DECEMBER 2023

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Economic Headwinds

While many of you might well be into your fiscal year, we have a strong suspicion you're constantly adjusting your "sails" to stay afloat in strong headwinds. This issue takes stock of the economic outlook and how companies are using current conditions to move themselves through technological evolutions, workforce shifts, and financial changes. Even with these headwinds, there is forward progress to be made.

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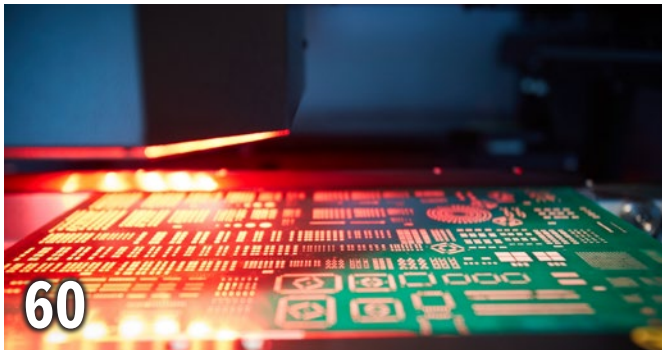

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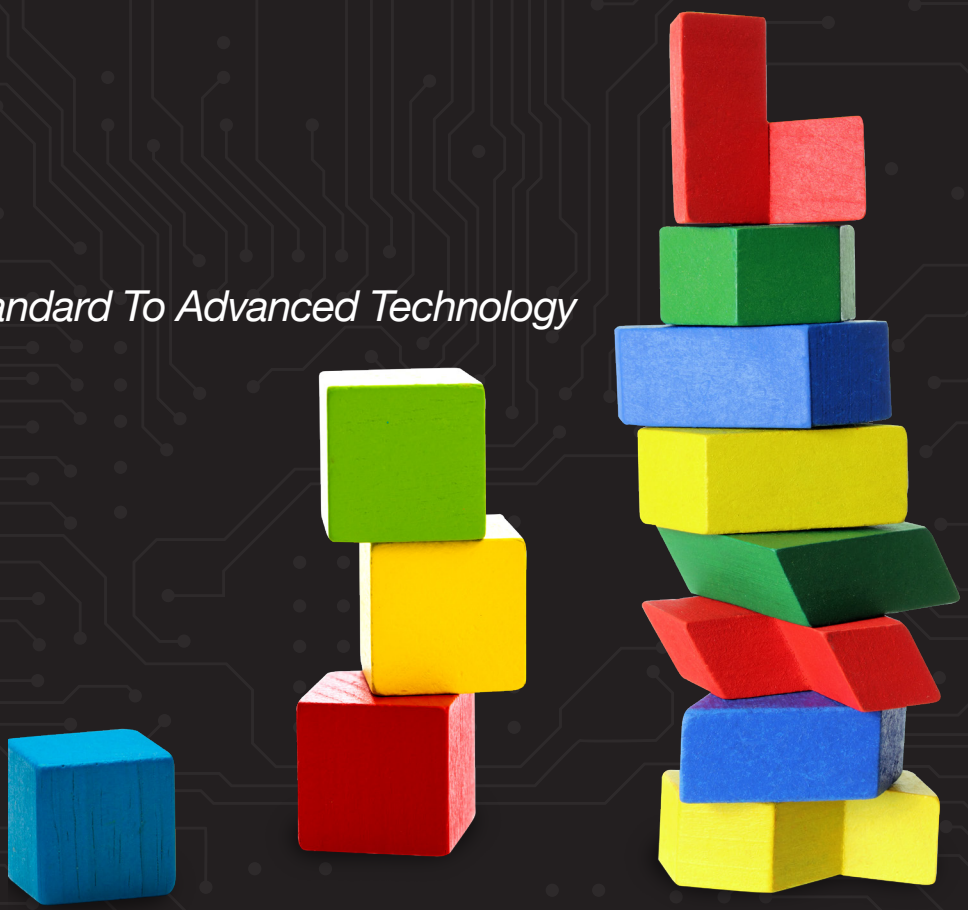

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Set Your Sails Properly

Nolan's Notes

by Nolan Johnson, I-CONNECT007

In the world of sailing, we talk about headwinds—that strong wind that opposes forward motion—to gain momentum (mostly). But isn't this counterintuitive? How can wind pushing into your sails help you move in the direction you actually want to go? Of course, it's much more easily understood when we apply the principles of aerodynamics—which I think most of us understand—and some sailing techniques that take advantage of the headwinds. So, I wasn't surprised when the term headwinds popped up frequently in our discussions for this issue about the current economic climate.

I have some sailing experience in my background and what I've learned is that sailboats can and do sail *almost* into the wind. Generally, the sailboat must be aimed so that the wind is off to the side of the bow just enough to inflate the sails. Most modern sailboats are sloops using triangular sails. The shape of the sails is important: When the sails inflate, the shape is much like an airplane wing. Some of the force pushing the sailboat forward comes from the wind pushing against the back side of the sail, while much of the force comes from the "lift" created by the airfoil shape across as the wind passes over the front of the sail. That lift is directed, not upward like an airplane wing, but forward, pulling the boat across the water. In other words, sailboats take advantage of the headwinds to create momentum.

So, when talking with IPC's chief economist, Shawn DuBravac, for example, about headwinds in the global economy, I knew exactly what he meant. Metaphorically speaking, while it seems intuitive to try and sail around the winds or

wait for a day when the winds look more favorable, Shawn suggests being realistic about what's in front of you and adjusting your sails to create space for growth. A bit of a zig-zag, to use a sailing term. He addresses the needs directly for contract manufacturers who have questions about investing, supply chains, talent management, and more.

We also heard about headwinds in our interview with Amy Pine and Brian Carey of Innovative Capital Resources, which provides capital and operating leases to the EMS provider industry. Amy and Brian stay as close as they can to the technology side of the business so they can better understand what headwinds mean to electronics manufacturing. Their counsel is well placed.

This issue also features Q&A sessions with several EMS providers who share their vision for 2024 and some of the biggest challenges they face. I think you'll find you're in good company.

I round out this issue with strong columns from Mike Konrad, Michael Ford, and Ron Lasky—whose story about Professor Patty's travel mishaps are probably ones we all can relate to.

While many of you might well be into your fiscal year, I have a strong suspicion that you're constantly adjusting those "sails" to stay afloat. This issue of *SMT007 Magazine* takes stock of the current economic outlook, the headwinds, and how companies are using current conditions to move themselves forward, through technological evolutions, workforce shifts, and financial changes. Even with these headwinds, there is forward progress to be made.

Wishing you all a joyous end to 2023. I'll see you in the new year. **SMT007**

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

IPC Attains U.S. Dept. of Labor Approval of National Apprenticeship Standards

Washington, DC—The U.S. Department of Labor (DOL) approved IPC's National Program Standards of Apprenticeship—the first-ever in the U.S. electronics manufacturing industry—in a move designed to expand the skilled workforce for this strategically vital industry.

The recognition was bestowed during a ceremony as part of National Apprenticeship Week, Nov. 13-19. The DOL's action ensures that IPC's Registered Apprentice programs are recognized nationally and align with the industry's highest standards of proficiency in electronics manufacturing. IPC is now authorized to register with each state's Eligible Training Provider List.

National Program Standards of Apprenticeship are occupational training standards developed and sponsored by an employer, an industry organization, labor organization, educational institution, or consortium. IPC's apprenticeship standards cover two critically important occupations—electronics assemblers and printed circuit board fabricators—and provide valuable, hands-on experience with a defined pathway to secure, well-paying careers in electronics manufacturing.

"More than two-thirds of IPC's U.S. members report that an inability to find and retain skilled workers is limiting their growth and global competitiveness," said John W. Mitchell, IPC president and CEO and author of *Fire Your Hiring Habits.* "The Department of Labor's endorsement of IPC's apprenticeship standards will help foster a larger, more skilled, and more diverse workforce. We are excited about the positive impacts on workers, their communities, and the electronics manufacturing industry."

IPC Chief Economist's Industry Forecast for 2024

Feature Interview with the I-Connect007 Editorial Team

To better understand the current economic situation for electronics manufacturing, we brought in Shawn DuBravac, IPC chief economist, to provide an update with a high level global economic outlook. As you might expect, the seas have been a bit turbulent in the aftermath of the pandemic. Shawn breaks down the headwinds and the tailwinds of an economy in flux, and what it means for you.

Barry Matties: Shawn, give us a brief review of 2023.

Shawn DuBravac: The U.S. economy held up much better in 2023 than we anticipated and showed significant resiliency. Europe faltered somewhat, and that was not unexpected. In fact, we saw some growth in Europe, so one might argue that Europe held up better last year than we had anticipated. Yet, headwinds remain in Europe. The conflict in Ukraine continues to weigh on Europe.

China has faced stiffer headwinds than many anticipated. There was the expectation that, following the reopening of China early in 2023, things would pick up. We saw an initial bounce, but things have since settled, and in fact, there are some very big warning signs coming out of China right now.

Matties: When it comes to the economic forecast, what should we be concerned about?

Looking ahead, industry should be thinking about a few things. First, where does growth

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Shawn DuBravac

go from here? There is concern that the U.S. market will slow. We've had interest rate hikes across the globe, not just from the Federal Reserve, but from the European Central Bank and others. Ultimately, this means slower growth, and a potential recession. Those risks remain acute.

Second, as we head into 2024, in every region—and certainly in the U.S. and Europe—there remains a big open question about shifting supply chains. Even with all the talk about building greater diversity and resiliency into supply chains, so far, the shifts have been quite subtle. What does that mean for the type of investments a company makes and when? What conversations should they have with their sourcing partners or distributors? There are still a lot of open questions.

Third is the topic of inventory management. In the aftermath of the pandemic, there was an idea we would move away from just-in-time to just-in-case. But, of course, just-in-case has a cost and it's a harder one to face when interest rates are high—presumably carrying costs are higher, and demand is slower. Company leaders should be fine-tuning their inventory management strategy as we move into 2024. This applies not just to inventory, but to equipment as well.

Ask yourself: What's my near-term demand? Long-term, what will happen to my demand in the years ahead as my company and customers look to potentially changing their regional exposure?

Nolan Johnson: Where do labor and staffing fit into these dynamics?

Overall, the demand for workers is starting to settle, but labor costs remain high. Inflation rates surpassed wage rates last year and much of this year. Labor groups are trying to recoup some of the purchasing power they've lost, which means that as we look ahead, wage rates will probably accelerate faster than inflation. Even when inflation comes down, we will probably continue to see wages moving up.

Another facet of higher labor costs is the higher cost of doing business overall. For example, UPS workers renegotiated their labor contract this year. The new deal increased wages and benefits by 3.3% over the life of the agreement, but 46% of that will show up in the first year. This will inevitably result in higher transportation costs for businesses.

Johnson: Shawn, what's your take on how we compare to U.S. manufacturing, in general?

On one level, a rising tide lifts all boats. Manufacturing has done well. We've seen job growth, an increase in output for many sectors, and general improvement across the manufacturing economy.

The defense and aerospace sectors have been growing pretty well, and that has benefited electronics manufacturers in the U.S. because we have pretty high exposure in those areas. Consumer electronics did very well right after the pandemic but have faced more headwinds this past year, and probably will next year as well. That impacts Asia more than the U.S. because it has more exposure to consumer electronics than the U.S. does. In some ways, all manufac-

turing has benefited from the changing sentiment in the world.

Matties: I'm curious about risk factors as we move into 2024. What should assemblers and fabricators take into consideration regarding investment strategy?

The number one risk factor is the significant shift in the economic environment. We have seen interest rates move higher and more quickly than in the past. Monetary policy tightening has been pronounced, and it often takes about six months for interest rate hikes to transmit fully through the economy. There is a significant risk of a real slowdown in economic growth next year. However, I'm optimistic there are still a lot of investment dollars in certain areas and electronics may benefit from that.

A second risk concerns the major geopolitical risks in areas like Ukraine and the Middle East. China is also facing some real economic headwinds with high unemployment among its youth. Companies are looking to shift their supply chains to investment in new geographic areas, like Southeast Asia and Mexico, which puts China at risk.

Matties: Let's talk about board pricing. I often hear fabricators say they're getting beat up on price, so does the price of boards match reality? What do you see?

Those battles will probably continue. The cost of materials, inputs, and labor is still high. We know that any destabilizing factors in the geopolitical environment can drive prices higher. Oil prices are high, and I don't think we will get back to the pre-pandemic level of $35 a barrel anytime soon; the new norm is maybe $60–$70 a barrel. We see these dynamics playing out as input costs push higher while companies try to contain costs. All these factors contribute to a continued conversation about board pricing.

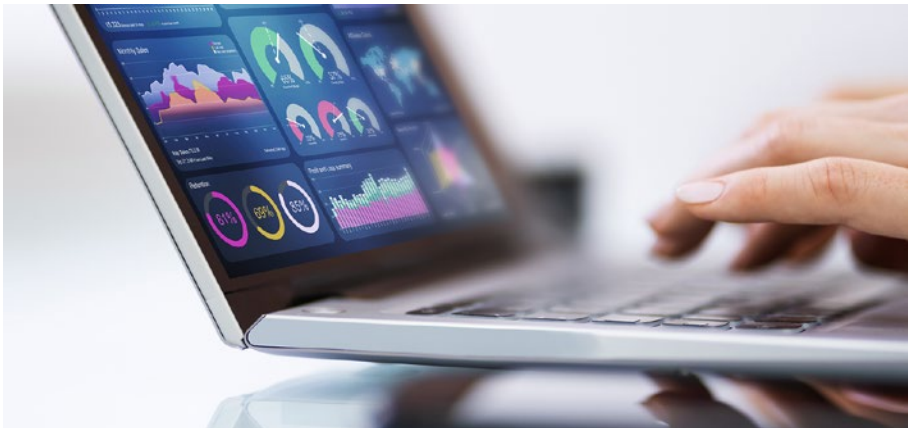
Matties: Everything you're saying suggests now is the best time to focus on operational effectiveness. Lower your costs because, inherently, there's a lot of waste in the manufacturing process for those companies that aren't paying attention. That's one thing that you can absolutely control to drive costs down.

That's right. As demand continues to improve in North America due to supply chain resiliency goals, companies will begin adding capacity, and by definition, the newest technology. It all means companies will be more productive and efficient.

Keep in mind that the U.S. and Europe aren't just competing with Asia like they were five to 10 years ago. Now you're competing against other companies in your part of the world that are building more efficient capacity through newer equipment. When you think about becoming more efficient with your resources, consider the cost perspective as well as what other companies in your geography are doing.

Johnson: There's a lot of discussion here about the potential to grow through investment, but banking right now is somewhat unpredictable. What's the best way to handle this situation?

Banking costs have gone up. It's not like the 2008-09 financial crisis, where big banks cut back on their lending. During that time, I would hear almost daily from companies that were having lending issues with banks. For example, a company would have a loan on a



warehouse. These were often financed as five-year balloons. When the five-year term ended, companies would just initiate a new five-year loan. But banks in 2008–09 were not renewing these loans and wouldn't let the companies roll them over. Companies would either have to sell the warehouse or find alternative sources of money. It produced accelerating sales of assets, often at discount prices, which then filtered back to the financial market. The Fed has learned from that, so they put in stopgaps to avoid it, and now it doesn't feel like the big national banks are creating an environment that forces asset sales. However, there is more pressure on regional banks.

If you're an EMS provider or a PCB fab and you're using a regional bank, it's always good to check in regularly with them to ensure your lines of credit are still intact and there are no unforeseen changes. Companies often rely on those lines of credit to buy the inventory in advance, and then they're not getting the payment until 30 days after they've shipped the box, so those lines of credit can be very important. My sense is many EMS companies have very good relationships with their banks, but it's worth making sure nothing has changed.

