughnessy: So, the EDDI is free to download, and you just have to register and provide your email, which seems like a fair trade.

Schoenfelder: Yes. I don't think I'm talking out of school here to say that sometime soon we will launch this as a self-service tool on our portal. We wanted to get to market quickly with this reporting because we think it's really valuable. For now, users can register with an email, and we will send you a PDF on a monthly basis, but in the future we'll make it self-service so users can access EDDI directly from our site.



Dan Schoenfelder

Shaughnessy: Well, I signed up for it, and it has a lot of timely information. Even though we're seeing improvements, the supply chain is still a little wacky right now.

Schoenfelder: It's interesting, Andy, that things have become so challenging in some aspects of managing the supply chain that individuals who may not have had to pay attention to these market conditions, such as engineers and designers, now need to

take these considerations into their day-to-day work. The EDDI is free and accessible industry insights, with very low barriers, and it can be influential in a designer's decision-making.

Shaughnessy: A designer recently told me, "We probably should have been double- and triple-sourcing components all along, but we never had to." That's one trick that's not going away, right?

Schoenfelder: Yeah, every company should have an alternate source strategy. Having your finger on the pulse of availability in the market, particularly relative to your demand requirements, is critical. I think the EDDI is a tool that can help assess where there is opportunity and where there is risk present.

Shaughnessy: Very good. Is there anything else you want to add, Dan?

Schoenfelder: That's it for now. I appreciate the time, Andy.

Shaughnessy: Thanks for taking the time to talk to us, Dan. **SMT007**

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IPC Commends House on Passage of CHIPS+ Legislation ▶

IPC issued a statement from President and CEO John Mitchell on the recent passage of the “CHIPS+” legislation in the U.S. House of Representatives, which follows Senate approval and paves the way to U.S. President Joe Biden’s signature.

L3Harris, Air Tractor Sky Warden Team Selected for USSOCOM Armed Overwatch Contract ▶

U.S. Special Operations Command (USSOCOM) has selected L3Harris Technologies and Air Tractor Inc.’s AT-802U Sky Warden system for its Armed Overwatch program. Award of the Indefinite Quantity, Indefinite Delivery contract includes a cost ceiling of \$3 billion.

Airbus Helicopters, VRM Switzerland to Develop the World’s First H145 Virtual Reality Simulator ▶

Airbus Helicopters and VRM Switzerland are co-developing a Virtual Reality (VR) training device for the twin-engine H145 helicopter. Containing the OEM data package, the H145

VR simulator, once qualified, will allow pilots to perform proficiency checks and receive training credits. It will be used to perform type ratings including normal flight, emergency situations, hoist operations and flight with night vision goggles, as well as instrument ratings.

Graphic PLC Secures Nadcap and AS9100 Rev D Approval ▶

Graphic PLC, one of Europe’s leading manufacturers of advanced PCBs, is delighted to announce that it has successfully passed its Nadcap reassessment and has been awarded Nadcap accreditation with merit.

REGENT, Siemens Collaborate for Revolutionary Zero-emission Seaglider ▶

Siemens Digital Industries Software announced that REGENT has adopted the Siemens Xcelerator portfolio of cloud-based software and services to help pioneer a new category of vehicle called the seaglider.

Antaris Closes \$4.2 Million Seed Funding Round for Development of Software Solutions for Space ▶

Antaris, the software platform provider for space, announced the company has closed a \$4.2 million seed round of funding led by Accquia Capital and Possible Ventures. The round also includes investment from leading space tech investors Lockheed Martin Ventures, HCVC, E2MC and Ananth Technologies.

Aspocomp Posts Excellent Q2 Results ▶

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Opening a Trace on the Surface of a PCB

Knocking Down the Bone Pile

by Bob Wettermann, BEST INC.

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. In general practice, the length of this trace cut is as least as wide as the minimum conductor spacing. In most cases, a very sharp-edged knife or high-speed mill will make the cut. After cutting the area is tested and sealed with epoxy.

