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FEBRUARY 2019

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**Selling Your
Services:
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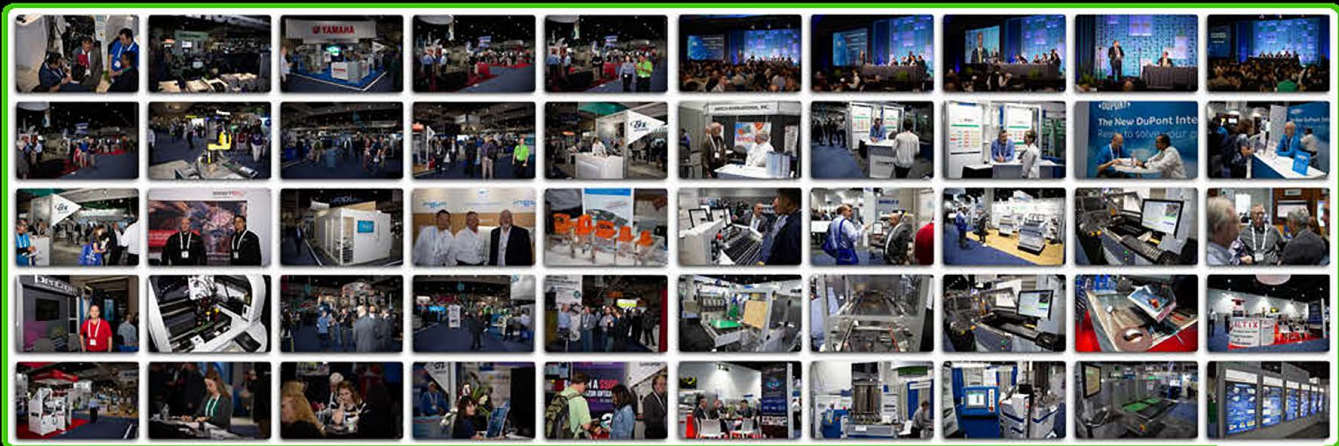
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Selling Your Services

“Survival of the fittest” is a maxim in business as well as ecology. In any environment with steadily evolving conditions, success strategies must change to stay on top. This month we look at your selling strategies.



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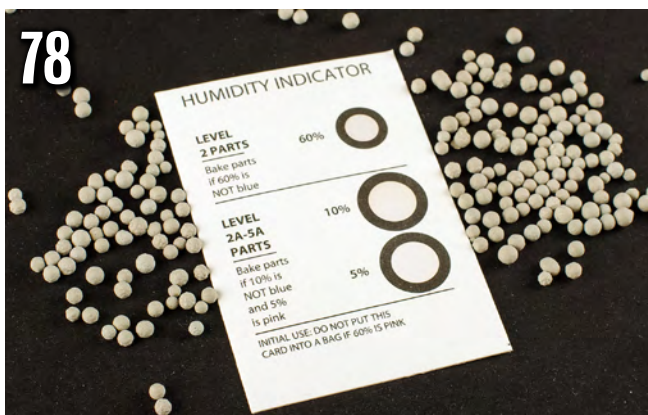
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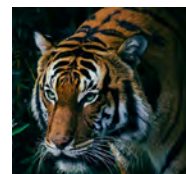


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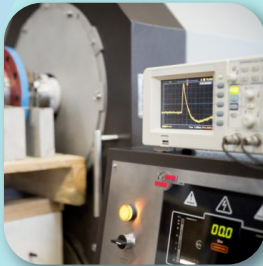


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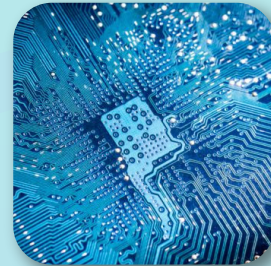
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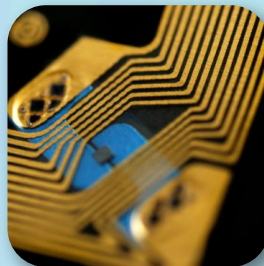
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Selling Your Services: Welcome to the **Jungle**

Nolan's Notes
by Nolan Johnson, I-CONNECT007

Our theme this month is sales strategies, which seems especially relevant since we're still early in 2019 and it feels as if the whole year lies in front of us. IPC APEX EXPO has just wrapped up, and the sales teams are working their way through all of the contacts and leads they gathered at the show.

And yet, I sense a change. Maybe you've sensed it too? Some sort of new, vibrating rumble just below your hearing threshold that you can feel but not hear. You know what I'm talking about. Marvel Comics fans would call it "Spider-Sense." I sense the business of electronics manufacturing is evolving; the customer and marketplace are changing.

Duane Benson from Screaming Circuits (also an [I-Connect007 columnist](#)) recently said, "Your sales strategy today will dictate your success for the next decade." Benson is right, and he has backup. Steve Koenig, VP of market research for the Consumer Technology Association (CTA, the entity that organizes CES), stated in his CES 2019 kickoff address, "The 2000s were the digital age; the 2010s were the connected age; the 2020s will be the data age...More business decisions are backed by data."

Back in Koenig's digital age, our industry built e-commerce models and started moving data electronically. We all but aban-

doned the fax machine, started using email instead, and reduced our sales forces because the internet would be more effective.

In the '10s, that trend continued but also lost momentum. Internet connections to your fabricator became table stakes for doing business (unless, of course, you were content to remain a small, local supplier.) Even as a web-based e-commerce option came to be expected, the lost



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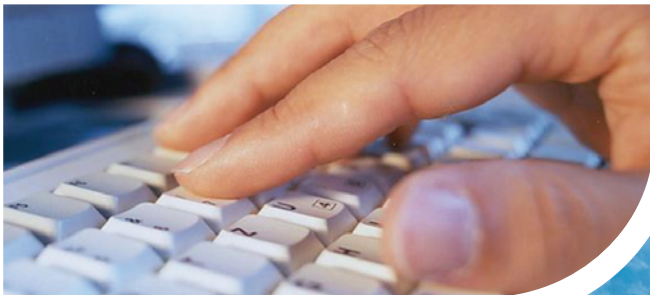


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sense of a relationship between the designer and fabricator became even more prevalent.

“Now hold on a minute!” I hear you saying, “If a no-touch e-commerce tool is expected, but the customer wants a personal touch, then how does this work?” Well, it does if you look at it right. To do that, it’s the millennial generation’s effect on the buying experience that gives us an example, as does a popular supplier of prescription eyewear.

There may be two generational groups (Gen X and Gen Y) between baby boomers—the largest generational wave in U.S. history—and millennials, but millennials are even more numerous than the boomers. Since we’re talking sales strategies, here’s your jungle survival pro tip—master the process of attracting millennials now to bridge the gap.

Let’s look at a successful example by going outside of our industry. Warby Parker is a newer player to the eyewear market. Though they have physical retail stores, there aren’t very many of them; by many accounts, Warby Parker came into public awareness with their web presence. In a traditional retail business model (targeting baby boomers), Warby Parker would try to drive customers to the store and use online purchasing to support the store. Given that eyeglasses are a custom-manufactured item specific to an individual—the frames may be standard, but the lenses that go into them are custom—traditional business models persist in continuing to drive customers into a store to interact face to face with the optician to order glasses.