Because costs are up and it will be more costly to expand, we may see more merger activity; in some instances, it might be cheaper to buy out a competitor than to buy the equipment new.

Johnson: So far, we've been talking about assemblers and fabricators, but what about the capital equipment manufacturers? How bullish or bearish is the economy for them?

Capital equipment providers face unique challenges. Many are likely to see a shift in the geographies where they sell. Pre-pandemic, pre-trade embargoes, and pre-tariff, U.S. companies were likely selling a lot of equipment to Asia. As Asia slowed, it tried to force their manufacturers and facilities to use more domestic capacity, capital, and machinery. But areas like Mexico, parts of Western and Eastern Europe, and the U.S. are growing. That's where that capital equipment is shifting. It's a tougher environment, though, so it will probably be harder to sell some of that equipment. The decision whether to increase capacity will be a big one to make in a slow growth environment with high interest and finance costs; it becomes a much more challenging decision.

Johnson: There have been times when capital equipment manufacturers got into the finance business and carried the paper themselves. Is now the time for that tactic to return?

We could see that. You see it already happening in the U.S. residential market, where builders are willing to buy down rates for buyers so they can get better rates. They're essentially putting money into the financing. Maybe they're not carrying the note, but they're paying down the rate. That could definitely make more sense now.

Equipment is more software-sensitive now. Much of the value is in the software and the services, not just in the metal and the hardware. Getting that recurring revenue by having customers pay for ongoing service contracts may be lucrative for the companies.

The other thing is the resale value, precisely because it's more software-dependent and can be updated and upgraded. If you needed to reclaim some of that equipment, you could probably place it at other facilities without a lot of heartache. If you had to take back used equipment, you could probably refurbish and resell it. The software would be up to date, so it's not like you're having to sell it for pennies on the dollar.

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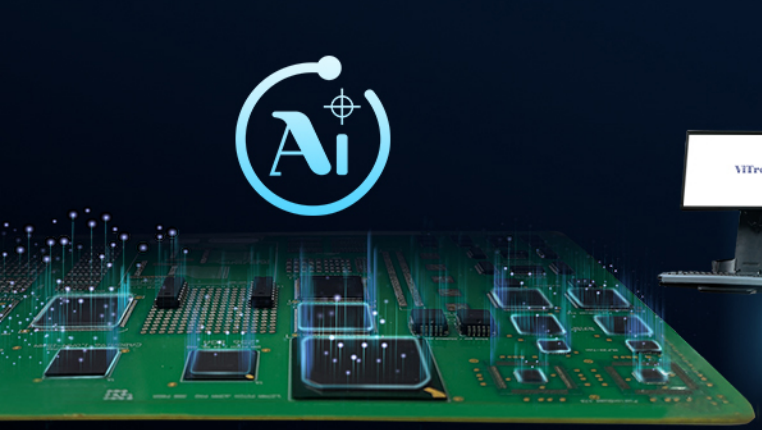

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Johnson: More software in the capital equipment means that carrying the paper makes sense, because so much more of the revenue stream would be from the support contract.

Matties: Yes, and spare parts. There is talk about the CHIPS Act as a big influence. Where do you put that in this economic equation? What should we expect from that?

With respect to the CHIPS Act and other industrial policies, the U.S. hasn't historically had much industrial policy, especially when it comes to electronics. I have a lot of hope for 2024 and 2025.

There are several reasons why the economy was stronger in 2023, but it wasn't driven in large part by government policy. Government action thus far probably hasn't yet shown up in any big way. Those things will show up, but it just takes a long time. Legislation like that is never shovel-ready.

Matties: Should companies factor that into their economic plans now?

Yes. They can count on some upside, some additional volume, and demand that will materialize. It's hard to know the timing of that demand, so that's the risk.

We should see that growth show up in construction, as well as some other areas, like the industrial side of the economy. The challenge is the timing, but it's definitely sitting there, and it will come. Companies will benefit across the economy.

Johnson: How do our readers take all this economic information and put together an action plan for 2024?

Higher interest rates mean higher discount rates. If you think about using discount rates to determine capital projects, like net present value, this environment means that future investments have much higher hurdles to be economically viable. They must take that into account.

Johnson: So, that shifts the calculation for your ROI?

Yes. Let's think of net present value and the internal rate of return. The internal rate of return is the rate at which net present value is zero—you're indifferent between taking or not taking the project. When you think about investing in a project, take all the future cash flows you expect from that project, and discount them back to today. If those cash flows are higher than the investment today, then you would make the investment.

The discount rate you use is typically the risk-free rate, which is much higher now than it was pre-pandemic, and it will stay high. The 10-year treasury, which is often a risk-free rate used for a discount rate, is at, let's call it, a 15-year high. That means the hurdle for those investments is much higher, so the ROI must be higher. The way we do these financial calculations, projects will have to produce more cash flow than they had in the past. In other words, the framework in which they think about investment projects has changed; potential investments must be more lucrative.

Matties: All right, sir. Thank you very much.

Thanks. **SMT007**

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Joe O'Neil Has More Optimism than Concerns

Joe O'Neil

Feature Q&A

Joe O'Neil's background includes operating both printed circuit fabrication and printed circuit assembly companies. In his current role, Joe contributes to the strategic initiatives at IPC, including his involvement in developing advanced fabrication technologies demonstration facilities in the U.S.

For 2024, how would you describe the economic outlook for the industry? What are you optimistic about? What are you worried about?

Joe O'Neil: The global economic outlook for the electronics industry in 2024 presents a mixed landscape. While there's a sense of flatness, several opportunities are emerging. One notable trend is the relocation of manufacturing from China to regions like Southeast Asia, Mexico, and the U.S., fostering a more diversified supply chain. I am particularly optimistic about the renewed focus on building a robust domestic electronics manufacturing base. New domestic activities across the value chain are on the rise and are expected to continue in the coming year.

There are, however, valid concerns. Rising interest rates, inflation, and other economic headwinds have the potential to delay these projects. Geopolitical tensions and increasing complexities in the industry are also worrisome factors.

What concerns you most in your growth plans: capabilities, capacity, or competition?

Actually, workforce is my main concern. I believe that there are talented, extremely bright young people coming up through our education system and entering the workforce. Can the electronics industry attract them? If so, I am not worried about developing and sustaining domestic capabilities and capacities and competing on a global scale. Without the workforce, none of that is possible. I see massive opportunities for bright, young engineers in our industry. The challenges are large, but the opportunities are large as well.

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Is inventory management and/or supply chain tying up capital that would otherwise be used for capital investments?

I think the increase in inventory buffers—which ballooned during the pandemic supply chain debacle—have begun to wind down and that is freeing up capital. There is a significant amount of activity in both the PCB and EMS equipment areas but that has slowed because of rising interest rates and ongoing concerns about the economy.

What's your perspective on buying capital equipment with cash vs. financing?

I've always had a very conservative perspective on equipment purchases: If you can't afford it today, why do you think you will be able to afford it tomorrow? With that said, financing at very low rates or with payments over time from your supplier allows you to maintain liquidity and more flexibility.

> "Going green" is not just an option; it's a necessity.

Technologies are hitting an inflection point in both the EMS supplier and PCB fabrication realm, where densities, complexity, and I/O counts are requiring increased placement and fabrication accuracy, inspection capabilities, accuracy, and speed and test capabilities. All these drivers are pushing companies to find a way to make these investments.

Whether paying cash or financing your capital investments, I would encourage all companies to ensure that they are receiving the full benefit of government incentives such as the R&D tax credit. There are several programs available, and they are there to encourage investment in our industry, especially for small- and medium-sized businesses.

Is the CHIPS Act trickling down yet?

While I don't know the details of the funding status, I have seen the positive impact, renewed optimism, and lots of activity resulting from the effort. It seems there are ripples ahead of the waves. There is a lot of confidence that those CHIPS Act dollars and the commitment to the U.S. electronics industry are real and long term. That seems to be driving activity in all areas, from reshoring to new factory investment, and it is having a real effect on U.S. business by reinvigorating the market.

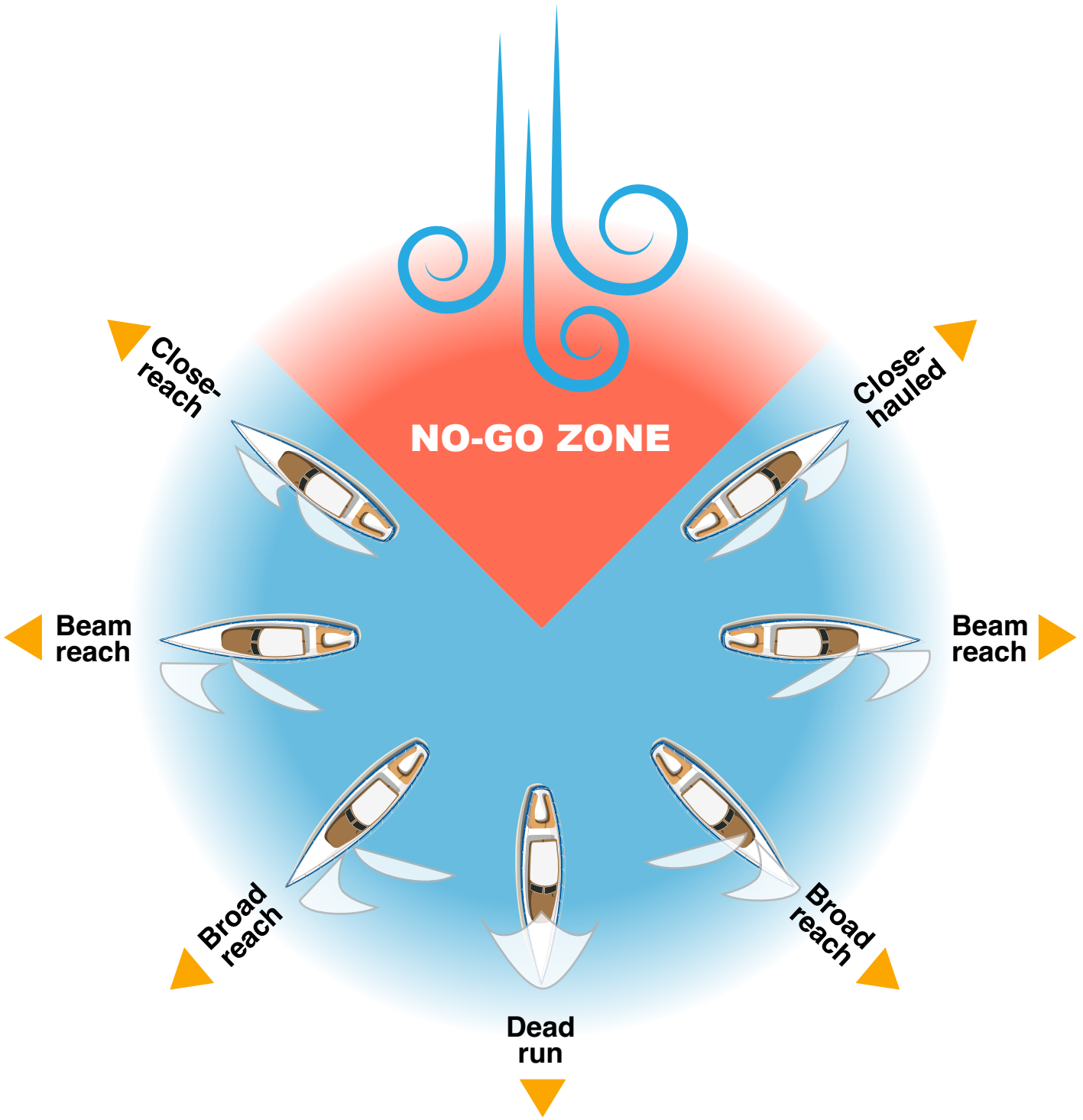
Which process technologies hold the most opportunity for growth in the industry in 2024?

The industry is expected to witness substantial growth in Smart, connected factory advancements in 2024. These developments form the foundation for real-time data analytics and actionable insights, enabling more efficient and informed decision-making. The integration of artificial intelligence (AI) and machine learning is particularly exciting, with several AI companies working within the industry. Additionally, the expansion of robotics and automation into higher mix, lower volume manufacturing areas presents a significant opportunity. These technologies enhance repeatability and throughput, leading to a strong return on investment while allowing the workforce to focus on more valuable tasks.

How does "going green" factor into industry dynamics? Is it a cost of doing business or a selling point?

Embracing sustainability and "going green" is not just an option; it's a necessity. New technologies, especially in PCB fabrication, are changing the economics of the business by reducing water and power requirements. Adopting green practices is not only socially responsible but also economically viable. It can serve as a selling point for environmentally conscious consumers. Companies should consider investing in green initiatives as it aligns with global sustainability goals and can contribute to cost savings in the long run. SMT007

Navigating Wind



Source: Royal Yachting Association

What's Happening With Financing Solutions?

Feature Interview with the I-Connect007 Editorial Team

Amy Pine and Brian Carey are principles of Innovative Capital Resources, a financing resource for electronics manufacturing with a 20-plus year history. They briefed the I-Connect007 Editorial Team on what they're seeing in the financing side of the industry, how it compares to the past, and a bit of what they see over the horizon in 2024. Hint: There's some good news for investors.

Nolan Johnson: Amy and Brian, please introduce us to Innovative Capital Resources. What's your mission and your specialty?

Amy Pine: We specialize in providing financing and leasing to high tech manufacturing companies specific to the electronics market, meaning assembly and board fab. Brian and I worked together prior to Innovative Capital at Copelco/CitiCapital. He financed his first pick-and-place machine in the 1980s.

We work with multiple funding sources, educating them on the electronics market and the type of equipment that contract manufacturers or OEMs use to assemble and inspect boards or to manufacture and fab boards. Over time, we have built relationships with vendors, customers, and our lenders.

Brian Carey: When we started in 2002, you may remember, it was in the middle of the "tech wreck." Amy and I were going to trade shows, saying that we specialized in the elec-

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Brian Carey and Amy Pine

tronics market. It really sounded like a recipe for disaster because everything was going overseas, but it gave us a jump.

We really care about this industry. I've been an officer in SMTA for many years, and we want to stay in touch—as much as a finance person can understand the technical aspects of this business. I think that makes us unique and allows us to work more closely with companies because we've proven our commitment to the industry.

Johnson: What is the outlook if someone is looking to respond to market dynamics—improve their processes, change out their equipment, add capacity, any of those sorts of growth options?

Carey: It's still positive. Our customers have paid well. We think there will be plenty of finance options for companies going forward.

Pine: Our portfolios have performed very well and paid on time. Based on this history, we are often able to offer preferred finance programs that other industry segments can't offer in these more challenging times, both with respect to interest rates and credit approvals.

Barry Matties: Don't you think interest rates are a hindrance as is the uncertainty with geopolitical situations affecting onshoring? You sound very optimistic, which is a bit contrary to what I'm hearing on the news.

Pine: We also see some uncertainty in the economy; businesses want to keep their cash reserves for that reason. So, while interest rates might be higher now, financing and keeping cash on hand is a bit of insurance for them. I've even had a customer point out that they'd rather pay 8% for a loan and put the cash into a money market account where they can earn 6% right now. Then, if they need the cash, it's available to them, so they perceive the cost of financing as only a 2% differential.

Carey: Keep in mind that we've gone through worse loss than this. We're tied to treasuries. Today, five-year treasuries are about 5%. In the 1980s, treasuries were 15%, and we got through that. We could hardly imagine how you'd buy a home when the prime rate was 20%.