To make this cut, the following should be on hand to the intermediate-level PCB rework and repair technician, including but not limited to:

- Isopropyl alcohol for cleaning
- Continuity meter and test probes for measuring electrical continuity
- PCB epoxy
- Oven for curing the epoxy

- Sharp knife for precision cutting of trace
- Stereo microscope with proper lighting for inspection
- Low lint wipes for cleanup
- Colorant matching the PCB mask color

The first step (Figure 1) is to make sure the proper location of the cut can be determined given the physical limitations of the neighboring components to the cut location. Use the mechanical assembly drawings in addition to the Gerber files. Determine where the minimum trace-width cut will take place. Clean the area using the isopropyl and the lint-free cloth. The cut should be perpendicular to the trace edges.

Make the cuts (Figure 2) by using a sharp edge and the knife, making the two cuts perpendicular to the trace direction cuts. Apply even pressure using a straight edge as a guide, slowly cutting through the trace so as to not

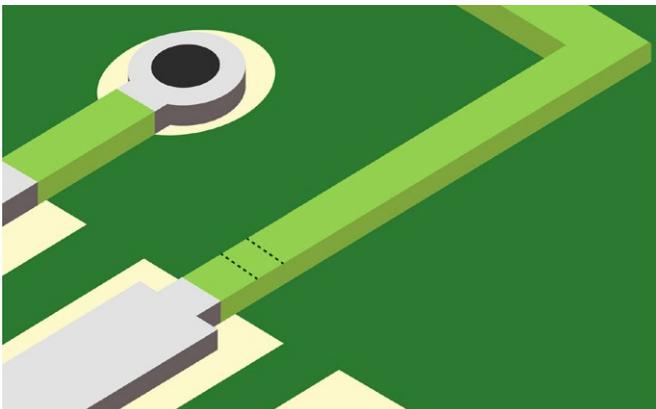


Figure 1: Determine the trace cut location.



Figure 2: Use a sharp-edged knife to make the trace cuts.



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damage other areas of the board. Remove the cut-out trace piece and discard.

An alternative to using the knife would be to clamp the board onto the milling bed making sure the board is parallel to the cutting tool. Size the cutting tool at half the width of the cut to be made. Make sure to protect the cut area so no foreign debris is left on the PCB. Clean after cutting as previously described.

Next use the continuity checker to make sure there is an electrical open between the cuts.

Mix the epoxy per the manufacturers' recommendations making sure you are aware of the humidity, temperature, and working time of the epoxy. In some cases, colorant needs to be added to color match the assembly. Using the edge of your knife, carefully fill in the gap (Figure 3) left by the missing trace. Cure the epoxy in an oven per the manufacturer's guidelines.

As a final step make sure the modification of board repair did not leave behind unintended damage to surrounding circuits while you were concentrating on the repair. Perform any remaining electrical tests as required. **SMT007**

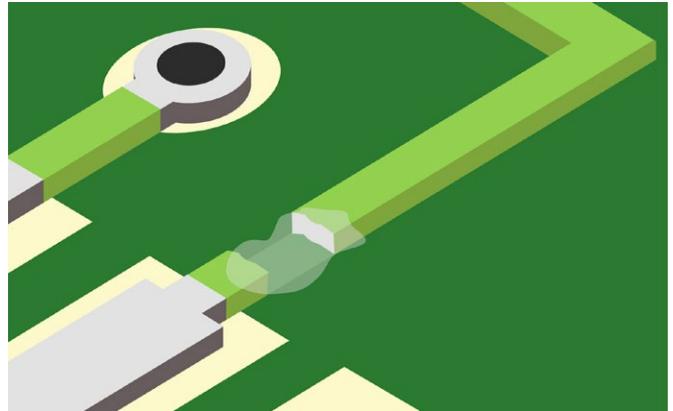


Figure 3: Fill in the gap of the trace cut using PCB repair epoxy.