Instead, Warby Parker appeals to millennials by doing things differently. Millennials expect the available online resources will make the in-person interactions more powerful. And to that end, Warby Parker does a large amount of business on the web by tapping into that millennial expectation. Sure, you can visit the store. You can also have up to five sample frames mailed to your home, or go straight to the website to order.

Back in the spring, I happened upon a Warby Parker retail store while on business in Boston. I stopped by to window shop and found a perfect pair of

frames. The salesperson volunteered to email me the frame information so I wouldn’t forget. Later in the year, after updating my prescription at my optometrist, I filled out the online order form. Easy, except I was missing some key measurements to get the fit right. The order form accepted my information anyway and informed me that a Warby Parker representative would call my optometrist to get the information they needed.

I was skeptical, but I got a confirmation email and phone call in about 90 minutes. Warby Parker had what they needed from the optometrist, and they’d be charging my credit card. I had questions, and the representative answered them. She didn’t give me a bunch of jargon like I was an industry insider, nor did she speak condescendingly below my intelligence level. Customer support was helpful, knowledgeable, and knew exactly how to walk me through the process both pre- and post-sale.

The transaction was much like being in the store talking to a human. Except I could bypass the normal communication channels and get my data straight to the fabricators, or opticians in this case. You can bet my expectations were high when I found a Warby Parker parcel in my mailbox. My glasses? Perfect. My experience? Also perfect.

Warby Parker is wildly successful right now. The rise of the brand’s cache is ballistic. The customer experience is stellar. They’ve figured out how to integrate the electronic channels into a primarily personal, interactive experience. The web-based functionality assists the sales staff, not the other way around. This new approach is the vibration you’re feeling because in our industry, some sales teams are still say-



ing, “Look at our website! We have an order form! We quote online!” Frankly, that’s not where it’s at anymore.

In this issue, we bring you current perspectives on selling your services including a recruiter, career coach, board fabrication buyers, and our industry-insider columnists. These are all outlooks you’ll need to think about if you, like Duane Benson, are planning now for your company’s next 10 years of selling success.

Dr. Jennie S. Hwang’s column, “SMT Perspectives and Prospects,” continues her ongoing series on the role of bismuth in electronics. In this installment, she looks at plausible underlying operating mechanisms among the four elements (Sn, Ag, Cu, Bi) in an SnAgCuBi system.

In Eric Camden’s column, he discusses “The Cost of Quality and the Higher Cost of Failure,” where he makes the case that quality and reliability sell again and again.

Expert recruiter, Terry McNabb, discusses “Filling the Skills Gap: Strategic Hiring and Succession Planning.” Terry has great insight into the persistent process of hiring new staff, and his perspective in this conversation is doubly appropriate for building out your sales team.

Nate Ramanathan, VP of operations at AEye—an autonomous vehicle startup—is the voice of the customer in this issue. I met with Ramanathan at CES in January, and he discussed what a technology startup looks for in an electronics manufacturing partner in today’s market including a “modest proposal” toward the end of the conversation. Read what he has to say in “Nate Ramanathan on Choosing a Prototype Partner and Production Supplier.”

Ramanathan’s closing remarks were so intriguing that I took a side trip at CES to visit Eureka Park—the exhibit hall specifically for startups—to test his point. Read what I found in my research in “Eureka Park: Chock Full of New Customers for a Market-maker.”



In “Accelerating Tech—Insights from the Smarter Factory,” Michael Ford looks at the truth behind AI and why you shouldn’t worry about the risk of being replaced by software.

Tom Lavoie is an industry veteran and a career coach. In “Career Planning and Professional Development,” Lavoie makes the case for incorporating career coaching for ourselves and as a component in an employer’s career development programs.

In “Controlling Oxidation and Intermetallics in Moisture-sensitive Devices,” Richard Heimsch addresses environmental storage and moisture management and its effect on lead-free reflow.

As we enter the 2020s—marking the beginning of the age of data as well as widening the gap between boomers and millennials—it’s time to take a hard look at how you sell. You may need to make some adjustments and change the lens through which you view the market and how your customers see your product. There’s no better time than 2019 to plan out your next decade. I-Connect007 is glad to help start that conversation. **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](#).

The Role of Bismuth (Bi) in Electronics, Part 5

SMT Prospects & Perspectives

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

Part 5 of the series will address the most interesting, yet intricate, aspect of the subject—plausible underlying operating mechanisms among the four elements (Sn, Ag, Cu, Bi) in a SnAgCuBi system. I will provide some illustrations on relative elemental dosages in relation to relevant properties and performance. In an Sn-based system, the starting point is to consider the metallurgical interactions of three elements—Ag, Cu, and Bi—with Sn as the matrix. How do these three elements affect physical and mechanical properties individually and collectively as well as the importance of the specific dosage of each element in the system to the resulting properties and performance of a specific alloy composition?

First, to be in line with SnPb eutectic reflow peak temperature (SnPb eutectic continues to be a viable reference point), the target is to

make the melting temperature as close to that of SnPb eutectic as feasible since the required reflow process peak temperature is directly determined by the alloy's melting temperature. And the reflow temperature is crucial to the integrity of the circuit boards produced, primarily to avoid encountering the risks of any detectable or undetectable thermal damages while not to marginalize the required process window.

Accordingly, a challenging goal has been to lower the melting temperature of the lead-free Sn-based alloy without entering into the territory of low-temperature alloys (e.g., melting temperature below 175°C). Thus, research, development, and manufacturability efforts have been so directed in our studies. Also, in this writing, for practicality, the liquidus temperature of a non-eutectic alloy composition is ex-



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pressed as melting temperature, and all dosage percentages are expressed in weight percent.

Melting Temperature

In an SnAgCuBi system, all three elements (Ag, Cu, Bi) affect the melting temperature of the resulting solder alloy. More practically, they can lower the melting temperature of the Sn matrix when their respective dosages in the system are properly constituted. With an objective to lower the required reflow temperature, the identification of the optimal dosage of each element in this quaternary system to lower the melting temperature of the resulting alloy while maintaining the desired level of physical and mechanical properties is an intricate endeavor as well as most scientifically appealing.

Within practical dosage ranges, the following is a capsule view of experimental findings ^[1] in the relationship between the melting temperature and respective dosages (all dosages are expressed in weight percent; percentage bears approximately $\pm 10\%$ variations):

- The melting temperature dropped with the addition of Cu and reached a minimum at 0.5%. Beyond 0.5% Cu, the melting temperature remained almost constant with further increase of Cu up to 5.0% (Figure 1)
- Similarly, the melting temperature decreased with increasing Ag and reached a minimum of about 3.0%. When Ag content increased from 3% to 4.7%, any further reduction in the alloy melting temperatures is negligible. However, when the Cu content is in the range of 0.5–3.0 % and the Ag content is less than 3 %, the liquidus temperature of the melting range increases notably with the decreasing Ag content (Figure 2)
- Bi in this alloy system plays a major role in further reducing the alloy melting temperature. The alloy's melting temperature near-linearly decreased with increasing dosage of Bi, but increasing the dosage of Bi to lower melting temperature is not a panacea, which will be highlighted later (Figure 3)

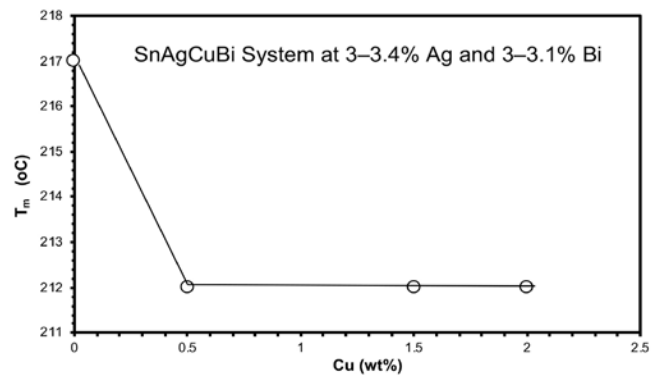


Figure 1: Melting temperature vs. Cu dosage wt% ^[2].