Matties: Do you get a sense of trends in terms of equipment being sought or purchased, specifically along the lines of automation, that help offset the workforce challenges?

Pine: We see it from the standpoint of companies bringing in high-end inspection equipment vs. inspecting or reworking manually. Also, if they get the high-end assembly automation, there is potentially less hand work, and companies can potentially run a machine or a line with one or two operators vs. multiple people.

Carey: You do whatever you can to minimize some of the labor impact to compete with overseas manufacturing. If we look back about 20 years ago, we saw the exodus of manufacturing here in the United States. I think there will be a need for labor with skills that enable them to integrate with the new technology. That means there are still great opportunities for people seeking a career in electronics manufacturing.

Johnson: Amy, you described educating your lenders so they're knowledgeable of the industry in which they're participating. How do you do that, and how does that improve the financing process?

Pine: We provide a write-up to our funding partners on the EMS market as well as provide a diagram of an SMT line and how each piece of equipment works within the manufacturing line.

We explain the nature of a contract manufacturer, that they typically are not tied to one product doing well; they have many different customers driving their business, which diversifies the credit risk. This type of information, along with our aged portfolio history, allows credit to move more quickly and confidently with the approval process.

Johnson: In those conversations, what is unique about our industry that they definitely must know?

Carey: It's the dynamics of change. If you allow yourself to submit to the change—this gets back to technology—then you're better apt to go forward. Manufacturers tend to do a better job at budgeting and paying. At the end of the day, a lender has all these avenues and types of industries to finance. They analyze how well the various industries are performing and see that our industry has performed very well.

Matties: So, you're in the middle, working for both the lender and the contract manufacturer. How do you qualify your customers on the manufacturing side?

Carey: We actually serve three masters here: our funding source, customers, and the vendor. We really need to incorporate all three.

Pine: When we're referred into a transaction, or when a customer contacts us, we do a cursory credit review, looking at their time in business. There are credit reports we can access to see how they've done financing in the past. Then we have a conversation directly with the customer to learn more about them. What is the justification for the purchase? Where are they at financially? We review our programs to determine what will work best for them.

Brian and I both came from a direct funding source. When we started Innovative Capital in 2002, we branched out and found several different funding sources to partner with. The benefit is we have funding partners who work with more challenged credits, as well as sources who work with high-end customers who demand better terms. If the opportunity doesn't fit in one box, we can take it to another, whereas direct funding sources can't provide that. After our research, we can put together a proposal that will best meet the customer's needs and offer them the best terms available.

Matties: Credit standards have tightened up significantly. Do you see that in equipment leases? Has that also become a higher standard?

Pine: We've been fortunate, and that's based on our portfolio history. Even through COVID, many of our clients stayed open, we didn't have a big default rate. Over 20 years,

we've maybe had one or two. We're benefiting, and so are our customers and vendors, because we haven't seen a tightening in the credit market.

One popular program we have offers customers up to $500,000 in credit approval with just a credit application and no financial review. It's based on their pay history, how long they've been in business, and public credit reports. But it says a lot that lenders are willing to offer that funding opportunity to our clients without reviewing financial statements. That is a result of how the portfolios have performed.

Matties: The economic indicators we hear about on the retail consumer side don't seem to overlap into manufacturing.

Carey: I don't think it's overlapping in electronics. Even in 2003, a CitiCapital (former employer) called me regarding a problem account, and I asked quite bluntly, "Despite all the industry problems, how's my portfolio performing?" His reply was, "Surprisingly well." So, if we can get that kind of response during that difficult time, we can absorb the current situation pretty well. So, I am optimistic. There will be some pain, but we're positioned well, and we'll be fine.

> **Devices built in the U.S. are more likely to be assembled and board fabricated in the U.S.**

Matties: How does the CHIPS Act influence the businesses that you're pursuing?

Carey: To bring semiconductor business back, we need to go in with our eyes open and be patient. If you're building chips over there, it certainly makes sense to fabricate and assemble boards over there. Devices built in the U.S. are more likely to be assembled and board fabricated in the U.S.

Pine: Over time, I think we will see an increase in domestic assembly and board fab business tied to the CHIPS Act.

Andy Shaughnessy: Over the years, Wall Street has been skittish about EDA tools and the circuit board market, in general—something they didn't really understand 10 years ago. Do you see that changing? Does Wall Street seem to be getting more accustomed to it?

Pine: We have seen venture capital companies become more involved. We see them purchase contract manufacturers and start building networks across the country by buying existing assembly shops. That says they're seeing value. Venture capitalists are in it to make some money and be able to grow that business to go public.

Carey: This industry isn't overly proprietary. We don't create the product; we build it. If you invent the products, and you're selling the newest thing, that gets Wall Street excited, but you also have proprietary risk. I agree with Amy that venture capitalists like this market. There is less product risk and still good profit margins with the right technology.

Matties: Are green initiatives a factor in finance today?

Carey: Yes, lead-free and other changes have been good for the industry and the environment. We have financed this equipment in the past. Not sure this is what I would call a factor in finance today. We trust the environmental equipment purchases made by the EMS companies and assist in the financing.

Johnson: What can we expect for 2024?

Carey: There's a lot of quoting going on. In this

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industry, if you're not going forward, you're going backward. There is no standing still. I am confident but also a little cautious going into next year.

Pine: We're still seeing a high level of quoting activity. Customers are looking at equipment and getting proposals. It's been a very active year. Not quite as much funding as in 2022, but close. I'm not sure I have a specific outlook for 2024, but I see companies still looking to invest, with customers telling me they plan Q1 purchases. Tier 4 companies comprise the bulk of our business, and we see them adding complete lines, and replacing and upgrading equipment.

"Customers are looking at equipment and getting proposals. It's been a very active year."

Johnson: Do you see themes in what your clients want to add? Is it more capability, capacity, or moving toward Factory 4.0 interoperability?

Pine: It has been across the board this year. A few years ago, I saw more test and inspection when their customers were making it a condition in the contract. Now, purchases seem to be about upgrading technology or increasing capacity.

Matties: What should someone be planning for when they're looking at their finances?

Pine: Since we're working with Tier 4 companies, likely it's because they see additional business opportunity out there. We always talk about diversifying funding sources. You may have a bank that will help with your accounts receivable and inventory line that you rely on to help grow your business. We step in by helping with term debt.

There are some benefits to separating financing relationships. Businesses can grow credit history with multiple funding sources, and don't overload their bank. If you're asking for a million-dollar term loan to buy an SMT line, but also asking them to increase receivable and inventory lines, you can get to a threshold where your bank becomes uncomfortable. You don't want to do that when you're trying to grow your business.

We also educate our customers on the importance of having a borrowing history. You might have $250,000 set aside for equipment purchase, but if you're always paying cash, you're not building a credit history. When you don't have any credit history it's hard to provide the lender with a level of comfort that you can pay debt back in a timely manner.

Carey: Established credit history also makes the EMS company more attractive if they are looking to sell, particularly to venture capital companies.

It's always a good idea to stay liquid. Paying cash for equipment and then deciding to refinance creates problems. It brings up red flags in the credit process. In some cases, it could create another taxable event. It probably makes sense to pay cash for small ticket items. On larger ticket purchases, paying cash could be disastrous if the economy immediately tanks. Is paying cash worth the risk?

Matties: Thank you both for taking the time to talk with us.

Pine: Thank you. SMT007

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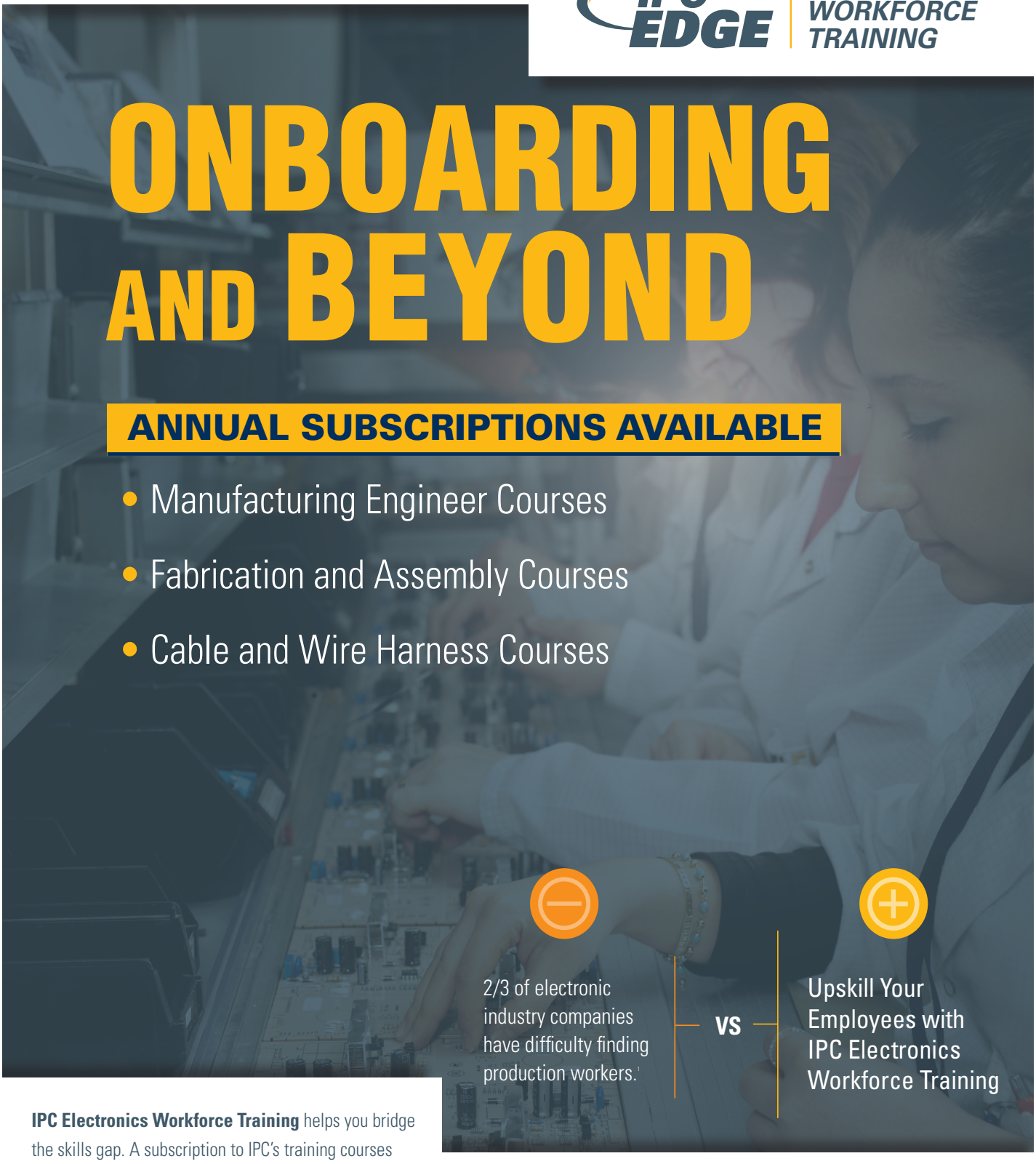

2/3 of electronic industry companies have difficulty finding production workers.[1]

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[1] IPC. (2017). Findings on the Skills Gap in U.S. Electronics Manufacturing.

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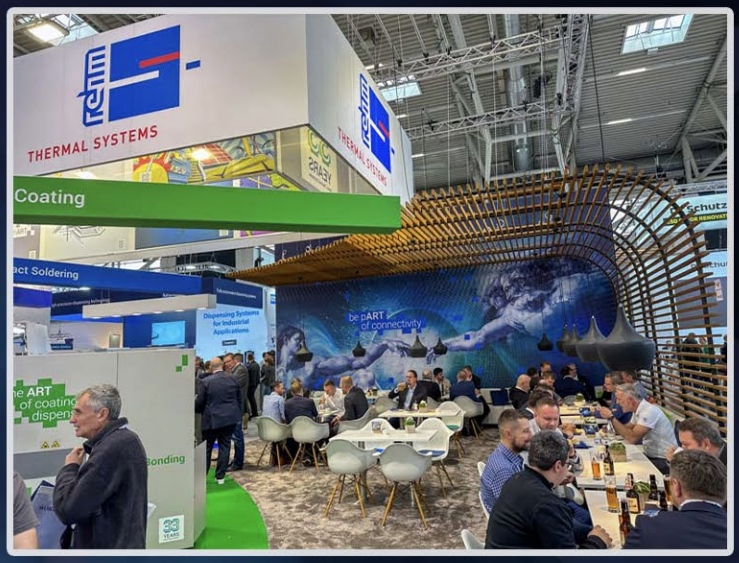

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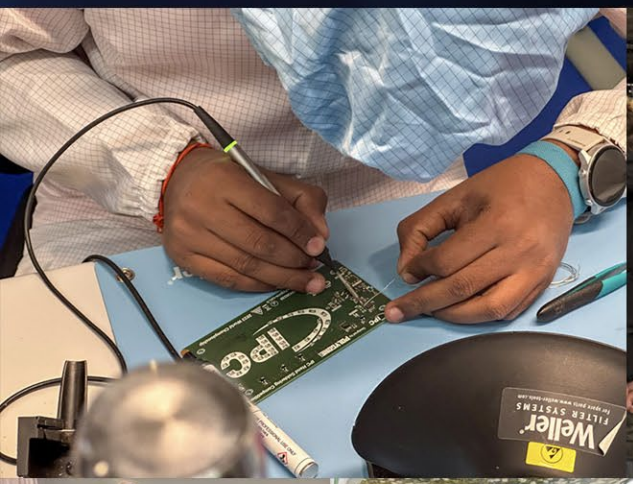
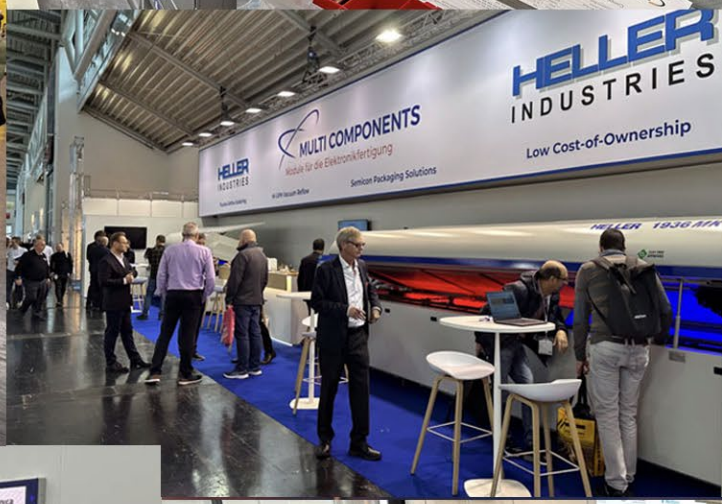




Mil/Aero Gaining Altitude and Velocity at Axiom

Feature Q&A

Rob Rowland

Oregon-based Axiom Electronics specializes in complex assembly services for aviation, mil/aero, and similar complex high-reliability sectors. Rob Rowland, director of engineering at Axiom, shares a bullish outlook for 2024 tempered by a few key concerns.

For 2024, how would you describe your economic outlook for the industry and your company's business outlook? What are you optimistic about? What are you worried about?