Resource

- IPC 7711/7721 *Rework and Repair Modification of Printed Boards and Electronic Assemblies*, January 2017.



Bob Wettermann is the principal of BEST Inc., a contract rework and repair facility in Chicago. For more information, contact info@solder.net. To read past columns, [click here](#).



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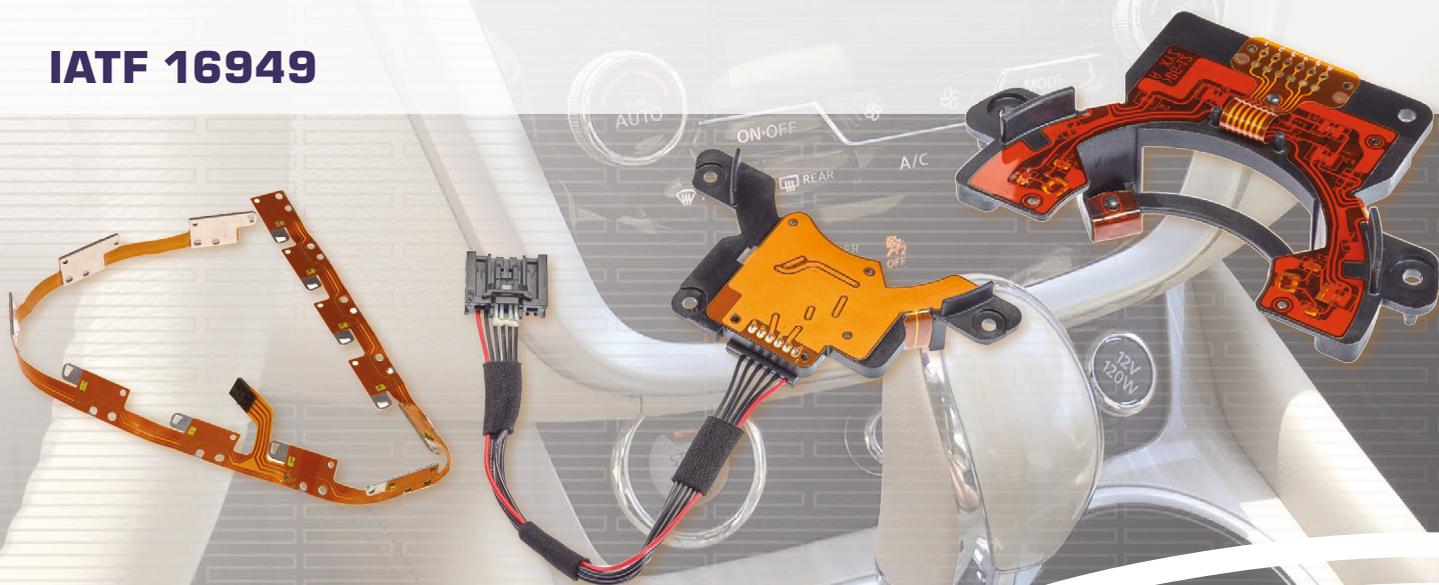
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Solving for ‘X’

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 Maggie Benson, a fictional character, to demonstrate continuous improvement and education in SMT assembly.

Andy and Sue were having pizza before they went to their pre-calculus class.

“Now I’m really confused,” Andy sighed. “Limits!”

“How so?” Sue inquired.

“I don’t see how the limit of $\sin(x)$ divided by x equals 1 as x goes to 0,” Andy groaned.