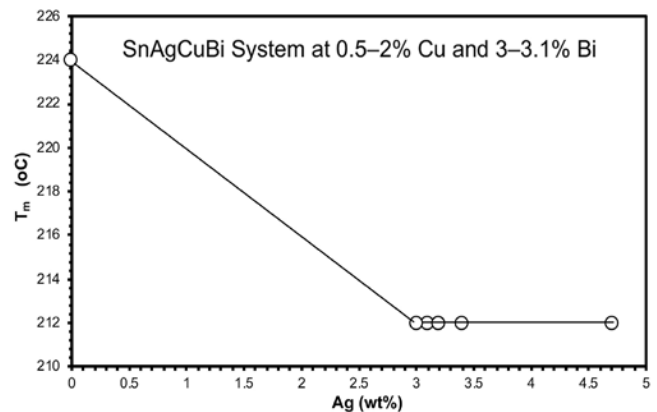


Figure 2: Melting temperature vs. Ag dosage wt% ^[2].

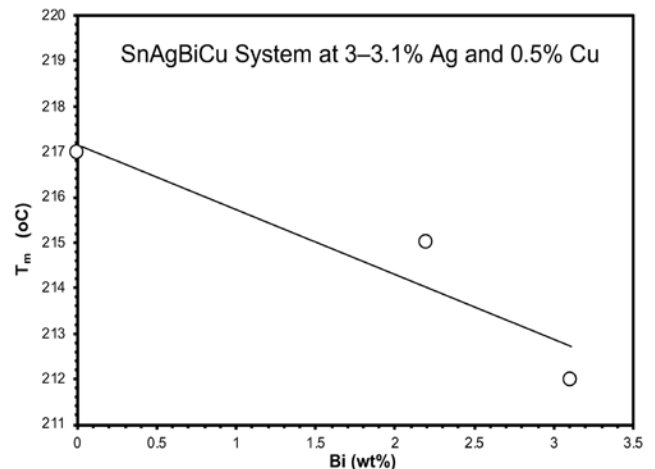


Figure 3: Melting temperature vs. Bi dosage wt% ^[2].

Experimental results are consistent with the indication of binary or ternary phase diagrams where available.

Metallurgical Science vs. Properties ^[2]

Metallurgically, Ag forms a second phase—primarily ϵ (Ag_3Sn) in the Sn matrix. The morphology of Ag_3Sn particles, intermetallic in nature, can range from nodular to long-needle shapes; Cu interacts with Sn to form intermetallic compound η (Cu_6Sn_5) in essentially nodular shapes. The element Bi works differently in the Sn matrix. The solid solubility of Bi solute in Sn solvent can reach about 21 wt% at the eutectic point (138°C). However, the solid solubility of Bi solute in Sn solvent can be dramatically reduced with temperature, which is about 1.0 wt% at room or ambient temperature. Additionally, the three elements (Ag, Cu, Bi) are expected to interact mutually in a thermodynamically competitive manner.

In mechanical behavior, the yield strength of the SnAgCuBi quaternary system generally follows an approximation of the linear rule of mixture in the volume fraction of the second phases (Ag_3Sn), the volume fraction of intermetallic compound (Cu_6Sn_5) and the volume fraction of Bi precipitates in the Sn matrix. In accordance with Mott and Nabarro's strain field theory, the strengthening effect of Ag_3Sn particles is interpreted as the result of the long-range internal stress built by the elastic modulus and volume differences between the second phase and the Sn matrix. The mobile dislocations in the soft Sn matrix can largely pass by the Cu_6Sn_5 particles in a largely free manner due to the relatively larger interparticle spacing. The strengthening mechanism of the elastic Cu_6Sn_5 particles is attributed to the building of an elastic internal stress field in the Sn matrix, giving a backstress for dislocation movement.

In fatigue life, like other alloy systems, the underlying operating mechanism is more complex, engaging in multiple events and varying with strain amplitudes. At the relatively large strain amplitudes, fatigue crack propagation is a dominating event throughout the fatigue lifetime. At the small strain amplitudes, fatigue crack initiation is a dominating event throughout the fatigue lifetime.

In terms of the mechanisms identified, at the large strain amplitudes, Ag_3Sn particles are a

much more effective block for the fatigue crack propagation than the Pb-rich second phase in 63Sn37Pb. The Cu_6Sn_5 particles in the Sn matrix are expected not to be fatigue-fractured at the fatigue conditions. Like the Ag_3Sn particles, the Cu_6Sn_5 particles serve as effective barricades for fatigue crack propagation. The formation of Cu_6Sn_5 particles also can partition Sn grains, resulting in finer grains, which contributes to the extension of fatigue lifetime by enhancing grain boundary gliding mechanisms.

At the small strain amplitudes, fatigue crack initiation is a dominating event throughout the fatigue lifetime. Since the cyclic deformation in the process of fatigue crack initiation almost entirely takes place in the Sn matrix, the Ag_3Sn particles and Cu_6Sn_5 particles are expected to play little role in retarding the cyclic deformation damage or fatigue crack initiation. With the presence of Ag and Cu in the Sn matrix, the overall fatigue life is controlled by the fatigue fracture capacity of either the Sn matrix or interphase bonding. In this regard, Bi, on the other hand, offers additive-enhancing events in the Sn matrix, which compensates the deficiencies of Ag and Cu. However, its dosage is an overriding factor.

As mentioned earlier, alloy's melting temperature near-linearly decreased with an increasing dosage of Bi. Does this imply that to achieve a lower melting temperature and thus the process temperature, we can build a high dosage of Bi into the SnAgCuBi? The answer is a resounding no.

The attainment of a delicate and tricky balance among the dosages of all three elements is the key to delivering the desired performance; simply put, this means the balanced strength and fatigue resistance as well as the desirable manufacturability. In electronics, to serve as sound solder joints that connect semiconductor packages to the outside world, it is safe to say that the mechanical strength can readily be obtained (within the scope of the electronic circuit board). The ability of resistance to thermal fatigue is the top priority in the performance of solder material to produce reliable products (barring other extraneous failure modes).

All in all, when Ag, Cu, and Bi can “comfortably” reconcile together within the Sn matrix, and when each element is at its optimal dosage, the system delivers wonders. **SMT007**

References

1. H-Technologies Group Inc., “Internal Reports,” 1990-1999.
2. Jennie S. Hwang, *Environment-Friendly Electronics: Lead-Free Technology* (Chapter 10), Electrochemical Publications LTD, Great Britain, 2001.