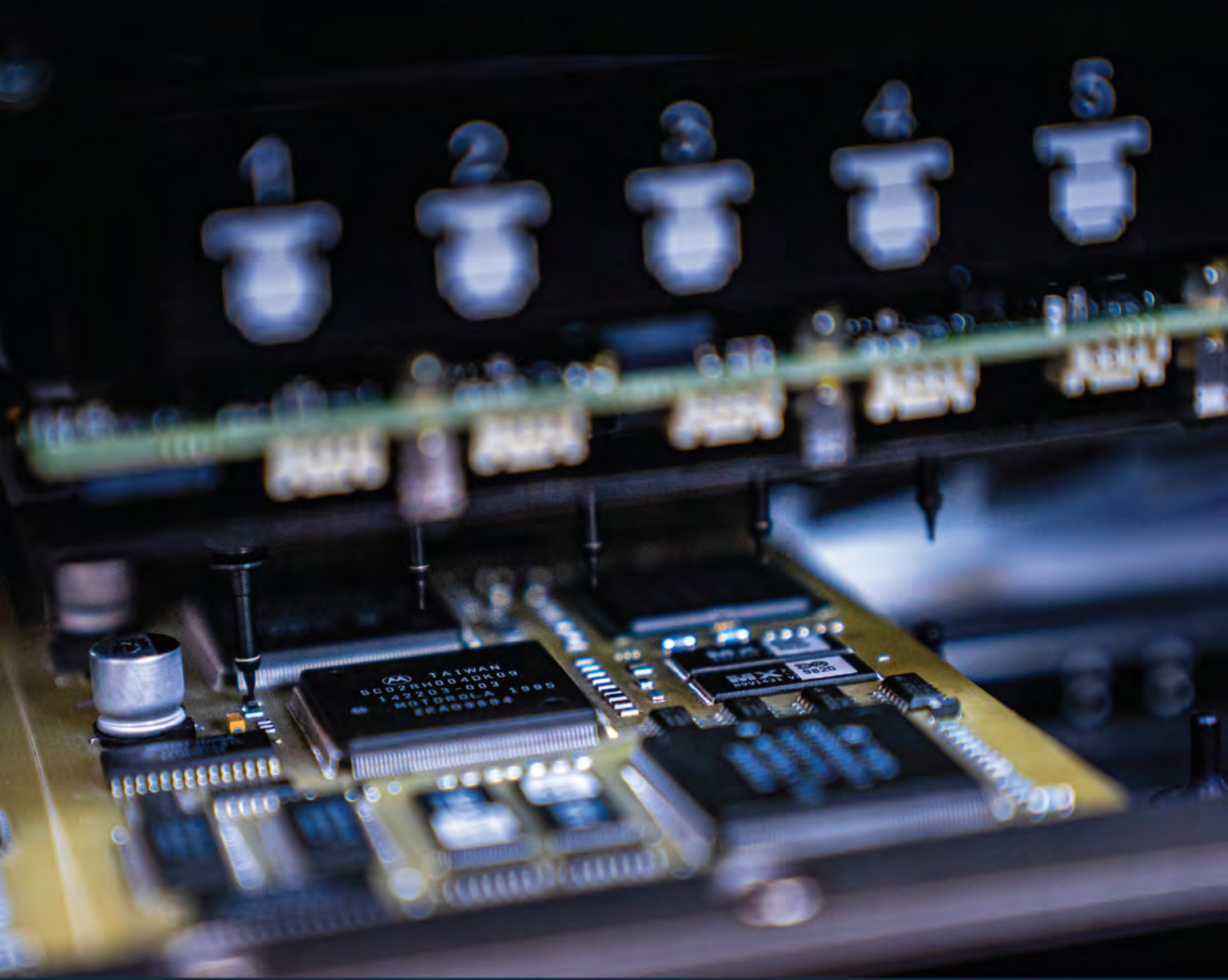
Overall, things are looking better for the electronics industry and, in general, companies are optimistic that 2024 will be a good year. The outlook for our company heading into 2024 is good. Like many companies, our business was flat during the pandemic, so we are pleased to see things heading in a positive direction. Material availability continues to be our main worry. It is better now than it was during the pandemic, but the mil/aero supply chain has not fully recovered. Inflation and interest rates are also a concern.

What's your perspective on buying capital equipment with cash vs. financing?

Managing cash is always important. With rising interest rates, financing isn't as attractive as it once was. It also depends on the cost of the equipment. For example, if it's less than $10,000 we would lean toward paying cash. If it's more than $10,000, we would lean toward financing.

Is inventory management and/or supply chain tying up capital you would otherwise use for capital investments?

Yes, inventory does tie up capital and this was an issue even before the pandemic. Some programs have component lead times of nine to 12 months, and even longer in some cases. While we are waiting for these long lead time parts, a key question is, "Do I buy the shorter lead time parts now while they are available or do I wait six months and hope they are still available when I really need them?" Of course, buying sooner ties up capital. This issue will always be a concern for some mil/aero programs with long lead times.



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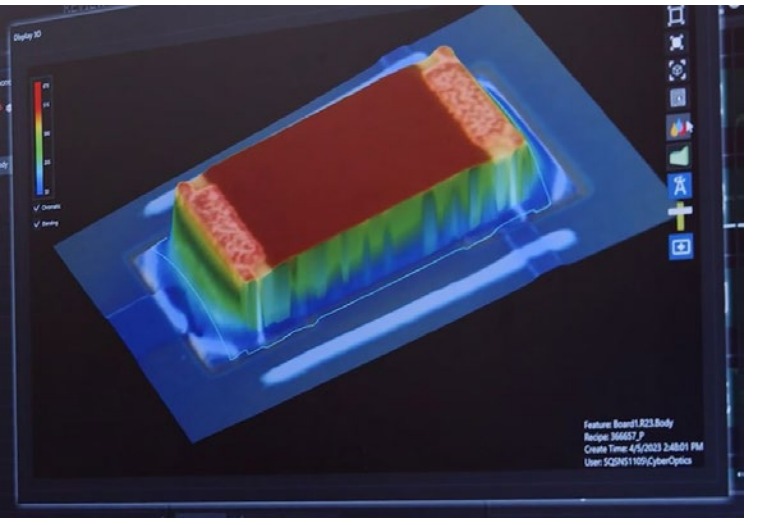


Is the CHIPS Act trickling down to you yet?

We are pleased to see more investment in component manufacturing capability/capacity in U.S. factories, but it will be a few years before it trickles down to our company. In the long run, the CHIPS Act will be a good thing for our domestic industry.

What concerns you most in your growth plans: capabilities, capacity, or competition?

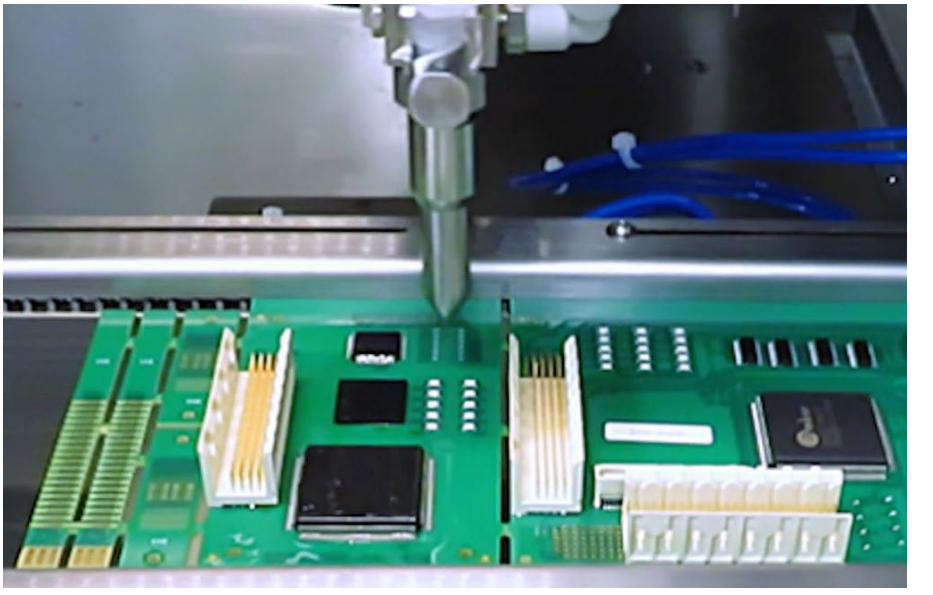
Our biggest concern for 2024 will continue to be material availability. Some of our programs use very unique components that have long lead times, so after we receive a purchase order, we may be in a holding pattern for up to a year. We continued to invest in our capability (people, ERP systems, equipment, etc.) during the pandemic so we are ready for upcoming assembly and test challenges.

How does "going green" factor into your business plan? Is it a cost of doing business or a selling point? Is this something you're investing in?

It's a cost of doing business, a selling point, and an investment in our future. There are many ways to be green and reduce our impact on the environment. For many years, we have endeavored to recycle as much as we can (paper, cardboard, etc.). We also recycle plastic packaging material (empty reels, matrix trays, bags) and solder waste (solder paste, dross). We aqueous clean all our boards after soldering so we use a lot of water. We have post treatment capability to clean the water so it's very clean when it goes down the drain.

Which process technologies hold the most opportunity for growth in the industry in 2024?

For our company, it's 3D AOI (automated optical inspection) and selective conformal coating. Last year, we invested in 3D AOI machines because they can measure solder joints and other critical factors. Most of our business requires IPC Class 3 workmanship, and in some cases the IPC Space Addendum, so the requirements are tight. Along with visual inspection, this capability enhances our ability to monitor our manufacturing processes and verify the assembled product meets the quality requirements. We invested in selective conformal coating equipment to eliminate the time-consuming task of masking boards. This will reduce our cycle time and increase our throughput. **SMT007**



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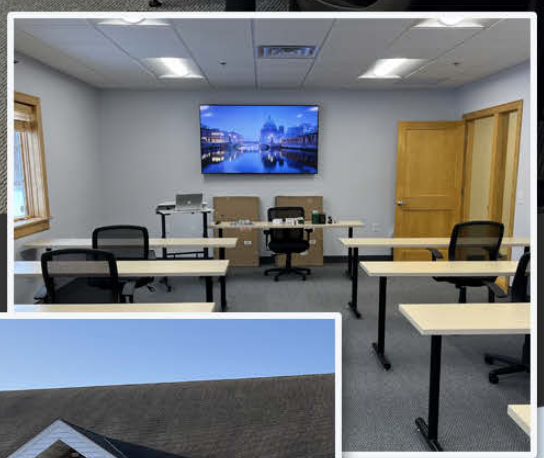

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Here and Abroad, Governments Investing in Industry

Feature Interview by Nolan Johnson
I-CONNECT007

I recently spoke with IPC's Chris Mitchell, VP of global government relations, and Rich Cappetto, senior director for North American government relations. Rich joined IPC this summer after serving as chief customer officer of the U.S. House of Representatives; he holds a master's degree in defense and strategic studies from the U.S. Naval War College.

I asked Chris and Rich to share their views on government investment in PCB manufacturing in the U.S., Europe, and Asia. They discuss how U.S. companies can tap into some of the federal and state funding, some of which remains unclaimed.

Nolan Johnson: Chris and Rich, from your roles in IPC Government Relations, I'm sure you have unique perspectives on the interrelationships between the economy and incentive legislation. What are you seeing at the moment?

Chris Mitchell: Here in the U.S., we talk mostly about the CHIPS Act, but there are initiatives underway elsewhere in the world. Earlier this year, Europe finalized its own version of the CHIPS Act. Japan is also making its own big investments in its domestic chip industry. There is fierce global competition for leadership in the semiconductor industry.

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Chris Mitchell

The question is always, "What does all of this have to do with the PCB and EMS supplier industries?" It would be great to have a more positive message to send to the industry. But right now, it's hazy at best, and perhaps not all that consequential at worst, because we're still seeing almost singular focus on the semiconductor industry with only rhetorical overtures toward supporting the wider ecosystem. That's certainly true here in the U.S. in terms of CHIPS Act implementation.

It's notable that the recent Calumet award was a DoD investment and not CHIPS Act money. Apart from some very broad statements that the Secretary of Commerce has made about support for the PCB ecosystem, we're still not seeing any real specificity about how this act will be used to catalyze a resurgence across the industry. That's a real missed opportunity because these funds could be utilized to create greater economic activity and technical capacity across the ecosystem.

In Europe, it's a somewhat similar dynamic. Europe is additionally challenged by the fact that, unlike the United States, the financing of its Chips Act is muddier. The European Chips Act meaningfully changed competition rules within the single market so that EU countries can subsidize new chip facilities within their borders. That sounds great but individual countries still need to allocate the funding, and there are interesting questions about how geographically dispersed these subsidies will be.

There's an open question about what all this means for the PCB and EMS supplier industries. If you talk to European PCB manufacturers right now, they'll say the European Chips Act had nothing to do with them. On the other hand, IPC's advocacy in Europe is having an effect. We're getting some indication that there's at least a question about whether the European Union can more effectively be leveraging the Chips Act to support more investment in both research and capital investment. We'll see in the long term whether these initiatives are good for the broader industry. Right now, there's no clear signal.

How is continental Asia responding to this new strategic build-out in the Americas and Europe?

Mitchell: Asia is making its own investments. We're seeing initiatives across many countries, including Japan and India, to name just a couple. In fact, I was just in Japan with IPC CEO John Mitchell to meet with both government and corporate leadership. What's really interesting in Japan is that you have strong leadership in terms of materials and manufacturing equipment, even as their chip fabrication industry has lagged over the past 20 years or so. They're making their own significant investments to build up capability and capacity.

So, bottom line, there is a global race to build capabilities and capacities. Each region is taking a slightly different approach given the politics and the strengths and weaknesses within those regions. We'll just have to see over time how these investments pan out and which countries make the right investments so that they can be on the cutting edge.

Rich, do you have insight into the PCB bill currently under development in the U.S. Congress?

Rich Cappetto: Yes, there are currently eight members of Congress supporting the bill in the House. In addition to the Republican primary sponsor, there are seven co-sponsors: six Democratic and one Republican. Our efforts, along with coalition partners, are focused on increasing the support for that bill and trying to even out the sponsorship to be more bipartisan, and then securing a Senate introduction of the bill as well. Passing any legislation, especially in this hyper-partisan environment, is a herculean effort. Our strategy is to get it introduced in both houses and build support. If a larger effort comes along, whether it's a tax bill or a trade bill to boost U.S. competitiveness, and we have enough support there, we'll fight to get tacked on. Basically, it's old-fashioned shoe leather advocacy, going up on the Hill to meet with as many members of Congress as possible to educate them about the topic and build their interest in the legislation.

In my conversations about the PCB bill, there is some concern about fatigue on the Hill for this kind of legislation. What other alternatives for participating with government activity should PCB suppliers be made aware of?