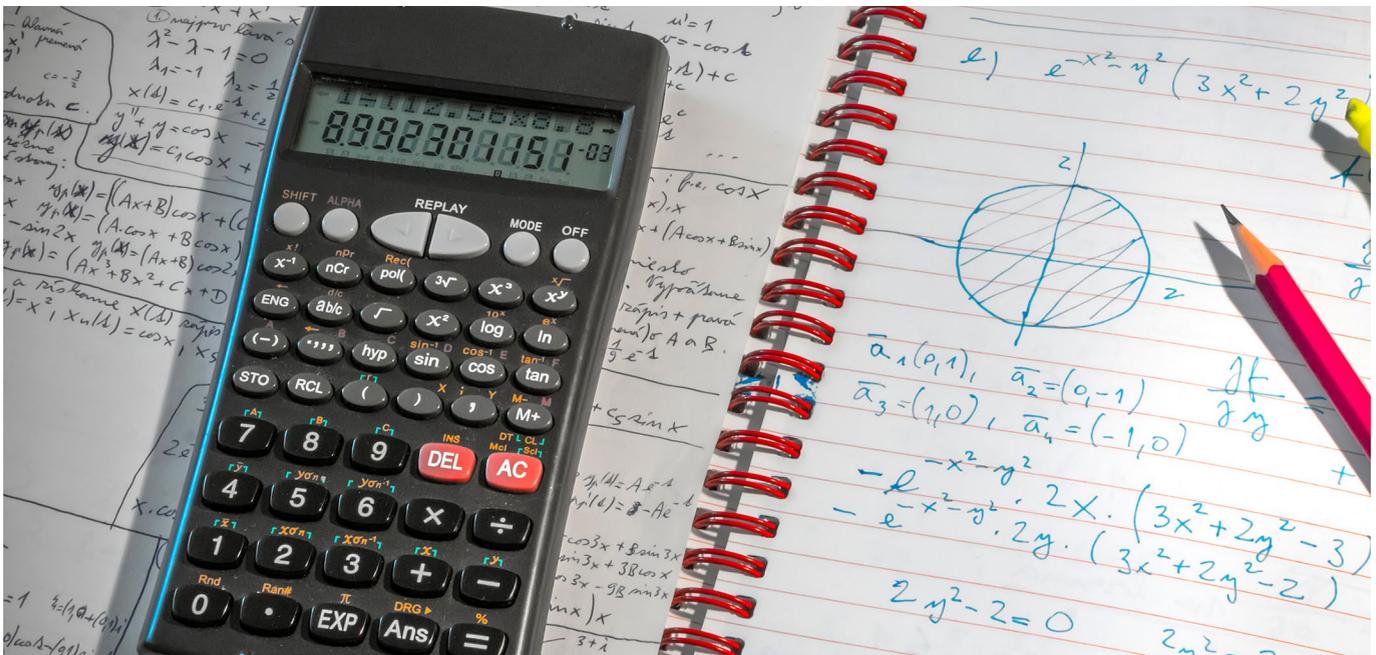
“Remember the professor told us that $\sin(x)$ can be expressed in a power series and the first term is x . All other terms are higher order, and they go to 0 much more quickly as x goes to 0. So, for small values of x , $\sin(x) = x$,” Sue explained.

$$\lim_{x \rightarrow 0} \frac{\sin(x)}{x} = 1$$
$$\sin(x) = x + \frac{x^3}{3!} - \frac{x^5}{5!} + \frac{x^7}{7!} - \dots$$

Figure 1: Because the first term in the power series expansion of $\sin(x) = x$, the limit of $\sin(x)$ over x goes to 1 as x goes to 0.

“I see it now. It’s actually kind of obvious the way you explained it,” Andy said as a compliment.

“You know, you are better at math than you think,” Sue said, encouragingly. “You have almost a 95% on the three quizzes and that is an A.”



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“But you have three 100s. The prof even said if he was sick, you could sub for him,” Andy teased.

They chuckled and both sensed it was time to change the topic.

“I still can’t believe your parents want me to go with you and them to Colonial Williamsburg,” Andy said. “They want to pay for everything, but I still feel that I should pay my own way.”

“I was kicking you under the table so that you would know that they really wanted to treat,” Sue said with a little exasperation. “You know they really like you.”

“I don’t understand why, I’m nothing special compared to you, the ‘math star,’” Andy groaned.

“You don’t get it, do you?” Sue asked. “What?” Andy questioned.