Dr. Hwang, an international businesswoman and speaker, and business and technology advisor, is a pioneer and long-standing contributor to electronics hardware manufacturing as well as to the environment-friendly lead-free electronics implementation. Among her many awards and honors, she was inducted to the International Hall of Fame–Women in Technology, elected

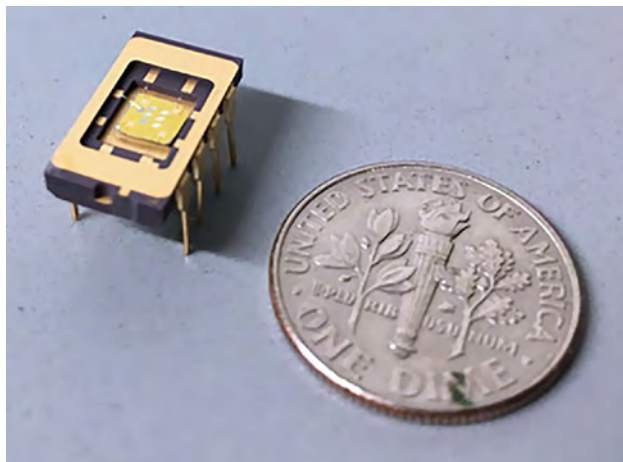
to the National Academy of Engineering, an R&D-Stars-to-Watch, and YWCA Achievement Award. Having held senior executive positions with Lockheed Martin Corp., Sherwin Williams Co., SCM Corp, and CEO of International Electronic Materials Corp., she is currently CEO of H-Technologies Group providing business,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

Phononic Devices Could Allow Smaller Mobile Devices

To make modern communications possible, today’s mobile devices make use of components that use acoustic waves to filter or delay signals. However, current solutions have limited functionalities that prevent further miniaturization of mobile devices and constrain the available communication bandwidth.

Now, a research team led by Chiara Daraio, Caltech professor of mechanical engineering, has developed phononic devices that could find uses in new kinds of sensors, improved cellphone technologies applied physics, and quantum computing.

The phononic devices include parts that vibrate extremely fast, moving back and forth up to tens of millions of times per second. The team developed these devices by creating silicon nitride drums that are just 90-nm thick. The drums are arranged into grids with different grid patterns having different properties.



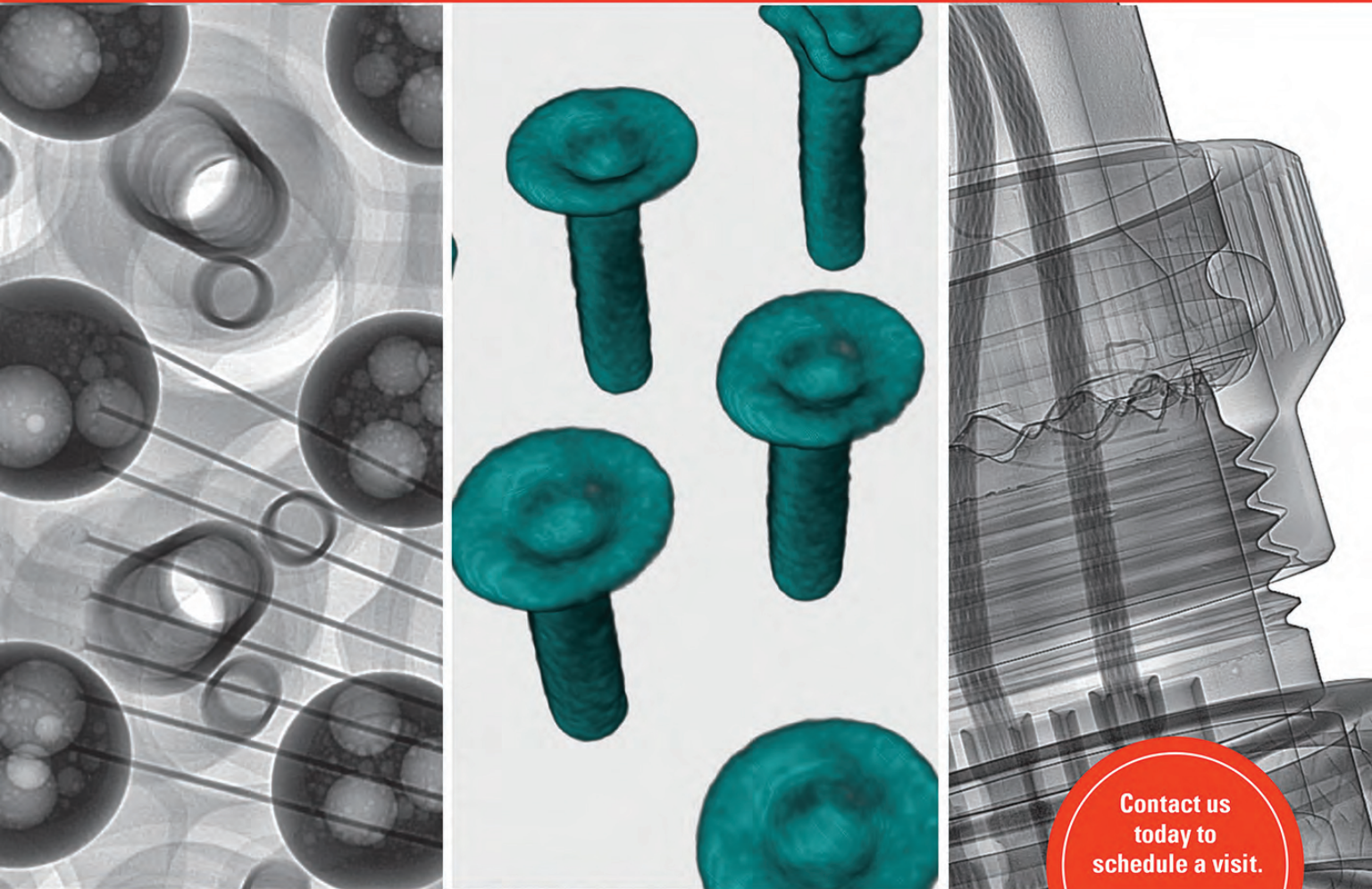
Daraio, along with former Caltech postdoctoral scholar Jinwoong Cha, showed that arrays of these drums can act as tunable filters for signals of different frequencies. They also showed that the devices can act like one-way valves for high-frequency waves. The ability to transmit waves in only one direction helps keep the signal stronger by reducing interference.

These findings open opportunities to design new devices—such as phononic transistors and radio-frequency isolators—based on phonons instead of electrons. Their findings appear in two papers published in *Nature Nanotechnology* and *Nature*.

Support for the research was provided by the National Science Foundation, the Binnig and Rohrer Nanotechnology Center at IBM Research–Zurich, and the Kavli Nanoscience Institute at Caltech.

(Source: California Institute of Technology)

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The Cost of **Quality** and the Higher Cost of Failure

Quest for Reliability
Feature Column by Eric Camden, FORESITE INC.