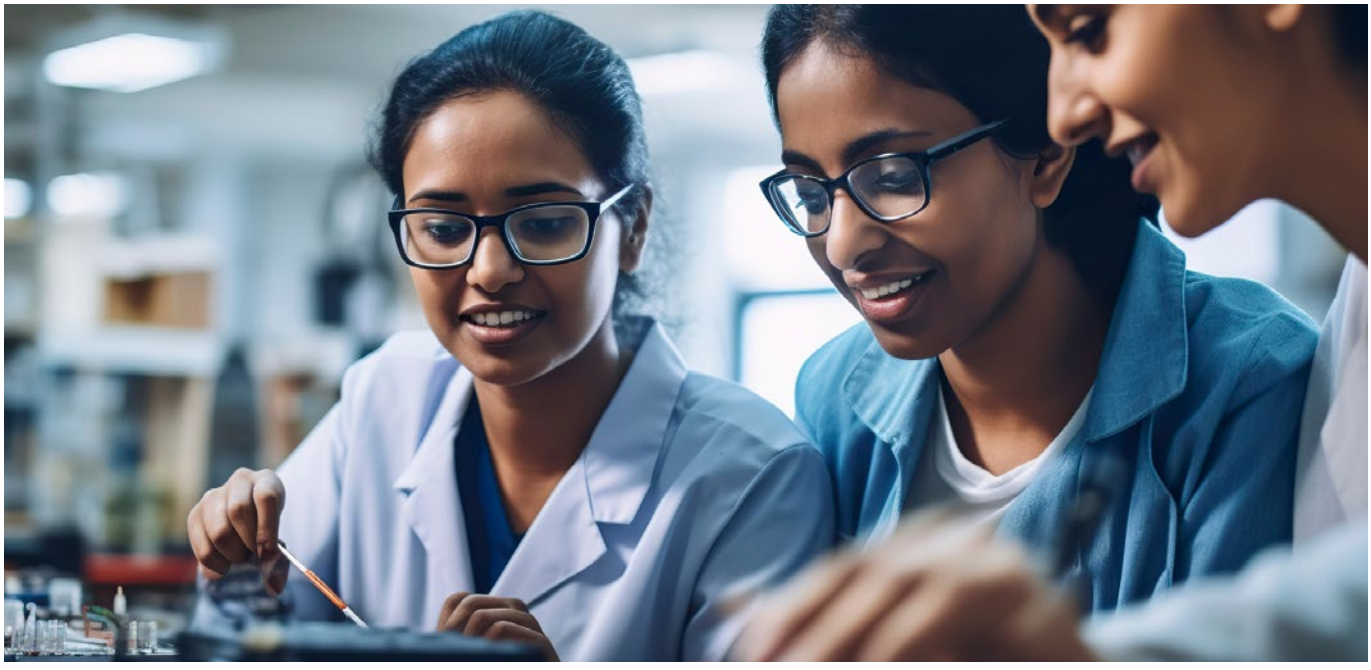
Mitchell: We see several opportunities. First, there are other opportunities within the Defense Department. Earlier this year, there was a presidential determination issued on PCBs and advanced packaging. Because the Defense Department is so acutely aware of the challenge we have in domestic sourcing of PCBs, especially PCBs for the most cutting-edge semiconductor chips, they have a real desire to address those issues. That's what leads to announcements like the recent one about DoD investment in the Calumet Electronics project.

Beyond that, we are not giving up on opportunities related to the CHIPS Act. In the end,

Rich Cappetto

you will see potential opportunities in two forms: opportunities related to the subsidy program, and a R&D strategy from NIST. On the first, we would like to see incentive grants made available for PCBs, especially those higher-end UHDI PCBs. Second, NIST will release its strategy this fall for chips R&D. That offers another potential set of opportunities for the EMS provider and PCB industries because NIST, in particular, has understood the connection between the success of the semiconductor industry and the success of the wider electronics ecosystem.

It's also a matter of looking broadly to see the opportunities where they exist. Just this week, John Mitchell was in Washington, D.C., for the signing ceremony for two new IPC apprenticeship programs that will create opportunities for companies across the country to tap federal, state, and local funding in order to support their own workforce development initiatives. Why is this important? Because we hear from companies across the country that workforce development and retention is their biggest challenge. Through better training and greater clarity around career paths, there's a



greater likelihood that individuals will choose to pursue a career in the industry. That is another path for industry to seek greater government partnership; it's more decentralized but, collectively, it could be meaningful.

Something I noticed about the Calumet news was state involvement as well, not just federal.

Mitchell: Companies need to be exploring more options, and IPC is committed to working with companies to do so. But how big is that opportunity? Obviously, the Calumet project was very forward leaning, and very much connected to the focus on the semiconductor industry. It remains to be seen whether that same kind of support can be leveraged for the broader electronics industrial base.

Referring to your comments about apprenticeship programs, though, when I talk to people with expertise in workforce development, they're reporting that a number of states had money allocated for apprenticeship programs that went unclaimed.

Mitchell: Absolutely. The money is flowing down from the federal government to the states and localities. Generally speaking, this funding is undersubscribed. With these apprenticeship programs now in place, we can better make use of that money and build our workforce. That's huge, and it will be a great contribution to the future of the industry in the United States.

Do you have any final thoughts?

Mitchell: The $52 billion CHIPS Act is focused principally on the semiconductor industry, but it has created context and space for the PCB and EMS industries to challenge government leaders to understand the breadth and strategic importance of the broader electronics manufacturing supply chain. I'm hopeful that, in the end, the CHIPS Act is not just about building mansions on stilts; if we're building the most cutting-edge semiconductor chips in the world, let's make sure that we can fabricate and place them on the PCBs. These PCBs are the foundation for electronics. That's a real challenge for the United States and elsewhere.

Chris and Rich, thank you for the insight.

Mitchell: You're welcome. **SMT007**

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Overcoming the Growth Bottleneck

Charles Capers

Feature Q&A

Charles Capers is the previous VP and general manager at Zentech Dallas and is currently working within the global quote group. He has started and managed several award-winning electronics companies during his career, which makes him well versed across multiple disciplines, including circuit board design, manufacturing, and assembly.

For 2024, how would you describe your economic outlook for the industry and your company's business outlook? What are you optimistic about? What are you worried about?

I cannot speak for the entire industry, but for the smaller EMS companies I'm in contact with, business seems to be very brisk. Our company has been extremely busy for the past several years as the demand for mil/aero has seen an increase due to tensions in the geopolitical landscape, and ongoing wars in certain regions of the world. We are optimistic about the next five to 10 years due to multiple, major program wins with some of the largest military contractors in the country. The downside is the ability to procure all the materials we need to build products in a timely manner. In some cases, we are still seeing lead times that extend beyond one year. Also, for the past couple of years, talent acquisition and retention has been a challenge.

Is inventory management and/or supply chain tying up capital you would otherwise use for capital investment?

Yes and no. EMS companies are somewhat acclimated to floating capital for 30–90 days before the end customer pays their invoices. Prior to the pandemic, this was the normal operating procedure. During the pandemic and later, we saw a shift in the willingness of customers to bear the materials cost burden to ensure uninterrupted production flow. Nowadays, customers are more willing to pay for materials in advance in order to stockpile while waiting on items that have extended lead times.

What's your perspective on buying capital equipment with cash vs. financing?

Cash is always king in my opinion, but not always a smart decision in running a company

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that requires millions of dollars in CapEx to sustain a profitable and high performing business model. With escalating interest rates, you must pick and choose where to pay cash and where to finance. ROI is always a concern when making these types of decisions. When financing or leasing equipment, you have several years to pay it off, so the ROI can be almost instantaneous, while preserving operating capital. Similar to buying a car, you can drive off the lot the same day without sacrificing the family budget.

Is the CHIPS Act trickling down to you yet?

The CHIPS Act is in its infancy and smaller companies will not feel the effect for the next five to 10 years at best. However, larger companies may be able to reap the benefits in a shorter period with government subsidies for building new factories and investing in capital equipment, as well as tax credits for hiring and expanding the workforce needed to eliminate the dependence on foreign countries to produce low-cost components and PCBs that we use in the products we build in the U.S.

What concerns you most in your growth plans: capabilities, capacity, or competition?

All three can pose a challenge to any service industry. It's like the old joke, "Fast, cheap, high-quality—pick two." For a salesperson to sell, they must possess the capabilities to even have the opportunity to bid the work. Capabilities come in several different forms, including upper management, plant and program management, engineering, customer service, and, of course, the staff doing the actual work. Capabilities can also be processes and the equipment necessary to meet the specifications of the customer. I feel it's important to look forward and plan your "capabilities roadmap" accordingly.

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capacity, you may become landlocked. Customers always question your current capacity so they can determine how much business they are willing to risk putting into your facility. You could possibly add another shift and personnel to increase capacity, but it's not always as simple as it seems.

Competition is always a concern in the EMS provider world, but it is not always based on pricing. Most customers may think that we all do the same thing the same way, but that is far from the truth. If you can differentiate yourself in capability, quality, capacity, and on-time delivery, then price could become secondary. It's always hard to convince buyers who base their decisions on price alone.

How does "going green" factor into your business plan? Is it a cost of doing business or a selling point? Is this something you're investing in?

I think going green is something that a lot of businesses are working toward these days, but there are costs involved in being environmentally responsible. We do what we can to recycle paper/boxes, stencils, solder, and paste, etc. We also look for ways to conserve or reduce energy consumption such as factory lighting and new equipment which uses less energy. Unfortunately going green is a cost of business that is hard to recover. Most customers do not consider your carbon footprint when making their buying decisions, so I don't think it is much of a selling point.

Which process technologies hold the most opportunity for growth in the industry in 2024?

If you've been around the industry long enough, you've seen a lot of changes over the decades. Automation is the one thing that is always constant. Any process on the front end or in the factory that can be enhanced with automation should be considered. Automating a factory can be time consuming and capital intensive, but in the long run, it will pay dividends. I've seen a lot of companies that either refuse to automate processes because "that's the way we've always done it," or just do not realize how much more efficient they can become.

Automation can be scary to a lot of people, but it is necessary to achieve long-term growth. **SMT007**


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The Sustainability Gold Rush

Smart Factory Insights

Feature Column by Michael Ford, AEGIS SOFTWARE

A gold rush represents an opportunistic, get-rich-quick scheme. With just one or very few potential winners in each case, most participants are left disappointed with their share, especially when compared to how much effort they put in. These scenarios are usually not thought through very well, even by the winners. When it comes to sustainability in manufacturing, I've seen a gold rush of sorts to find solutions, but the pieces are disjointed and not uniform. Sustainability needs to be a forever thing—not a race to find gold, but rather a race to work together.

The simple discovery of a gold nugget in California on Jan. 24, 1848, started a movement of pioneers, each set on getting rich the quickest. Unfortunately, in the seven years that followed, as many as a hundred thousand people may have lost their lives in their quest for the gold. Masked by hopes of success, they ignored the risks. How many of us today find that risk to be attractive in our modern business plans?

In fact, modern gold rushes happen more frequently than we might imagine. Good examples would be the rush to dominate the videotape format, Industry 4.0, cloud comput-


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ing, and blockchain. The opportunity to make money is a key driver for industry and the economy, as is the opportunity to save money. Sustainability, however, is quite an emotive subject because it brings sudden lifestyle changes into both business operations and society. We often implement urgent initiatives without fully thinking them through.

For example, finding discarded plastic bottles on beaches led to biodegradable plastics, without really considering the effects these new plastics themselves would have as they degrade. According to recent studies, we each consume a credit-card worth of plastic every week—the damage is done. The core problem has always been those who carelessly discard dangerous items, such as plastic bottles, disposable barbecues, and glass, rather than making the effort to recycle them. Everyone ends up paying a greater price due to the acts of careless individuals. Meanwhile, companies see this and meet the demand, provide solutions—and gain revenues. Unfortunately, they often just shift the problem rather than solve it, all at the customers' expense.

> "We often implement urgent initiatives without fully thinking them through."

Therefore, it is natural that companies feel powerless and frustrated with growing sustainability requirements. Demands are made on them to take responsibility, and openly collect and share data. There is a vast new level of reporting overhead to meet customer and government sustainability requirements at a time when there is no form, structure, or interoperability throughout the industry, nor even agreement on how things should be measured and presented. Groups of companies and organizations, usually within a narrow segment of their respective industries, are currently being driven to "go for gold," creating whatever solutions they can to fulfill these sudden sustainability requirements. Companies then devise countless offset schemes to provide quick wins without really considering the impact of not really changing anything. They demand a high degree of pioneer-based investment for development and adoption, followed by a high cost of ongoing ownership and connectivity, with a high risk that their solutions will fall short of customer requirements, or exceed supplier capability. Manufacturers are currently left daunted with an unbearable cost and risk.

Providers of quick-and-dirty sustainability solutions are springing up everywhere to meet immediate needs, but are these really thought through? Almost every manufactured product has a complex supply network behind it—companies of all sizes creating and supplying materials from the most critical to the least significant. They can be based anywhere in the world and support a variety of customers and industry segments simultaneously. It is very unlikely that a small group of closely related entities will come up with solutions that are scalable, secure, and acceptable for those who currently are rightly very concerned about leakage of IP as well as privacy.

Learning from hindsight is a lazy excuse for not initially thinking things through, and for setting goals that are too short-term. Let's envisage where we need to be for sustainability in a way that suits individual business needs, is interoperable with others, scalable, and sustainable. We need a mechanism for exchanging information that defines, discloses, and shares facts with shared universal definitions. They will be proofs of actions, events, measurements, results, or constituents, all exchanged in the form of signed digital certificates (credentials). There is, therefore, no need to expose

any existing internal design, manufacturing, supply network, or other restricted business data.

This is the subject of IPC's new sustainability standard. It's the ability to automatically create declarations that satisfy all matters related to sustainability, as well as provenance, supply-network trust, traceability, and cybersecurity. It's all included in one mechanism and fueled by the data that is already a part of the Smart manufacturing software we use today.

The best modern MES solutions, utilizing the IPC Connected Factory Exchange (CFX) standard, for example, are already capable of recording energy usage at any point in the factory. When this is combined with exact material traceability, enough information is available to enable the automated accumulation of material sustainability credentials against products, including all materials and manufacturing conditions. Manufacturing data in the digital domain is flexible enough to be formatted into whatever sustainability reports are required. Automating the required reporting and proof of conformance comes, therefore, with very little additional cost to the manufacturing operation. Substantial benefits are made in parallel as reduced wasted energy consumption helps reduce manufacturing costs significantly.

The greatest challenges and opportunities for manufacturing today involve sustainability. Having a pragmatic approach using existing tools in a collaborative, sustainable, standards-based ecosystem, in which an open market of sustainability credential solutions are appropriate to the scale of the manufacturing company, sector and material type, make them "plug and play."

The idea for a "sustainability gold rush" may sound very exciting, until you realize it is your gold that companies are after. Better to think first and avoid the risk and waste of poorly thought-out solutions with limited scope. Please contact me or IPC if you are interested in understanding more about the collective approach. **SMT007**

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

Cascade Systems Technology: The Confluence of Assembly and Advocacy

Shantanu R. Gupta

Feature Q&A

Shantanu Gupta is president and CEO of Oregon-based Cascade Systems Technology, a contract manufacturer specializing in volume assembly, box build, and testing services. Shantanu was part of Oregon's Semiconductor Task Force and testified on numerous occasions with the Oregon Legislature to help maximize Oregon's benefit from CHIPS Act funding.

For 2024, how would you describe your economic outlook for the industry and your company's business outlook? What are you optimistic about? What are you worried about?

Shantanu Gupta: In 2023, some of our largest customers were impacted by economic downturns or labor strikes that impacted their needs for our services. We saw the end of those issues in late Q4 this year and discussions about new projects are beginning. Additionally, volume opportunities we have worked on with our customers through prototyping and validation stages over the past several years will be going into production next year. For these reasons, our business outlook for 2024 is incredibly positive. We are optimistic that the growth of our existing customers will be strong, while winning new, large customers also looks to be a strong possibility. The combination of manufacturing onshoring with growing demand for semiconductor-based products will drive a strong demand for EMS companies like CST. Our biggest worry is the geo-political environment and the impact it may have on the semiconductor industry next year.

What concerns you most in your growth plans: capabilities, capacity, or competition? Why?

Our biggest concern for future growth is finding new employees who are qualified and want to work in the manufacturing services sector. As we know, all industries are having trouble

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finding qualified candidates to fill open positions. A significant percentage of our employee pool today has 25-year or greater tenure and that experience is hard to replace when they eventually retire.

Cascade has recently had success with a high school intern program, and we hope to expand this program for additional new employees. We also regularly host high school and community college-level student visits to our factory to encourage interest in the EMS provider industry. Finally, Cascade has participated in several collaborations with our local chamber of commerce, as well as with city, county, and state government officials and other technology companies in our local area on programs that attract qualified workers to increase the available engineering talent pool in our local area. We see this as helping to overcome the biggest hurdle in our growth plans.