She elaborated: “You are a natural leader, everyone senses that. And you are very determined. It’s clear you are going to be successful. And there is the language thing.”

“What language thing?” Andy asked.

“My mother is gaga over you because you speak Spanish and French,” she said, then sighed. “After all, she teaches both at Hanover

High. I always struggled with Spanish and never took French.”

“For me, it was a gift,” Andy started to explain. “I played with a group of friends that were of Hispanic heritage and I asked them to only speak Spanish when we played. Also, my grandmother was French-Canadian and she babysat for me when I was young. She spoke to me only in French.”

They continued to discuss this situation and the plans for their Williamsburg vacation.

“Oh, there is one more thing,” Sue mentioned. “PDA.”

“Yikes, I have never even touched you in front of your parents,” Andy groaned.

“That’s the problem,” she replied. “They can’t understand why you never hold my hand, etc.”

“That is a problem I can solve,” he said, leaning over for a kiss.

Later, after their pre-calculus class, the couple went to the ice cream shop and began preparing for their next SMT 101 workshop.

The workshop was on component placement. Both were comfortable discussing how the component placement machines work as well as ancillary equipment, like feeders. But Andy had a concern.

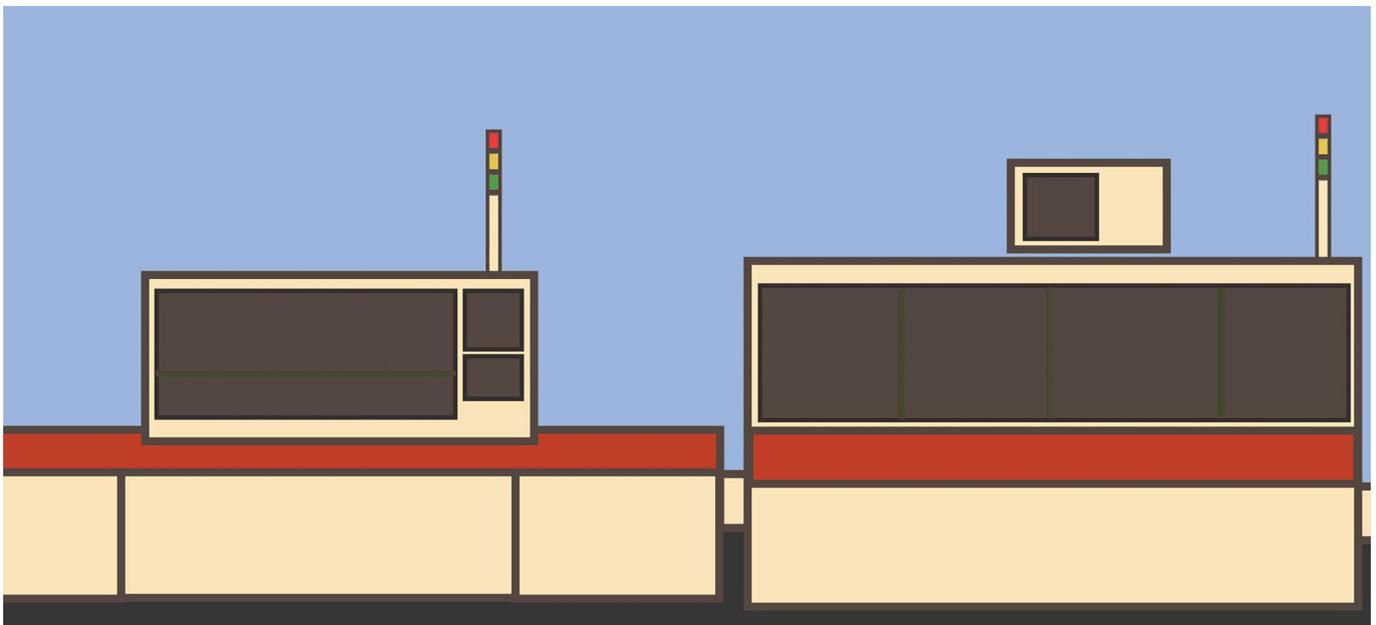


Figure 2: If component placement is the “gate” in the assembly process, the component placement machines must be time balanced.