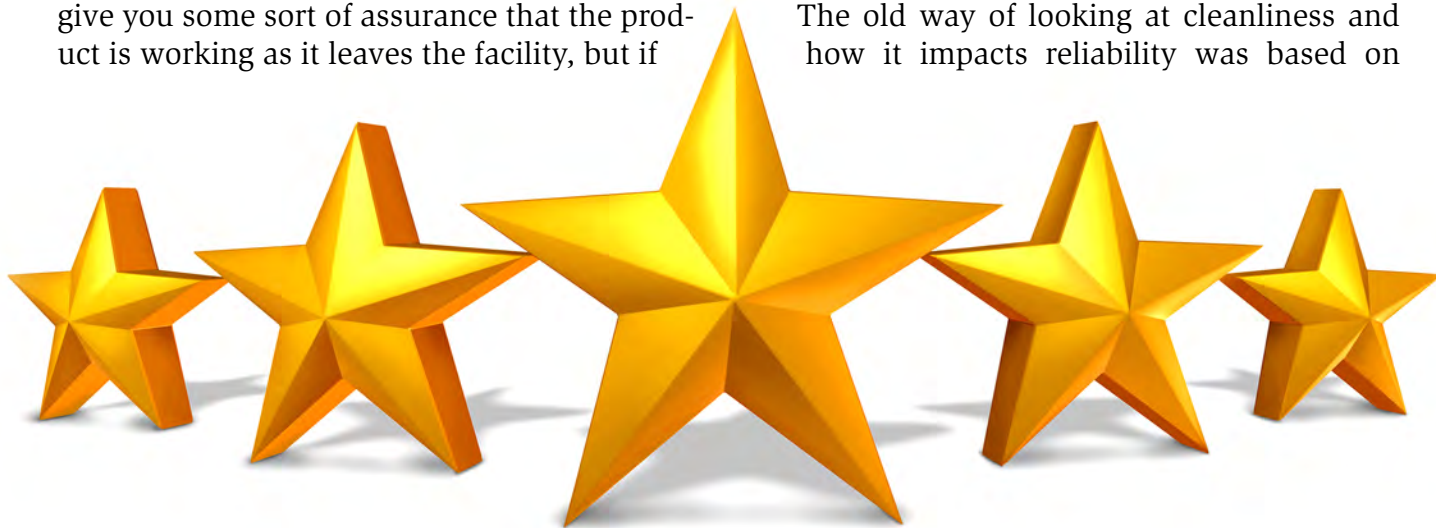
This month's *SMT007* topic is "Selling Your Services: "A look at strategies to help you improve how you sell your electronics manufacturing and PCB assembly services." This is a topic I can speak to regarding quality and how testing can be a selling point for your product based on how many times I have seen field failures here in the lab.

Think about it. If you are shopping a new product around to multiple CMs, and if all other things in two separate CMs are equal including price and delivery times but one offers a more comprehensive ongoing quality monitoring system, why wouldn't you go with that one? I realize that you usually pay some type of premium for the CM that has an overall quality monitoring system that goes beyond just ICT or bench level testing. Most CMs will give you some sort of assurance that the product is working as it leaves the facility, but if

one has a mindset that more than basic testing is required to show reliability, you will more than likely have fewer field failures.

This is something we see from many CMs in the form of a more expansive upfront set of testing at PPAP that translates into a more meaningful ongoing monitoring strategy that relates back to the original set of tests that shows the product will operate under harsh environments. If your product ends up in an automobile cabin or other controlled environment, all the better. Often, what we see with field failures are they come from a CM that is doing nothing more than checking a box. If there isn't a specific cleanliness requirement, the default is often to perform the historically accepted test that simply does not line up with today's technology demands.

The old way of looking at cleanliness and how it impacts reliability was based on



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1970s assembly procedures and materials, and may or may not have even been fully effective for that time. As components continued to shrink over the last 40 years, the acceptance criteria didn't adjust as it should have. One reason for this is the group of people with the mindset that, "This is how we have always done it, and change be damned, it's how we are going to keep doing it." Guess what? People used to die all the time from polio and tuberculosis, but as medical science advanced and people embraced vaccinations (except for Jenny McCarthy of course), those diseases are a thing of the past.

Now, I am not saying that a dirty PCBA is as dangerous as TB, but my larger point is that scientific advances are allowing us to make smarter choices in terms of adopting a quality strategy. Too many times I see an assembly

Now, I am not saying that a dirty PCBA is as dangerous as TB, but my larger point is that scientific advances are allowing us to make smarter choices in terms of adopting a quality strategy.

print without any reference to cleanliness or only the default of IPC, which is super vague as there are 200+ test methods and only a few related to cleanliness. The saying "you get what you ask for" comes to mind. It is so important to demand and clearly document cleanliness requirements and verifications on a regular basis to help mitigate cleanliness related issues in the field.

So, what is a good strategy to maintain quality related to cleanliness? Here in the lab, we love the customers planning new product to test bare fabrication, components, as well as

first-run production with ion chromatography. That is the first and easiest way to see just how clean each of those sample sets are before you go into full production. IC analysis gives you a good picture of the type of ionic residues present on each sample, and each of those ions can be traced back to a specific part of the process.

With that information in hand, and when necessary, you can go back to the supplier, review their process, and see where it can be optimized to reduce residual ionic content. After optimization, a second round of testing is in order to see the effectiveness, and then further optimize from there. Component manufacturing and bare boards share a lot of the same risk due to the plating processes, which use highly active chemistries. Those chemicals need to be fully removed or effectively neutralized to a low enough level that when they arrive at the CM, they won't be the root cause of assembly failure down the road.

Many PC fabrication shops aren't using the best quality DI water for rinsing after plating because good DI isn't cheap. The higher-quality wash or rinse water uses lower the surface tension. Lower surface tension allows the DI water to penetrate into vias and remove process residues better. In past studies, we have found that tap water is incapable of penetrating vias smaller than eight milliliters, which are ever present on today's PCBAs. We found one supplier that was using water directly out of a nearby river. I can't make this stuff up. The print didn't have any cleanliness specification or direction for proper washing after plating, and the customer was more than thrilled to save a few cents per board with no questions asked. When the boards were used for actual production, the customer had massive amounts of failures, and the cost of replacements couldn't be pushed back on the supplier because they got what they asked for—nothing.

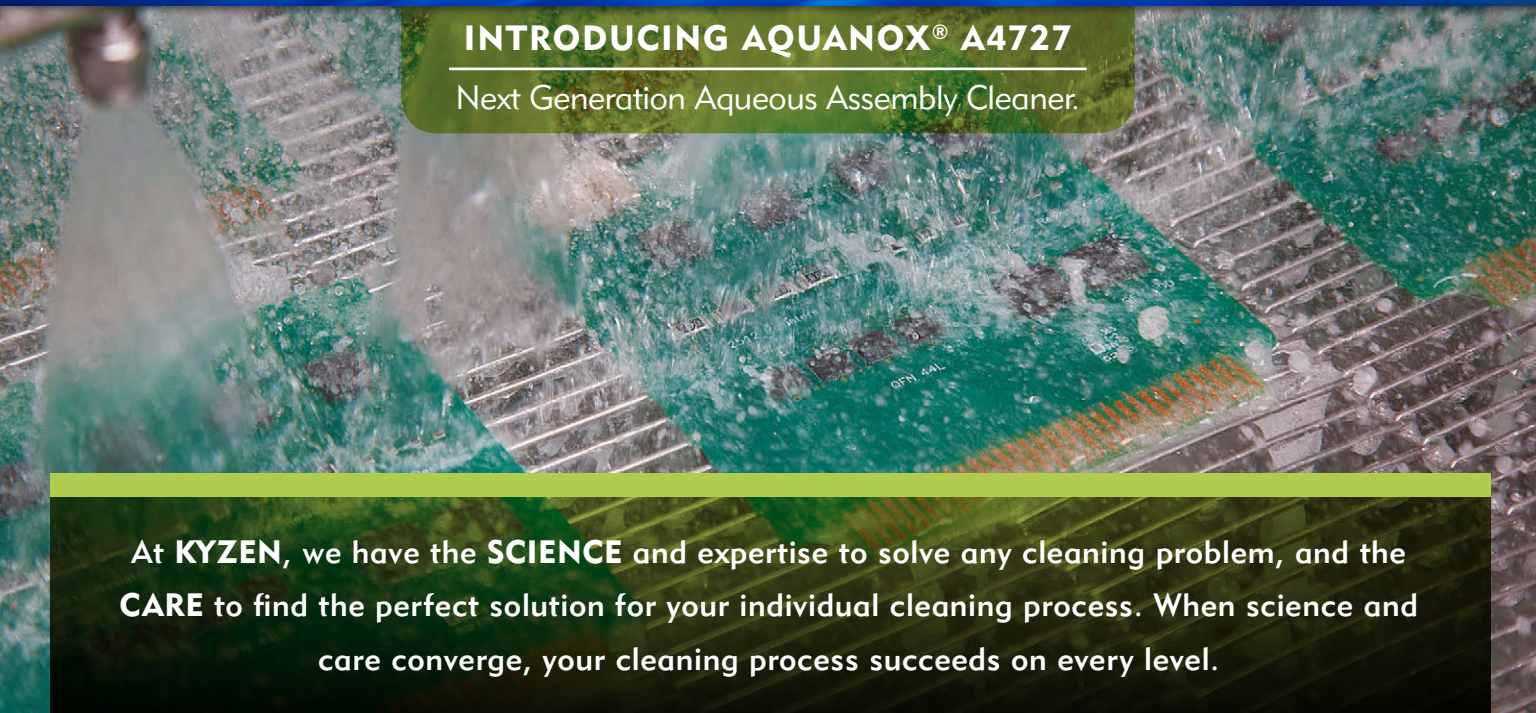
This company was an obvious outlier in the big picture, but it goes to show that you can't rule out anything if you don't have a rule in place. The strategy here for the PC fabrication shop would be to pay a little more for a good quality water system that can maintain at least 10-megohm resistivity DI water for more ef-