President and CEO Shantanu Gupta remains active at the state and local level to emphasize the need to foster the semiconductor-related supply chain. Shantanu was part of Oregon's Semiconductor Task Force in response to the CHIPS Act.

What's your perspective on buying capital equipment with cash vs. financing?

We prefer to invest in new equipment using capital equipment loans to keep the cash freed up for working capital. We believe this is the right philosophy for an engineering services business that typically can have peaks and valleys in revenue. We are careful to continually invest in new equipment where we have a guaranteed payback in increased efficiency and production capacity.

Is inventory management and/or supply chain tying up capital you would otherwise use for capital investments?

We view them separately in some sense. Inventory management is done using our working capital. Capital investment comes from either our savings or from equipment loans. In cases where inventory gets tied up for months due to various delays, that does impact our working capital, and we must manage through it. Also, not all projects tie up inventory as some customers request fully kitted assemblies where they provide all the parts.

Is the CHIPS Act trickling down to you yet?

No, unfortunately, but Cascade has been advocating for government incentives in the form of an R&D tax credit to revitalize the full U.S.-based technology process, not just IC development by itself. Keeping our leading-edge silicon technology within the U.S. is important, but to be competitive, chips need assembled PCBs, power supplies, cooling, box build enclosures, and software from U.S. companies.

A silicon chip cannot function without the tens, if not hundreds, of components around it, the circuit board beneath it, or the software stack that runs it. Semiconductor companies, too, cannot exist in a vacuum and must rely on an entire technology ecosystem.

So, in addition to supporting the federal government's efforts to reinvest aggressively in American semiconductor companies offering

substantial strategic incentives to U.S.-based chip makers like Intel, Qualcomm, Broadcom, and Micron, Cascade Systems vigorously supports enactment of a 2% R&D tax credit here in Oregon for all semiconductor-related manufacturing companies.

This modest incentive, an investment in Oregon's future, will go far toward encouraging innovation among many of Oregon's small- and mid-sized tech companies that enable and support silicon companies. (The ripple effect of that investment goes without saying.) It will also help ensure that tech jobs associated with the resulting innovation stay here in the U.S., just as the CHIPS Act is intended to promote rebuilding stateside chip manufacturing infrastructure.

Which process technologies hold the most opportunity for growth in the industry in 2024?

We are excited to see growth in our customer base in clean technology as we have delivered several projects for customers in this area. EV charging, battery storage, and solar and wind power companies all have needs for our services, and we are making it a focus area in our efforts. Many of our customers are based on the West Coast and we feel the Clean Tech sector has tremendous business potential for Cascade Systems Technology in 2024.

How does "going green" factor into your business plan? Is it a cost of doing business or a selling point? Is this something you're investing in?

Cascade Systems is a RoHS-compliant company, and our standard is to use lead-free solder during our manufacturing process. Cascade believes in being as green as possible in our business operations and have an extensive recycling program in place. We do not see it as a selling point, but rather an expectation from our customers to continually minimize impact on the environment. **SMT007**

Cascade Systems specializes in PCB assembly for volume production and NPI, custom microelectronics manufacturing, box builds, and testing services.

MilAero007 Highlights

BAE Systems to Develop Custom Microelectronics for Next-generation Radar, Electronic Warfare, and Communication Applications ▸

The Office of Naval Research (ONR) has awarded BAE Systems' FAST Labs research and development organization a $5 million contract for the COALESCE (Common-architecture Amplifier for Low-cost, Efficient, SWaP-Constrained Environments) program. BAE program's objective is to develop the world's highest efficiency high power amplifier module in its frequency band.

Terran Orbital Releases Enhanced Versions of Enterprise Bus ▸

Terran Orbital Corporation, a global leader in satellite-based solutions primarily serving the aerospace and defense industries, announced two additional configurations of its largest platform offered in the standard product line the Company initially announced in September: Enterprise. The Enterprise-class bus is the point of departure for flat packing requirements carrying up to 24 satellites per launch.

Viasat Deutsche Telekom Commit Long-Term to Deliver Inflight Connectivity ▸

Viasat, Deutsche Telekom Commit Long-term to Deliver Inflight Connectivity via the European Aviation Network, announced a new, long-term agreement that cements the companies' commitment to providing in-flight connectivity (IFC) solutions to airline partners across the European Aviation Network (EAN). EAN allows travelers in Europe to benefit from broadband services that support high bandwidth-demanding applications such as streaming.

Early Production Continues on Advanced Upper Stage for NASA Moon Rocket ▸

Technicians at NASA's Michoud Assembly Facility in New Orleans have completed a major portion of a weld confidence article for the advanced upper stage of NASA's SLS (Space Launch System) rocket. The hardware was rotated to a horizontal position and moved to another part of the facility Oct. 24.

Aalyria to Study Ultra-High-Speed Earth-Aircraft Optical Communication ▸

This collaborative study launched with Airbus aims to achieve two distinct objectives: to advance air-to-ground and air-to-air free-space optical communications technologies to improve their compatibility with terrestrial fiber networks, and to develop network traffic engineering and orchestration techniques to meet the needs of future air- and spaceborne networks.

CACI Awarded NASA Contract for Human Spaceflight Systems, Simulation and Software Technology III ▸

CACI International Inc has been awarded a four-year single-award, indefinite delivery indefinite quantity expertise contract worth up to $150 million to continue its support of spaceflight systems, simulation, and software for NASA Johnson Space Center (JSC). The program provides advanced aerospace engineering for crewed spacecraft systems, development of simulation and Virtual Reality (VR) applications, and software in support of human space flight. This award builds on more than three decades of CACI's dedicated support for JSC's mission.

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The Pivotal Role of Optimization

The Knowledge Base

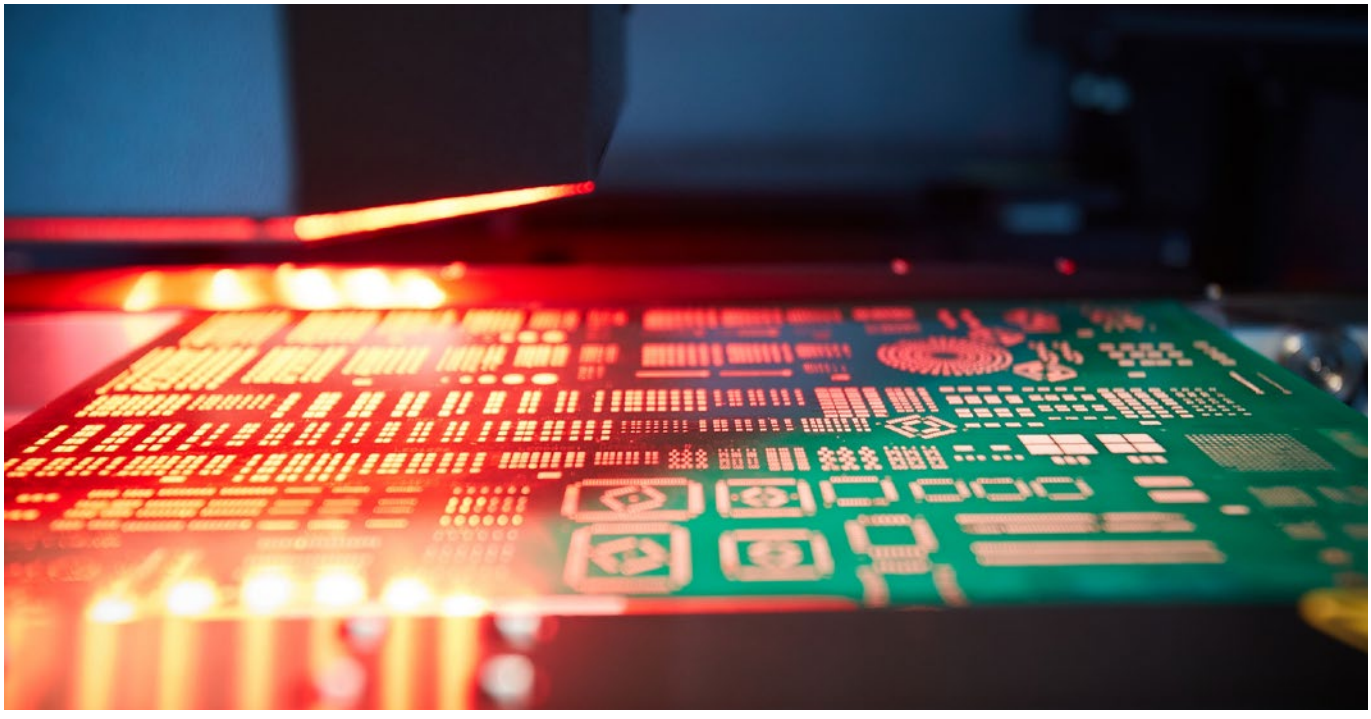
by Mike Konrad, SMTA

In the fast-paced realm of electronics production, where innovation is relentless and competition is fierce, the pursuit of optimization and efficiency has become the cornerstone of success. As technology evolves at an unprecedented pace, manufacturers face the dual challenge of meeting increasing demands while maintaining high quality standards. This month, I delve into the intricate landscape of electronics production and explore the pivotal role that optimization plays in driving efficiency across the entire manufacturing process.

I invited Patrick Stimpert, vice president of operations at Matric Group, to share his view on, and experience with, optimization and efficiency within the electronics manufacturing space. We navigate through the complexities of optimizing supply chain management, enhancing production workflows, and implementing cutting-edge technologies to minimize waste and maximize output.

Can you describe your experience with electronics assembly processes, including any specific projects or achievements related to process optimization?

Patrick Stimpert: I have been directly involved in the electronics industry for 10-plus years, from the conceptual design phase to manufac-



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turing, go-to-market strategy, and delivering finished products to the customer. I've learned that the electronics industry is widely diverse and evolving at a lightning-fast pace. How fast is that change? In the time it takes to declare that a process or design is perfect, the industry has already moved past you. The industry can have long days that spill into quick weeks and create very short years, so why would a person want to be part of this? Because it's short-fused problem-solving with creative, intelligent people who only need to be pointed toward success.

One day, you may find yourself at a lunch, sitting across from C-suite executives at one of the world's largest transportation manufacturers and they need a problem solved. As they explain the issue, the scheduling department is giving you a few text messages to update and expedite one of the channels of the products you offer. Because you have the team focused on the importance of the voice of the customer, they can expedite it through the shop, change the BOM, update the router, reset the controls package, and even powder-coat the assembly to the customer's needs. By the time lunch with the customer ends, your team enters the room and tells the customer about the performance of the sample they just produced for them.

When that happened to me, it was the moment I knew I could effectively vertically stack flexible manufacturing, leaving room to inspire creative problem-solving for the customer.

What methods and tools do you typically use to analyze and identify inefficiencies in an assembly process?

My fundamentals are based on the Toyota Production System, grounded in a realistic understanding that results matter, and everyone reports to the P&L. I have always embraced process guardrails in safety, quality, and reliability operations. All three need layered checks and balances, with Gemba[1] visual management boards in each department or critical process step. Accountability at all levels starts with the "Up and to the Right" program that each integral operator or leader completes daily. The daily emails tell the good, bad, and ugly to all key stakeholders. The magic is that everyone knows that the program only remains credible if you do something with what you learned. This is the foundation of opportunities for improvement (OFI), or rapid improvement program (RIP), a tremendous continuous improvement program. The next steps are the weekly, monthly, quarterly, and yearly KPIs used to track our fundamentals. The most important parts of this process are the daily stand-ups and GEMBA walks. Remember, the associates are always watching and taking note of your actions or, worse, remembering the non-action.

Patrick Stimpert

Could you provide an example of a situation where you successfully improved the efficiency of an electronics assembly process? What specific steps did you take and what were the results?

Five years ago, we set a goal to improve SMT line yields to improve throughput. This project started with not accepting the industry

standards which said that for parts placed per hour in a contract manufacturer with a high mix, low volume, 19–21% overall line up-time is excellent. Do you realize that's like the Mendoza Line in baseball where you get sent back to the minors?

We identified vital waste problems that needed a fix: line change-over time, line stall time, parts reel change validation, human intervention, exception calls requiring validation after the final AOI, and standardizing all go/no-go calls the same across all AOIs. Let me describe these in more detail.

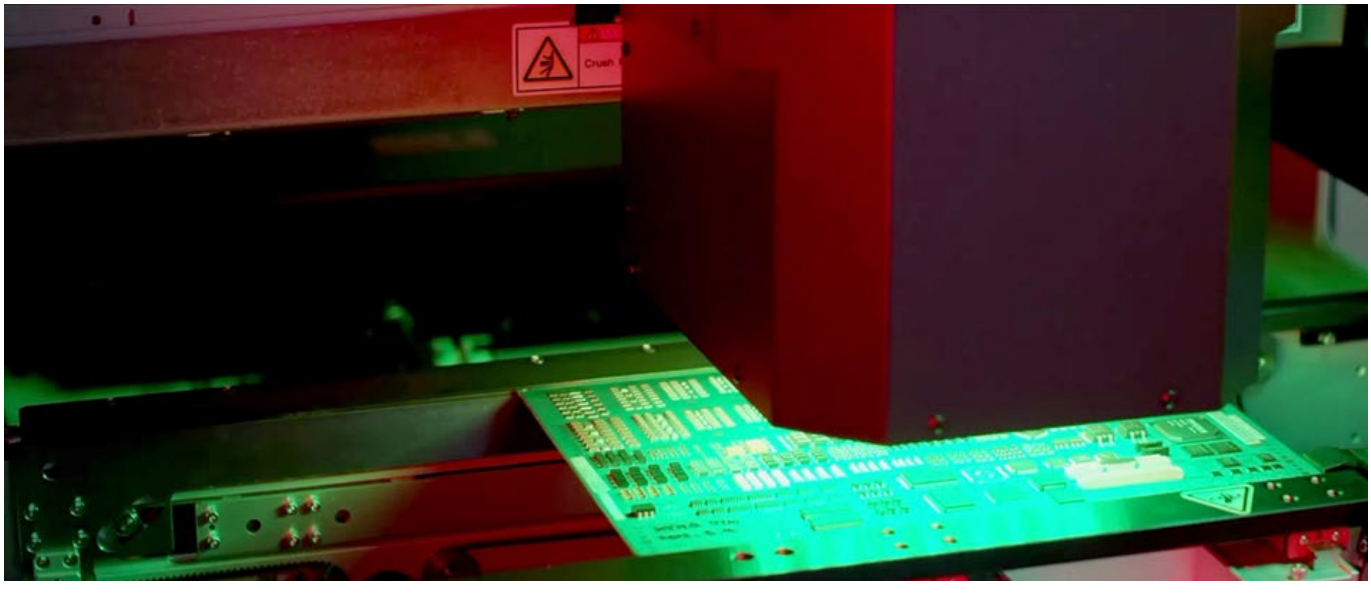
Line change-over time: Do you have the correct pit crew to win the race? The industry is first coming to grips that high mix can be overcome with family set-ups to maximize feeder positions, a screen print that could host several screens that will conduct an auto change-over to the new screen with the new job, so now we have a 4.0 standard started to make line changes automatically up and down the line.