“Ugh, line balancing,” he groaned.

“Well, what is usually the ‘gate’ in electronic assembly?” Sue asked, as Andy responded, “Component placement.”

“So, say we have two component placement machines, a chip shooter and a flexible placer,” Sue began. “The chip shooter takes 35 seconds to place all of the passive ‘chips’ and the flexible placer takes 25 seconds to place the simple integrated circuits (SICs) and the complex integrated circuits (CICs). What should we do?”

“Move passives to the flexible placer,” Andy responded. “But how many passives?” Sue teased.

“That’s where I get stuck,” he admitted.

“Well, we want the time on each placement machine to be the same, right?” Sue queried.

“Okay, so we take the passives off the chip shooter and that speeds it up and adds the passives to the flexible placer that slows it down,” Andy said, his voice rising in excitement. “We want to do this so that the times are the same. Now we need a math equation. Let me see if I can set it up.”

Sue commented, “Well, we need to know the numbers of components and placement speeds. Let’s assume there are 350 passives, 28 SICs, and six CICs. Also, that the chip shooter places passives at 30,000 per hour, and the flexible placer places passives and SICs at 8,000 per hour and complex ICs at 3,000 per hour.”

“Okay, so the chip shooter takes $350/30,000 = 0.01667$ hours to place the passives and the flexible placer takes $28/8000 + 6/3000 = 0.0035 + 0.002 = 0.0055$ hours,” Andy added. “So, we are waiting on the chip shooter.”

“Can you set up the equation to determine how many passives need to go to the flexible placer to time balance the line?” Sue asked.

Andy responded: “I think so. It would be: $(350 - x)/30,000 = 0.0055 + x/8000$. The left side of the equation is the time that the chip shooter takes with x less passives and the right side of the equation is the time the flex-

ible placer takes to place the integrated circuits and x passives. To be time balanced, the times must be equal. All we have to do is solve for x .”

With a little manipulation of the equation and their calculators, they solved the equation that x must be equal to 39 passives. So, the time for each machine is $(350 - 39)/30,000 = 0.01037$ hours or 37.3 seconds.

They discussed a few more things about the workshop on component placement and called it an evening.

Epilogue

Andy Connors and his dad, Frank, were never very close. Let’s listen in on them while they have a little chat.

“You know, son, I have never really talked to you much about life or your plans, but I have to tell you, Mom and I are extremely impressed with the change that has come over you recently,” Frank said proudly. “Even your boss, Maggie Benson, called us to tell us how proud of you we should be.”

“Wow, thanks, dad,” Andy said. “I think a lot of my motivation has come from knowing Sue March. She is so smart, especially at math.”

“Well, you know a guy could live 100 lifetimes and never meet a gal like her—don’t lose her,” Frank replied.

Both Andy and his dad felt a closeness like never before. **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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LITEON Technology Reports Consolidated July Sales of NT\$14.8 Billion



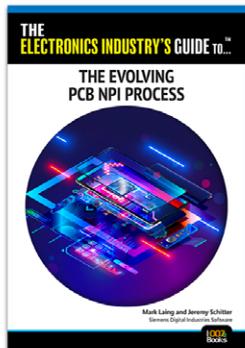
LITEON Technology reported its July consolidated revenue of NT\$14.8 billion, up 1 % M-o-M and 8% Y-o-Y, hitting a record high of the same period in 3 years, as a result of ongoing demand from data center in cloud computing and automotive electronics.

New Book from I-Connect007 Examines Evolution of Electronics Industry NPI

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.