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fective wash and rinse processes. If they have that, and the shop down the street is using a one-megohm dummy light, you can pretty much guarantee that the shop with a better water system is supplying you higher quality bare boards. Bare boards are the basis of your final product, so if you start with better quality boards, you will ultimately have higher quality final product. As previously mentioned, the component manufacturers are up against some of the same issues in terms of removing plating chemistries, so the same recommendation for water systems applies here. There isn't a lot more you can test with bare boards regarding cleanliness, but having a quality system in place for every customer can put you in front of your competitors without a doubt.

When it comes to the CM and the actual assembly process, there are more tests you can add to your overall quality system to help give you the edge over your competition. You can start with using suppliers that perform tests previously mentioned that show you're using quality parts and boards. This is especially important when using no-clean flux for the production as there is not a final wash process that can help remedy the sins of your suppliers. IC analysis is still the gold standard for determining the exact type and amount of ionic residue present on final assemblies, but that is also expensive and not realistic to have in-house in most cases. A few of the larger CMs do have IC in-house, and when used for process qualification and monitoring instead of just failure analysis, it can really help put them in their own league.

As part of an assembly house's cleanliness strategy, it is important to understand that overall ionic cleanliness is one thing, but looking at specific locations on an assembly is even more important. The reason that is true is that when you have a failure, the entire assembly doesn't fail but a single point related to a single process or part does. Knowing this you can separate each assembly process, better determine which one is the culprit, and be able to do it much faster than any full board analysis. Being able to distinguish reflow from wave-from-hand operations is crucial when you are

looking to qualify and monitor an assembly process. Looking at each solder operation as part of an overall quality system allows you to control cleanliness better.

When you are testing PPAP samples, we always recommend some sort of environmental exposure testing along with IC test to help correlate performance under elevated heat and humidity conditions. What this additional test does is show that whatever level of residues you have on your product after assembly won't cause electrical leakage related issues, and you will have IC levels to correlate to. When going into full production process monitoring, IC is much faster than a 168-500 hour environmental exposure test. Monitoring specific location

When going into full production process monitoring, IC is much faster than a 168-500 hour environmental exposure test.

cleanliness can be done in several ways. Doug Pauls from Collins Aerospace and I released a presentation at the High-Performance Cleaning and Coating Conference in 2012 that detailed about a dozen different ways to perform localized extractions for IC analysis.

I've mentioned that this type of testing isn't cheap, but when you compare the cost of proving you have a good, clean process against the cost of a wide-scale recall, it's not even in the same ballpark. When you're competing against other suppliers or CMs, having a better quality system in place than your competitor will pay for itself many times over. **SMT007**



Eric Camden is a lead investigator at Foresite Inc. To read past columns or contact Camden, [click here](#).

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Filling the Skills Gap: Strategic Hiring and Succession Planning



Feature Interview by Nolan Johnson I-CONNECT007

While attending the IEEE Rising Stars Conference in Las Vegas, Nevada, I had a long and insightful conversation with veteran technical recruiter Terry McNabb. We covered so much information that the interview has been broken into two sections. In this section, Terry and I discuss the shortage of mid-career expertise in the workforce and best practices for hiring experienced technical staff.

Be sure to read the other part of my conversation with Terry in this month's issue of *PCB007 Magazine* where we discuss how to sell your services.

Nolan Johnson: I'm here with Terry McNabb who is a senior regional trainer from MRINetwork. Can you refresh us on your role and organization?

Terry McNabb: MRINetwork is one of the largest executive search and recruitment organizations in the world. It has been in business as a franchise organization for over 50 years with approximately 400 offices spanning four continents.

The most interesting thing about MRINetwork is that, for instance, most of the people who place electrical engineers are electrical engineers, so they understand the industry. They have a depth of understanding from years of working in it. Then, we teach them the recruiting process and how to identify the top performers in any marketplace, engage those people, and deliver them to our client companies.

Johnson: And you are involved with the training that they were doing yesterday afternoon here at the IEEE Rising Stars Conference.

McNabb: And this morning as well. Yesterday, we did a workshop helping young engineers create a strategy to get their first job or advance themselves. Topics included how to write a better resume, engage managers, identify their value, and increase that value by preparing for their next move.

Johnson: Have you been doing this for a while?

McNabb: Yes, I've been with MRINetwork for 34 years—18 years placing people within one of our franchises, and 16 years as basically a

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Johnson: One of the things going on in the industry I cover is that there is an age demographic gap. There are a large number of people who are 55 and older and starting to look at retirement. Then, the majority of labor after that is 30 and under. There's a large gap between the experts and entry-level employees with not many people to fill that gap. It's starting to look like a crisis for electronics and contract manufacturers, especially in the U.S. and North America. There's increasing activity to figure out how to bring skilled technical labor in through organizations like SMTA, IPC, and also here at IEEE. Do you see this dynamic in the skilled workforce you interact with?



Terry McNabb

McNabb: It's interesting because yes, I think there is a succession planning crisis in most companies. Many HR managers get trapped in what we call "administrivia," which is handling all of the other aspects of their job and not being able to rise to the strategic leadership of the company.

Johnson: So, getting stuck in the urgent but unimportant.

McNabb: Exactly. Companies need HR to be on the strategic leadership team. They need succession planning, talent mapping, and strategic hiring rather than just tactical hiring. Now, I know that's not a common phrase, but it's a phrase that I use a lot. It represents a mentality of, "I need an engineer with five years of experience so that I can fill this empty slot," which is a tactical hire. HR should move to strategic hiring or workforce planning, which looks at new problems the company will face,

or a case of, "We're about to leverage this new technology. Let me find an engineer who's already completed that transition with another company, and examine the composition of talent that's on my team now. If I have a lot of strength in several areas, but I have a bit of a deficit in one, I should find the person who will most effectively augment the composition of talent on my team." That new hire could not only do that important new task, but they can also mentor all of the other people on the team, making everyone on the team better.