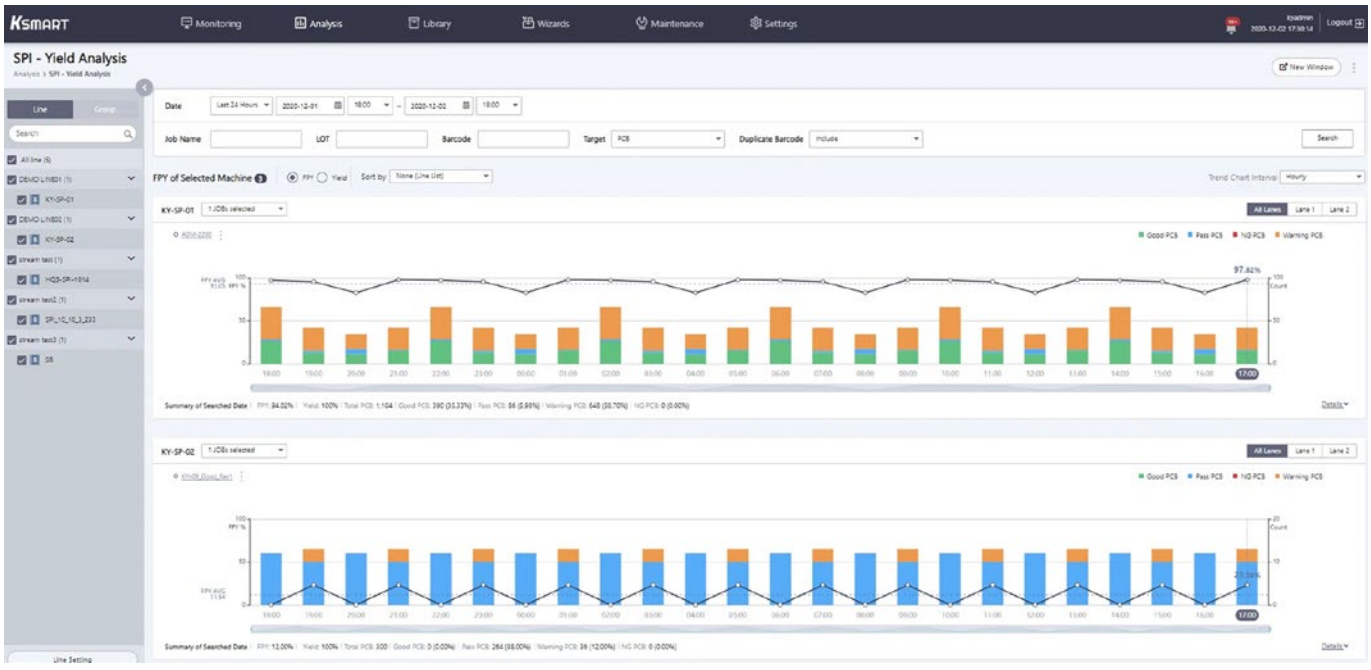
Line stall time: Someone needs to coin a catchphrase for this one. You can't achieve a placement time percentage if every occasional fault stops the line. After each optical inspection, we installed inline stackers to push the fault to the side and keep the line moving.

Parts reel change validation: Humans make mistakes. We have installed pre-flow AOI to check rotations and 100% compliant placements. This was a simple ROI measure of your rework on double-sided high, populated small-size parts when you apply an iron to fix something. I can wipe a board, reclaim the expensive parts, and re-run it cheaper than the rework adventure.

Human interventions: The new package sizes leave little room for errors, and the operators/process technicians always modify programs with good intentions, but the programs have very open-ended subjective inspection parameters. Here's a good example: A 1% contrast adjustment on a standard X-ray camera can swing the voiding scale more than 10%. Sleep well, quality engineers, now that you know.

Exception calls: These are the calls that the AOI has been programmed to ignore or bypass because the AOI and 3D camera remodeling can't produce a predictably correct result. In these situations, the industry does one of two things: Whistle through the graveyard and give it a false call pass or flag the PCB as a failure to have a manual visual conducted offline; when that's done, you need to run it through a final go validation.





KSMART Screenshot Spy Yield analysis.

We decided to partner with Koh Young and have them stop the PCB before the post-AOI to inspect and capture the validation of the exception in the Koh Young database. Now, a post-AOI good call needs nothing else but to have the job moved on to the next manufacturing step. Go/no-go makes the calls the same across all AOIs. I joke that something is wrong if you have a chair in front of an AOI. To fix this problem, we deployed KSMART Solutions. We now have one person monitor all 15 AOIs in the war room, and they make all the calls. If it needs further review, an alert is sent out to the process technician or QA to expedite the call.

How do you approach balancing the need for process efficiency with the requirement for maintaining high-quality standards in electronics assembly?

Ask these two questions often: "Why?" and "Does this process add value that we get paid for?" A good rule is to never be confused for a nonprofit. Process efficiencies always start with fundamentals; this should be monitored with any safety-associated costs recognized or, worse, the unrecognized hidden costs.

Quality (QMS) is next, with a foundation that uses the voice of the customer program or, as we call it, "escapes." Listen to what the CAR and SCAR tell you; this should match the MRR logs used by production.

New production review (NPR) should demand engineering design for full-functional testing that includes sign-of-life testing and uses this testing to produce a COC that reduces in-field risk. The third and final approach is reliability. The guardrail here: If safety or quality is not world-class, why talk about going faster? The cost of rework always outweighs the increase in speed. I always turn the reliability conversation into this: Hold up your promise to internal and external customers; we will maintain margin if we are safe, build with excellent quality, and keep our promises.

In your opinion, what are the most common challenges in optimizing electronics assembly processes, and how do you address them?

Waste is the most common challenge. My favorite rule in manufacturing is, "Stop rearranging deck chairs on the Titanic. Just fix the problem." How do you stop this from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happening and focus your team? The first question in every meeting should be, "What problem are we here to solve?" The second is, "What do we know about this problem?" Stop the meeting if you don't have a problem to solve, and politely ask people to leave if they can't add value to the discussion. Optimization requires risk from leadership and overcoming fear of the unknown of changes. It's faster to make 100 small changes than one significant, preplanned change. Why? It's the upfront emotional investment and pride. You must be willing to try and fail, but fail quickly and cheaply, adjust, and try again. That's how humans learn.

Have you worked with automated equipment or robotics in electronics assembly? If so, can you share your experience and any successful implementations?

One of the first undertakings here at Matric Group was to solve the challenge of speeding up component handling accurately and efficiently for the surface mount technology (SMT) placement lines. The overall handling is simple: fulfilling the BOM that is typically 250–300 different components on 10 to 15 changeovers a day on time and accurately. The complexity comes from equipment for medical, aerospace, and others to have complete lot tracking and moisture controls on components.

> **"Optimization requires risk from leadership and overcoming fear of the unknown of changes."**

At Matric Group, those requirements have a combination of 3,750 reels, trays, tubes, and strips being picked and set up daily; 3,700 more staged in front on the SMT lines or actively consumed; and the final 3,750 are being actively removed from the equipment with remaining quantiles being a stock return. If the CFO is reading this and feeling uneasy, it is because there are 5.6 million components hanging out in the work-in-process. Solution: We partnered with Juki Storage Systems as well as Nordson's Assure X-ray counter to meet our requirements, which are also seamlessly expandable. This project reduced labor by 85%, and we completed the ROI in less than one year.

What strategies do you employ to ensure the timely availability of components and materials for the assembly line, reducing downtime and production delays?

The onset of COVID and the two-year international supply chain disaster have realigned my vision and the practicability of just-in-time inventory. The "ready" and "set" seem way more important than the "go." One of the biggest misleading statements is "all parts here" (APH). This doesn't mean you can release and build.

Every ERP system has known programming faults that can hold up the job release. I have always deployed visual management boards to overcome the trapdoors and create a robust material review program (MRP) with one standard rule: No one gets to just come to the meeting and report the news. The program must require all bottlenecks to be solved by the key shareholders in each department. The weekly meeting needs to be with customer service, sales, scheduling, QA, manufacturing engineers, and top-level leadership. The second lesson learned in the last three years is to control your destiny. Internal and external sourcing are preferable to dual external sourcing, but both are better than external single sourcing.

How do you assess and minimize defects or errors in the assembly process, and what tools or methodologies do you use for quality control?

Most importantly, in any manufacturing process, set and enforce a culture that, "No one is allowed to pass on bad quality." To improve our first-pass yield and final yield, we needed to slow down and have proper gates and guardrails. It seems counterproductive to make a margin, but the alternative is rework.

The speed of today's technology can produce two things: a large amount of high-quality electronics or a quickly produced "rework mountain." Our learned lesson came from having to buy more racks to stack up the avoidable margin erosion. To solve this problem, a safety gate was created for first-piece inspections with AOIs, X-ray, and flying probe inspections. Yes, we run the first few PCBs to get to the golden board condition before we release the complete run. We also repeat this process between shifts. We found that we can outperform standards for the entire build by getting to and maintaining a 99.95% or higher SMT yield.

> "Individual ownership of the process ignites enthusiasm, which is contagious in a manufacturing building.

Can you discuss any experience you have with Lean manufacturing principles or continuous improvement methodologies in the context of electronics assembly optimization?

Individual ownership of the process ignites enthusiasm, which is contagious in a manufacturing building. We use our GEMBA daily meetings for feedback and encourage using our suggestion ECM (engineering change management) program. We found that when an associate has easy access to documents and tracks the progress of their suggestions, it sets in motion a robust continuous improvement program that maintains its momentum. The recommendations ECM submits are reviewed by the manufacturing engineers, who are also responsible for giving feedback to the associates.

How do you stay up to date with advancements in electronics assembly technology and manufacturing best practices? Can you give an example of how you have applied this knowledge to improve an assembly process?

The Toyota Production System has a core fundamental: learn by sharing ideals. My lesson learned is to listen before you speak. The amount of free educational opportunistic training is overwhelming right now. The quality of podcasts and interviews with my peers is a mountain of treasures. Take the time each week to learn something and encourage learning in your company uncomplicatedly. Ask your leaders each Friday in a group: This week, what went right, what went wrong, and what did you learn? Manufacturing needs levity; today's problem is not tomorrow's problem, and people need to vent and mostly have fun. **SMT007**

References

1. Gemba is a Japanese word meaning "the actual place." In Lean practices, it refers to the place where value is created. In manufacturing, for example, Gemba is the factory floor.

Mike Konrad is founder and CEO of Aqueous Technologies, and vice president of communications for SMTA. To read past columns, click here.

Lightspeed Manufacturing Sees Company Growth in Industry Consolidation

Feature Q&A

Lightspeed Manufacturing is a Massachusetts-based contract manufacturer specializing in production, prototyping, and repair services. Rich Breault, Lightspeed chief executive officer, shared his outlook from the northeast United States.

For 2024, how would you describe your economic outlook for the industry and your company's business outlook? What are you optimistic about? What are you worried about?

Rich Breault: I see the outlook for the EMS provider business as very positive for the upcoming several years. I can especially speak about the EMS in the U.S. Northeast region. There has been much consolidation and M&A activity in the last couple of years. There is currently just a fraction of providers compared to five years ago. Most of the larger Tier 1 suppliers have left the territory, and many of the small providers have not continued to make the investment in new capital equipment and advanced process. As such, at Lightspeed we expect to see a minimum 50% sales growth in 2024.

Rich Breault

What's your perspective on buying capital equipment with cash vs. financing?

We recently invested in a top MRP system and materials team. We believe this is a significant and critical investment needed for the future of Lightspeed. It has already started to give us much more insight into how we purchase and inventory the material. We have dramatically increased material turns and reduced inventory values, helping to improve cash flow. We do not have any long-term debt on our balance sheet, which is critical to maintaining a strong financial future.

Is inventory management and/or supply chain tying up capital you would otherwise use for capital investments?

We have always liked to purchase capital equipment with cash compared to financing. With interest rates rising, we are trying to continue

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down this path. We add a new piece of capital on a very regular basis, and we work closely with key suppliers to ensure value. In coordination with our sales growth projections, we are budgeting for our largest capital investment in 2024.

Is the CHIPS Act trickling down to you yet?

The CHIPS Act has not had any impact on our company yet. There seems to be a lot of talk and discussion, but nothing concrete.

What concerns you most in your growth plans: capabilities, capacity, or competition? Why?

We are very excited about our growth and future. With the current consolidation and recent shake-up in the local marketplace, we have seen a very significant increase in new customers. This has also caused issues for some of the local manufacturers, so there are many very talented and experienced employees looking to make a change to a fun and growing company. We have been fortunate to hire more very experienced employees in the past several months than during our previous 20 years in business.

How does "going green" factor into your business plan? Is it a cost of doing business or a selling point? Is this something you're investing in?

As a company we always want to do our part to be as "green" as possible. We run a very clean and safe facility. It has not really affected us.

Which process technologies hold the most opportunity for growth in the industry in 2024?

We see several areas for growth and opportunity. The aerospace and defense markets, I believe, will see a significant increase over the next couple of years. With some of the current geopolitical turmoil, we have already seen increased orders and forecasts. We are also very engaged in the start up/emerging technology markets. Many of these emerging companies we are working with and developing alongside; they are poised for very rapid growth and implementation. **SMT007**

Forecasting the Wind

By Shawn DuBravac

In the enchanting world of Shakespeare's plays, prophecies often set the stage for unforeseen twists and turns. Just as Macbeth could not have anticipated the tumultuous journey that lay ahead after encountering the three witches, the financial markets and policymakers find themselves in a similarly uncertain terrain.

Take prices, which rose sharply in 2022. The Federal Reserve was slow to respond. Although the rate of inflation has declined since reaching its zenith last year, it continues to exceed the Federal Reserve's 2% inflation goal. "Higher for longer" is likely the mantra for interest rates. This prolonged period of higher interest rates will have a ripple effect on various sectors of the economy.

A Historic Battle with Inflation

For the past 18 months, the Federal Reserve has been battling historically high inflation with annual inflation peaking in June 2022 at 8.9%. Core price inflation, which excludes volatile categories like energy and food, peaked a few months later in September 2022 at 6.6%. Both measures remain high. Annual inflation is still running at 3.3% and core prices are 4.7% higher than they were a year ago.

This article originally appeared in the fall 2023 issue of *IPC Community.* To read Shawn's three ways that higher interest rates are likely to impact the economy in the coming year, click here.

Problems solved!

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It's Just One of Those Days

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.

Professor Patty was a little early for her flight home from SMTAI, so she sat in the waiting area by her gate. She was glad the Hal Lindsey episode was over. It should not have bothered her that he called her "Professor Fatty," considering the source. But it did bother her, and she was even more embarrassed that when she had told her husband Rob about the incident, she burst into tears. That was the first time since she had met Rob that she got teary eyed around him. She asked him not to tell anyone about what Hal said or that she had cried about it. Anyway, since then she had lost nine pounds... only eight more to go.

SMTAI was a great show, and she learned a lot listening to the technical papers. She also was able to congratulate Hongwen Zhang on receiving his well-deserved Member of Technical Distinction Award.

Her laptop's battery was quite low, and she was relieved to find a plug under the seat. But when she plugged it in, it fell out of the recep-

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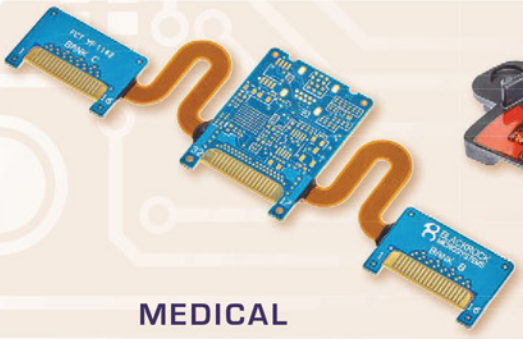

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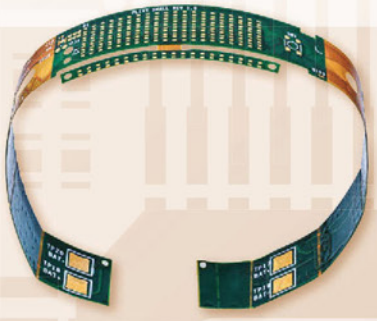

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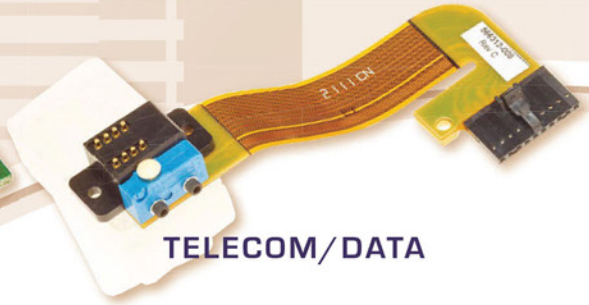

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tacle, so she moved to another seat. The plug stayed in this time but there was no electricity. She tried a third plug to no avail. Finally, a fellow passenger saw her plight and offered to share the only receptacle that appeared to be working.