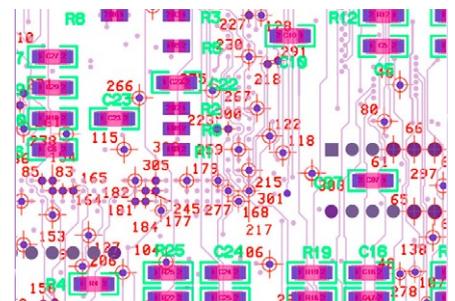
Printed Circuit Boards: Past the Lobby and Onto the Floor

One bill, the CHIPS Act, was signed into law last year. A new bill introduced this year seeks to allocate funding for printed circuit board fabrication. In this exclusive interview, our team spoke with Travis Kelly, CEO of Isola Group and president of the Printed Circuit Board Association, and U.S. Rep. Blake Moore, R-Utah, who has co-sponsored the bill now before the House. Travis and Blake both express optimism about onshoring domestic production, but the realities of the legislative calendar may pose some risks.



Optimizing Test Engineering Practices for High-Mix Electronics Manufacturing

For PCB and assembly manufacturers, test engineering has become a critical factor in enhancing the profitability of new product introductions (NPIs). Given the trend toward high-mix, low-volume production, the journey from design data to an automated PCB testing program must be quicker and more efficient than ever before. In this article, we will discuss how to optimize the efficiency of the test engineering process in accordance with these new market realities.



SMTA International 2022 Conference Program Finalized

The SMTA announced that the technical program of their annual conference, SMTA International, is finalized and registration is now open. The event will be held Oct. 31–Nov. 3, 2022, at the Minneapolis Convention Center in Minneapolis, Minnesota.

Solder Paste Printing and Optimizations for Interconnecting Back Contact Cells

The interdigitated back contact (IBC) is one of the methods to achieve rear contact solar cell interconnection. The contact and interconnection via rear side theoretically achieve higher efficiency by moving all the front contact grids to the rear side of the device. This results in all interconnection structures being located behind the cells, which brings two main advantages.



Rocket EMS Outfits New Nevada Facility with XQuik II Plus Counter



VJ Electronix, Inc., a leader in rework technologies and global provider

of advanced X-ray inspection and component counting systems, is pleased to announce that Rocket EMS, Inc., has installed its second XQuik II Plus component counter.

Cicor Awarded With Major Multi-year Aerospace and Defence Business

Cicor Group has been awarded with a major multi-year follow-up business for a total value of around CHF 30 million by a market-leading European manufacturer of specialized aircraft solutions.



Jabil Penang Expands Automation and Digitalization Capabilities Through a First-Of-Its-Kind Workshop

Jabil, a global manufacturing solutions provider, recently hosted an “Automation and Digitalisation Workshop” in Penang designed to strengthen its automation capabilities for greater operational and resource efficiencies.

Plexus Opens New Manufacturing Facility in Bangkok, Thailand

Plexus Corp., a global leader in complex product design, manufacturing, supply chain and aftermarket services, announced the opening of its new advanced manufacturing facility in Bangkok, Thailand.



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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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Altium®

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.

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Career Opportunities



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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Electrical Engineer/PCB/CAD Design, BOM/Component & Quality Support

Flexible Circuit Technologies (FCT) is a premier global provider of flex, rigid flex, flex heaters, EMS assembly and product box builds.

Responsibilities:

- Learn the properties, applications, advantages/disadvantages of flex circuits
- Learn the intricacies of flex circuit layout best practices
- Learn IPC guidelines: flex circuits/assemblies
- Create flexible printed circuit board designs/files to meet customer requirements
- Review customer prints and Gerber files to ensure they meet manufacturing and IPC requirements
- Review mechanical designs, circuit requirements, assembly requirements, BOM/component needs/and help to identify alternates, if needed
- Prepare and document changes to customer prints/files.
- Work with application engineers, customers, and manufacturing engineers to finalize and optimize designs for manufacturing
- Work with quality manager to learn quality systems, requirements, and support manager with assistance

Qualifications:

- Electrical Engineering Degree with 2+ years of CAD/PCB design experience
- IPC CID or CID+ certification or desire to obtain
- Knowledge of flexible PCB materials, properties, or willingness to learn
- Experience with CAD software: Altium, or other
- Knowledge of IPC standards for PCB industry, or willingness to learn
- Microsoft Office products

FCT offers competitive salary, bonus program, benefits package, and an outstanding long-term opportunity. Location: Minneapolis, Minn., area.