Johnson: In that sort of a hiring decision process—how long of a tenure should that hiring manager be targeting? Are we talking up to five years or longer than that?

McNabb: Companies are faced with a quandary. One is that they have a succession crisis. They have to find a way to develop the future leadership of the company, and they can't wait on millennials. But at the same time, the average tenure keeps dropping. So, if I'm convinced that you'll be in the C-suite five years from now, you might well be three companies down your career by then. The bigger trend that we see is people are hiring more to a specific need. I might not be able to keep you for several years, but you can solve this million-dollar problem, so even if you only stay for a year, I'm in good shape. It's also a huge trend among millennials to not be hired at all but instead appear on a contract basis.

Johnson: I see that a lot.

McNabb: Two major forces are driving that. One is a lack of trust that companies have their best interests at heart such as, "You laid off my parents, and I don't trust that you're going to keep me." That's a part of it, but I think the larger part of it by far is simply the rate of change in today's world.

Johnson: How else do you keep up? That's a lot of technology transfer and evolution underneath you in one particular position with one particular company.

McNabb: Yes. So, what's happening in today's world? A lot of people are saying, "I just solved this important problem for my current company," and many top performers experience a post-accomplishment letdown. They had all the resources and attention—it was exciting work—but now they're going back to checking code? Instead, what many of them do is say, "There's an infinite number of companies out there who need to solve this problem. I don't need job security; I have career security."

Johnson: Skills security.

McNabb: Yes. "I have skills security, and I'm going to jump from company to company following my personal highest and best use." Basically, anything other than that highest and best use would create less value. "I'm worth \$75 per hour doing this new thing and I'm only worth \$40 per hour doing anything else!"

Johnson: How does that fit into more of a manufacturing floor sort of environment?

McNabb: Let me give you a quick example. One of our search consultants works with leadership professionals within manufacturing processes that include rolled sheet aluminum within the United States; that's his entire marketplace. When plasma cutting first came out, he found a project manager who had successfully installed the plasma cutting, but started feeling a letdown because his job was exciting the last month and his old tasks seemed boring by comparison.

Our consultant approached the companies that ought to install plasma cutting. Rather than saying "I'm a recruiter and I'd like to have some of your business," he said, "Many of the top companies are switching to plasma cutting for these reasons. Where do you folks stand in that process?" And that's another interesting shift that has happened. More of the managers and companies around the world are looking to the recruiter for insight into what's changing in the marketplace, more than anything else.

Johnson: You are in a place to watch a larger sample set.

McNabb: Exactly. Even if you're brilliant, I'm talking to you and 400 of your peers, so we become aggregators of insight. We bring that insight to our clients, changing their search parameters and goals in many instances. It's a fascinating process. Then, we approach the top performers who are in that post-accomplishment letdown and make them aware because these are things they don't think about. You get so busy being competent in your job that it's easy to become complacent about your career.

**You get so busy being
competent in your job that it's
easy to become complacent
about your career.**

Johnson: That makes sense, but there's one other factor—the unemployment rate is particularly low.

McNabb: Absolutely.

Johnson: In electronics manufacturing, we have this succession gap, which means we also have a knowledge gap. Manufacturers need to hire people and are starting to think tactically rather than a long-term career, and there's a very small talent pool.

McNabb: Yes, there is structural unemployment where there are more jobs for a specific skill set than there are people who have those skills.

Johnson: As a recruiter, what would be your suggestion to the HR department at a manufacturing facility? How do they cope? How do they get themselves so that their facility stays viable and they don't have to close just because they can't get anybody to run the shop while they wait for the millennials to get there?

McNabb: They need to identify a tier-one talent pool and tier-two talent pool. They need to

have a better strategy for engaging those people and attracting them. Let me give you an example. Again, in many roles, there's an extremely small population that has that skill set that they need. What that hiring manager should do is to identify the entire talent pool. At MRINetwork, we do that by identifying which companies would have people with that skill set, and how many people they have in each of those companies. If there are 15 companies with an average of three people in each, there are 45 people who have the skill set that we want.

If there are 15 companies with an average of three people in each, there are 45 people who have the skill set that we want.

However, most people get a candidate and act on that candidate or not. But in many ways, they're guessing about the timing of that decision. If they wait, will somebody better come? Or will they lose this one, and then find they were the best? What we recommend instead is to identify that talent pool and exhaust it. Approach each of those 45 people with the most powerful message possible, which is fascinating because high performers get excited about different things than bottom performers. It's one of the ways that we tell. If the person is saying "I want more authority, lead the charge, work with this exciting stuff, and have someone help me grow," then the chances are very good that they're a top performer.

Then, what we do is identify that finite talent pool. We then co-create the most powerful message, leveraging what we understand are the primary motivators for top performers and that hiring manager's insight into their company. When we combine those two things, we end up with a message that's pretty special.

Johnson: This makes for a pretty solid value proposition for what you do.

McNabb: It certainly does.

Johnson: What if you're at a top-tier company with a full-blown HR department that is able to do that sort of work in-house?

McNabb: There's a problem with that. They can't do it even if they have those resources because they only have access to opportunities within their company. They can't offer the rest of the world. I had one instance where I asked the manager, "Are there any specific individuals you especially respect and would like me to approach on your behalf?" He started laughing and said, "There is a guy who just won a major award with the number one company in our space. We already approached him twice and he said no to us. My employee, who I just promoted, talked to him. Later, I ran into the other guy, talked to him, and tried to get him to interview with us, but he said no again. So, I have nothing to lose. Here's his name and phone number. Go get him, Terry."

Johnson: As a recruiter, that's just a sweetheart deal—one phone call, one guy, and get them in.

McNabb: It is, but the better part of that deal was that once I placed him with the company, the word spread like wildfire throughout the company: "Terry can get people we can't get."

Johnson: There you go.

McNabb: And the only reason I was able to get him is because he thoroughly discounted my client's company. His attitude was, "Of course, I'm not going to go there." But when I was able to engage him and talk about what was going in this or that direction, he responded: "Absolutely."

This key prospect then partnered with me to create a comprehensive strategy to advance his career. But when we examined his strategy, we realized he had a lot of misperceptions about that client. I was able to answer those questions, put him into that environment, and afterward, he said, "This is the best-kept secret in the world. I had no idea that companies

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could be this much different, and that it could be this much fun.”

But back to that broader strategy.

Johnson: Yeah! So if I have an HR department that’s basically using postings on Monster and trying to roll the stuff themselves, they’re not going to find the people that they should be seeking for this position. At least, that seems to be one cautionary tale coming out of this conversation.

McNabb: It’s even worse than that because there are no passive ways to reach people who are not actively looking. What they’re doing is following a selection process, looking at the people who have made themselves the most available, and then selecting the best of those. We start at the other end of the spectrum. We say, “Forget about who’s available. Who are the most valuable people on the planet?” Then, systematically approach each and every one of them with the most powerful message possible.

Forget about who’s available. Who are the most valuable people on the planet?