Patty was starved, so she checked on the airline's website and saw they had tasty sandwiches she could purchase on the plane. With that in mind, she continued working and before she knew it, it was time to board. The plane had internet, power plugs, and a good meal. She would be set.

Patty was one of the first to board. After settling into her seat, she plugged her laptop in, and knew she would have about 15 minutes to work on a paper she was writing before the plane taxied to the runway. However, her battery was still low and there was no power coming from the airplane's power plug. She mentioned it to the person seated next to her, who commented that the power plugs might not have power until after takeoff.

So, she got out her phone and sent some texts to Rob and their twin sons. Soon the plane took off, and after a few moments, the pilot announced that it was okay to use laptops.

"See, as soon as we get the 'okay' sign to use our laptops, the power plug came on," her seatmate said, who then introduced himself as John Archer.

"Patty Coleman," Patty responded, and shook his hand slightly awkwardly as the seats are so close together.

She then turned back to her laptop and realized that despite having her cord plugged in, the machine was still getting no power. She pushed the call button, and when the flight attendant came over, Patty expressed that her power plug wasn't working.

"Mercy, they haven't fixed that yet," the cheerful flight attendant said in a warm, sympathetic way. Despite her kind response, Patty grimaced at the words.

John then said in his own sympathetic way, "I'm sorry, but I am out of power too, and I have to get this report finished soon and send over the plane's internet or I'm toast. So, I can't let you use my power plug."

Patty felt the frustration rise again in her face. So, she decided to put the paper aside and continue reading Walter Isaacson's Elon Musk on her smartphone until they brought the food out.

"Oh, no," John shouted. "The internet doesn't work."

Discussions again with the sympathetic flight attendant confirmed that the internet would not be working for the entire flight.

Discussions again with the sympathetic flight attendant confirmed that the internet would not be working for the entire flight.

"Well, at least the food is coming out," Patty thought to herself as she saw the flight attendants moving the food carts into the aisle. Patty thought she might faint if she didn't eat soon.

"I'll take the ham salad sandwich, some potato chips, and an oatmeal raisin cookie," Patty told the same flight attendant.

"That will be $14," the flight attendant replied as Patty handed her a credit card. Can you believe what the flight attendant said next?

"I'm sorry honey, we only take payment through our app," she told Patty, who at that point was just about to burst into tears. She didn't have the app and she knew she couldn't load it on her phone because there was no internet.

John, who had been sitting in the middle of this exchange, spoke up. "I'll have the same thing she's having and charge both of ours to my app," he remarked to the flight attendant,

What are Elon Musk's "The Algorithm" and the "Idiot Index?" Could implementing them into your facility revolutionize your costs and productivity?

then looked at Patty and said, "By the time you finish your lunch, I will be done with my report. You are welcome to use my power port then."

Patty thanked John and held her composure, but a careful observer would notice a single tear streaming down her face.

Patty couldn't remember enjoying a lunch so much. True to his word, he let her charge her computer up, so she was able to get some work done. She finished some of her most urgent work and there was still about 45 minutes of the flight left. She then noticed that John was reading the same book on Elon Musk.

"What do you think of Isaacson's *Elon Musk*?" she asked him. He chuckled, and said, "Wow, what a book, what a character, especially his love life."

"I agree, Patty said. "What did you think of 'The Algorithm' and the 'Idiot Index'?"

"It's funny you should mention them," John said, continuing the conversation. "I am thinking of implementing both into the manufacturing plant that I manage. I think they have the potential to revolutionize our costs and productivity."

What are Musk's "The Algorithm" and the "Idiot Index?" Could implementing them into your facility revolutionize your costs and productivity?

Stay tuned to found out. **SMT007**

Dr. Ron note: While Patty's experiences at the airport and plane might seem somewhat out of context for this series, they mirrored mine of a short time ago. Each day is a journey.

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, or contact Lasky, click here.

Download Lasky's book, *The Printed Circuit Assembler's Guide to... Solder Defects.* You can view other titles in the I-007eBooks library here.

Developing Soft Electronic Devices Mimicking the Brain

Simone Fabiano, senior associate professor at the Laboratory of Organic Electronics, has been granted SEK 23 million from the European Research Council to develop a new type of soft electronic device inspired by the human brain.

In recent years, Fabiano's research group at the Laboratory of Organic Electronics, LOE, has successfully engineered artificial neurons and synapses utilising polymers. The next phase is to integrate these components into an artificial network that emulates the computation ability of the brain, with the ultimate goal of creating the next generation intelligent bioelectronic devices. It can be likened to a tiny "extra brain" made from polymers.

"This technology has the potential to serve a myriad of functions, from monitoring physiological parameters such as temperature, pressure, and blood sugar to directly interfacing with the body's nervous system," says Fabiano.

He describes this as "in-sensor-computing," where information is processed within the body itself, eliminating the need for external data processing in the cloud, a departure from current electronic systems.

"With this closed-loop system, we won't have to send sensitive data over the internet, addressing privacy concerns associated with conventional cloud-based data management and reducing energy consumption," says Fabiano.

(Source: Linköping University)

TOP TEN

EDITOR'S PICKS

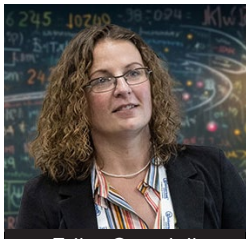
BTU International Receives Double Honors with Two 2023 Mexico Technology Awards

BTU International, Inc., a leading supplier of advanced thermal processing equipment for the electronics manufacturing market, is pleased to announce that it received not one, but two esteemed 2023 Mexico Technology Awards. The company secured recognition in the categories of Soldering Equipment–Reflow for its innovative Aurora system, and Software–Process Control for its cutting-edge Profile Tracer.

Silicon Frogs and Smashing Asteroids: A Review of the IPC High Reliability Forum

In the electronics industry, we all agree about the expectation that items leaving Earth must work all the time, and we expect the same level of reliability from our communications systems and our cars. There may be differences in the hardware, but vigilance during design and build are integral to ensuring mission success.

An Introverted Physicist in a Press-Fit World


Erika Crandall

As a physicist who has spent much time for my PhD utilizing various surface analysis techniques, plating conditions, and environmental exposures to investigate the underlying mechanisms behind metal whisker growth, many of my main projects for the automotive industry were focused on the development and testing of new surface finishes for whisker mitigation of compliant press-fit pins.

Koh Young Case Study Underlines the Power of Supplier Partnerships with IMI

Koh Young has released their latest case study exploring their global partnership with IMI and specifically the success the collaboration has achieved at IMI's facility in Guadalajara, Mexico. This case study explores the changing climate for manufacturing in Mexico as volumes and demand increases in the region and manufacturers, including IMI, look to grow through greater automation and closer collaboration with key technology partners like Koh Young.

Meet the New Workforce at IPS: Caleb Aagard and Emory Ward

As the workforce continues shifting to the next generation—with a noticeable lack of appeal toward manufacturing careers—it's even more important to share the voices of those who have chosen to work in manufacturing. We believe that raising awareness will inspire others to consider manufacturing as the strong and viable career path that it is.

Registration Open for the 2024 WHMA Annual Global Leadership Summit

Registration is now open for the 2024 WHMA Annual Global Leadership Summit, taking place Feb. 13-15, 2024, in Myrtle Beach, S.C., influential thought leaders and forward thinkers will take to the stage to deliver their valuable perspectives on topics that are important to executives, including impactful leadership tactics, employee recruitment/retention strategies, and the emerging trends reshaping the electronics industry.

Winners of IPC's Taiwan Region Hand Soldering and Rework Competition 2023 Announced

Skilled technicians from the electronics industry across Taiwan showcased their expertise and engaged in a fierce one-day competition. After a rigorous judging process, first-, second-, and third-place awards were presented.

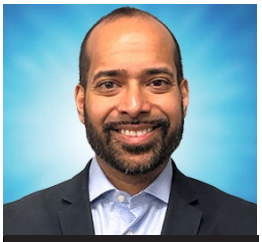
Global Sourcing Spotlight: Get Out of China? It's Quite Complex

There is a lot of uncertainty in the global marketplace, and because of that, I'm often asked to find alternative sources, particularly when companies want to get out of China. Now, I sympathize with that, but when you look at the entire situation, you'll see it's not always as simple as it might first appear.

Progress in Europe: An IPC Report

For far too long, electronics manufacturing has been overlooked in European policy circles, but exciting developments are taking place in Brussels. This year, IPC released a new, unprecedented SWOT analysis of the European EMS and PCB industries produced in collaboration with major stakeholders, including electronics manufacturers, OEMs, trade associations, and trade unions.

Facing the Future: Engaging a New Generation


Aidan Salvi

For some time now, many of us just assumed that robots would take over our jobs, and then, well, what would happen next? But what we've found is that one of, if not the best, aspects of a factory is the cooperation between humans and automation.

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- Follow up all enquiries for products and services; convert them into contracts/orders.
- Provide technical support – remotely and onsite.
- Be widely recognised and acknowledged as an "Industry Expert."
- Technical Sales and Account Management skills from an electronics background is desirable.
- Excellent sales, customer service, communication, presentation and negotiation skills.
- Recognised qualification in Electronics Engineering or related field.
- Knowledge of the electronics/SMT assembly process.
- Excellent written and verbal communication skills in English.
- Competent user of Microsoft Office applications.
- Ideally living in the Southern half of the UK.
- Willing and able to travel within and outside UK.
- A full, clean UK driving license is essential.

To apply, please contact John Barraclough at john.barraclough@gen3systems.com or by using the link below.

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USA Region

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- Cultivating strong customer relationships and ensuring comprehensive customer service to drive repeat orders and support business development in machine evaluation.
- Proactively understanding customer needs and feedback to drive continuous improvement in existing technologies and new product development.

Qualifications & Requirements:

- A recognized diploma/advanced diploma/degree in Science and Engineering, preferably in Electrical & Electronics/Computer Science/Computer Studies or equivalent.
- 3+ years of relevant experience in servicing automated inspection equipment (SPI, AOI, and AXI).
- Strong communication and troubleshooting skills.
- Willingness to travel extensively across the USA.
- Positive attitude and flexibility to accommodate conference calls with headquarters.
- Applicants from the USA and Canada are welcome to apply.
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2. Build strong relationships with existing and new customers
3. Troubleshoot customer problems
4. Provide consultative sales solutions to customer's technical issues
5. Write monthly reports
6. Conduct technical audits
7. Conduct product evaluations

QUALIFICATIONS / SKILLS:

1. College degree preferred, with solid knowledge of chemistry
2. Five years' technical sales experience, preferably in the PCB industry
3. Computer knowledge
4. Sales skills
5. Good interpersonal relationship skills
6. Bilingual (German/English) preferred

To apply, email: BobW@Taiyo-america.com with a subject line of "Application for Technical Sales Engineer".

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IPC instructors will primarily conduct training at our public training center in Longmont, Colo., or will travel directly to the customer's facility. It is highly preferred that the candidate be willing to travel 25–50% of the time. Several IPC certification courses can be taught remotely and require no travel or in-person training.

Required: A minimum of 5 years' experience in electronics manufacturing and familiarity with IPC standards. Candidate with current IPC CIS or CIT Trainer Specialist certifications are highly preferred.

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Experience: Electronics Manufacturing: 5+ years (Required)

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Willingness to travel: 25% (Required)

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  - 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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Career Opportunities

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

Requirements:

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

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Valid driver's license is required, as well as a passport for travel.

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Career Opportunities

Technical Service & Applications Engineer

Full-Time — Flexible Location

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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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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Career Opportunities

INSULECTRO

Are You Our Next Superstar?!

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

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

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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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Career Opportunities

eptac

TRAIN. WORK SMARTER. SUCCEED.

Become a Certified IPC Master Instructor

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

Qualifications and skills

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

Benefits

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

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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

APCT
Passion | Commitment | Trust

APCT, Printed Circuit Board Solutions: Opportunities Await

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

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

We invite you to read about APCT at APCT.com 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.

apply now

YOUR JOB AD HERE

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

I·Connect007
GOOD FOR THE INDUSTRY

ON DEMAND! Free 12-part Webinar Series

Smarter Manufacturing Enabled with Inspection Data

with expert Ivan Aduna

A smart factory is created from many parts, and inspection systems will play a critical role for process optimization in the next industrial revolution. Accurate, reliable 3D measurement-based data is essential, and a key element for a true smart factory. In this 12-part webinar series, viewers will learn about secure data collection, AI-powered solutions to manage and analyze data, and how to leverage the IPC CFX-QPL to succeed in the transformation to Industry 4.0.

I-007eBooks

Process Control

by Chris Hunt and Graham K. Naisbitt, GEN3

In this book, the authors examine the role of SEC test and how it is used in maintaining process control and support for objective evidence (OE.) Issues, including solution choices, solution sensitivities, and test duration are explored.

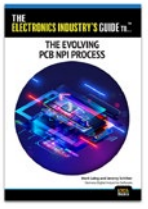
The Companion Guide to... SMT Inspection: Today, Tomorrow, and Beyond

Advances in artificial intelligence have been limited exclusively to the human world until now, but there are far-reaching applications within the manufacturing sector, too. In this guide book, learn how equipment providers like Koh Young are enabling the Smart Factory of the Future by adopting AI to generate "knowledge" from "experience."

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.



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.

PODCAST! On the Line with...

...is available now on Spotify. In this podcast, we speak with industry experts to get the latest insights and perspectives on the most relevant topics in the electronics industry today. The first series of *On the Line with...* features conversations on sustainability.

Our library is open 24/7/365. Visit us at: I-007eBooks.com

PUBLISHER: **BARRY MATTIES**
barry@iconnect007.com

MANAGING EDITOR: **NOLAN JOHNSON**
(503) 597-8037; nolan@iconnect007.com

ASSOCIATE EDITOR: **MICHELLE TE**
michelle@iconnect007.com

TECHNICAL EDITOR: **PETE STARKEY**
+44 (0) 1455 293333; pete@iconnect007.com

TECHNICAL EDITOR: **PATTY GOLDMAN**

CONTRIBUTING TECHNICAL EDITOR: **HAPPY HOLDEN**
(616) 741-9213; happy@iconnect007.com

CONTRIBUTING TECHNICAL EDITOR: **DAN FEINBERG**
baer@iconnect007.com

SALES MANAGER: **BARB HOCKADAY**
(916) 365-1727; barb@iconnect007.com

MARKETING SERVICES: **TOBEY MARSICOVETERE**
(916) 266-9160; tobey@iconnect007.com

PRODUCTION MANAGER: **SHELLY STEIN**
shelly@iconnect007.com

MAGAZINE LAYOUT: **RON MEOGROSSI**

AD DESIGN: **SHELLY STEIN, MIKE RADOGNA, TOBEY MARSICOVETERE**

CREATIVE TECHNOLOGIST: **BRYSON MATTIES**

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