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Career Opportunities



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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.

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Director of Operations State College, PA

Chemcut Corp., a world leader in wet processing equipment for the manufacture of printed circuit boards and chemical etching of various metals, is seeking a Director of Operations.

Objectives of the Role:

- Collaborate with the CEO in setting and driving organizational vision, operational strategy, and hiring needs.
- Oversee manufacturing operations and employee productivity, building a highly inclusive culture ensuring team members thrive and organizational outcomes are met.
- Directly oversee manufacturing operations, production planning, purchasing, maintenance & customer service (product support) and partner with the CEO and controller on sales management to budget for sufficient investment capital to achieve growth targets.
- Aggressively manage capital investment and expenses to ensure the company achieves investor targets relative to growth and profitability.

Qualifications:

- Bachelor's degree in mechanical, electrical, or related fields
- 5+ years' experience in leadership positions
- Leadership skills, with steadfast resolve and personal integrity
- Understanding of advanced business planning and regulatory issues
- A solid grasp of data analysis and performance metrics
- Ability to diagnose problems quickly and have foresight into potential issues

Preferred Qualifications:

- Master's degree in business or related field
- International business experience

To apply, please submit a cover letter and resume to hr@chemcut.net

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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

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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

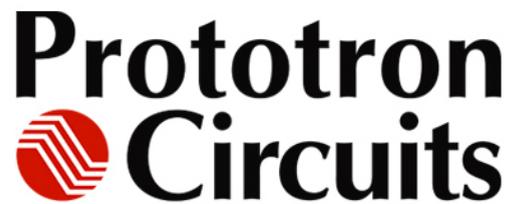
Requirements and Qualifications:

- 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:

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

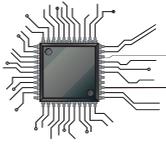
Reasons you should work with Prototron:

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- Capacity for growth
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- Production quality quick-turn services in as little as 24 hours
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- 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.

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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 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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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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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.

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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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Career Opportunities



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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. Please, no phone calls.

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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.

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

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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.

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Career Opportunities



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

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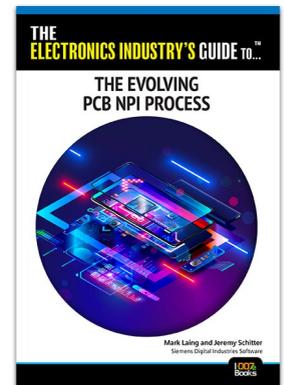
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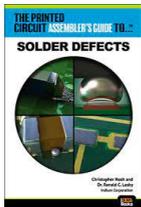
The Electronics Industry's Guide to... The Evolving PCB NPI Process

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.



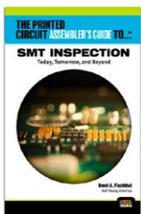
The Printed Circuit Assembler's Guide to...



Solder Defects

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

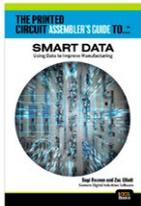
This book is specifically dedicated to educating the printed circuit board assembly sector and serves as a valuable resource for people seeking the most relevant information available.



SMT Inspection: Today, Tomorrow, and Beyond

by Brent Fischthal, Koh Young America

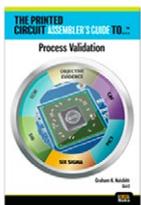
An in-depth insight into new and exciting true 3D inspection technology is provided in this book, along with a look into the future of leveraging big data management and autonomous manufacturing for a smarter factory.



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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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