With my best client—I did a statistical analysis for them at one point—we found that 92% of the people they hired from me not only weren’t looking, but said there was no way they were going to make a change when I first approached them. But then, they got excited about what they could do and be a part of. Surprisingly, money is something like number seven in the top-10 motivators for top performers.

Johnson: And yet, every hiring manager usually puts that in the top three, if not in the top slot.

McNabb: Exactly. Again, the right candidate is going to be more excited about how meaningful their work and role are. Consequently, they

arrive excited. Again, I say in a talent-starved marketplace, managers should have a dual strategy. One is to identify the finite talent pool. Who are the 20–50 human beings on planet Earth who would bring the greatest value to our team? Then, what level of talent do those people have, and what is it going to take for us to win them over? Another vital consideration for a talent-starved marketplace is that a posting will reach a very small percentage of the people who are actively looking. Those who are actively looking typically only amount to about 20% of the workforce. A proactive approach increases the available talent pool at least ten- to twenty-fold.

As a consultant, we approach those people. We engage them by talking about the things that they’re really excited about. Then, we learn what that level of talent is. If someone says, “No,” to us, we say, “Absolutely. I understand. Tell me, what would make an opportunity like this exciting enough that you’d want to investigate it?”

We learn what their motives are such as, “I want a company that will support me as I get these additional certifications. I want a company who will mentor me to learn in these ways.” Notice that all of these are things that companies want their people to want. Then, we go back to the company, help them customize that, cater to the audience, and customize that offering. We get people who never thought they would ever change.

Johnson: That’s powerful.

McNabb: That’s the preferred method, and often, even that breaks down. Who are the people within a commutable distance? Who are the people regionally? Who are the people globally? We can escalate as far as we need, knowing that the relocation costs and stability of that relocation both go in the wrong direction.

But there’s also a secondary strategy. If I can’t get those people and if it isn’t worth doing, then who are the developmental candidates ready to step into that role? Who is best positioned to make that transition? We end up

doing this with a lot of companies as well because, again, structural unemployment means it might be cost-prohibitive to get the few people who could be there.

One of my favorite examples is one of the guys in our company was approached by a client who had a bizarre combination of requirements. We called them “purple squirrel searches” as in that person probably doesn’t exist. But we also organize our information about people extraordinarily well. For example, we might have 30 variables we’ve identified about each person so that we can sort our people in 30 factorial ways. 30 times 29 times 28 is a lot.

Therefore, my colleague was able to say to that manager, “There are five people in the world who have that combination of skill sets. Two of them have an equity position in their company, and there’s not a chance that you can get them. The other three you can get, and this is what it would take.” One of the top things people want to know when they turn to us is in confidence is that they’re making an informed decision—eliminate the chaos.

Johnson: And there’s so much of that out there when trying to figure out a candidate, so that’s incredibly valuable, especially right now. If you’re trying to make sure that you keep the doors open by being properly staffed. And there are a lot of company owners facing that problem.

McNabb: Yes. It’s one of the reasons that I love this career. We’re always six months ahead of what shows up on the news because we’re talking to all the movers and shakers in that industry. Then, we get this news flash and think, “I knew about that six months ago.”

Johnson: What should hiring managers pay attention to as they evaluate candidates?

McNabb: Every hire should be evaluated in three different ways. For managers looking at the overall strategy, this is a vital consideration. The first way that every hire should be evaluated is the total cost per hire. Total cost includes things like postings and ads but also

the management hours per hire, travel and other expenses for that manager, training, relocations, and turnover costs if it’s a bad hire. That can be a difference of tens of thousands of dollars very easily.

The second way that every hire should be evaluated is the time to fill. If it takes an extra 30, 60, or 90 days, that can be hundreds of thousands of dollars. The third way that every hire should be evaluated is the career contribution to the profitability of the company because that can be a difference of millions of dollars.

Never lose sight of what’s important. Find the most valuable people in the world. Think about your own staff—the top performers versus the average people—and count up the millions of dollars over the course of their career with you. It’s an impressive number. Then, find those types of candidates as quickly as possible without wasting any money. If you follow a strategy where you eventually find somebody, but they’re not as good, you might have saved \$20,000 or \$50,000 by doing that, but it cost you \$10 million in the long run.



Johnson: One of the take-aways I’m getting is that when it comes to hiring right now, we need to be tactical, but the tactics better fit into our strategy.

McNabb: Exactly that. The world is changing so quickly that you have to stay on top of that change. That is the number one need that we see from hiring managers everywhere— “Keep me abreast on what’s changing. I don’t want to be the last person to know about something. Oh, and tell me how other people have solved that problem. Better yet, bring me the people who did it.”

Johnson: Thanks for having this discussion with me, Terry.

McNabb: My pleasure! SMT007

Dan Beaulieu on Magnetic Marketing

A Conversation with Barry Matties
I-CONNECT007



Dan Beaulieu, president of D.B. Management Group, has over 30 years of experience in the PCB industry. In this interview, Dan provides his expert knowledge on selling strategies for companies, and covers magnetic marketing, the extent to which education leads to sales, methods of marketing that used to work but not today, and more.

Barry Matties: There's a lot of equality in the strategies that people use for selling circuit boards, assembly, and so on. Most often, it's delivery, low cost, and high yields—all the bits and pieces that you normally hear about. When it comes to selling your services, what are the greatest challenges that you see that they need to overcome?

Dan Beaulieu: Every company that I talk to mentions how difficult it is to get appointments. Their generation doesn't really want to see people. They don't want their time invaded, if you will, like Seth Godin [author and marketing expert] talks about; you have to figure out other ways to get in there and bring something to the party that they need.

You see more and more companies offering technical expertise in the form of newsletters and other items that will help educate the customer and make them stand out in a crossover between traditional and modern. I know a couple of companies that are doing very well with technical bulletins using sales optimization companies. One company makes over \$11 million a year without outside salespeople, but they're putting their name in front of people. That is one way to do it, especially if you're not really selling technology.

If you're selling technology, it's important to create a sense of expertise so that the people who want that technology want to work with you. Years ago, all of the OEMs had their own experts and did their own R&D. Now, I think there are two R&D shops. Other than that, they rely on a circuit board fabricator to do this for them. The circuit board fabricator needs to have enough knowledge to be their PCB expert and to teach them about the board side of the product that they're building today. The fabricator must be willing to invest in the future so that the salesperson is more a guide into the PCB technology.



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The days of befriending a buyer, taking them to play golf, and then getting the big order when you come back to the office are over. There's a little bit of that, but for the most part, as the boards get more sophisticated, companies need circuit board experts. If you're a circuit board expert or you portray yourself that way through content—such as writings or technical newsletters—then you're going to be in good stead. I prefer to use the analogy that you can go fishing or you can get the fish to jump into the boat. If you position yourself as a technology expert, you're going to get them to jump into the boat.

Matties: That's certainly what I call an order-taking strategy versus a selling strategy because the idea is to have magnetic marketing tuned to attract exactly the kind of prospect you want. It is one thing to be out there casting a net and hauling everything in; however, more importantly, in today's marketplace, you have to define a sweet spot and make sure that you're filling that. You do this because that's where your core competency is and the highest level of efficiencies and profit are found there.

Beaulieu: That's absolutely right. By casting the net, you're going to get all kinds of fish, and it will be about what you want to sell. Position yourself as an expert, which creates tribes of people with aligned interests. If you're a golfer, you're going to open every newsletter about golf. My wife, a quilter, opens up anything that involves quilting. If you're interested in RF and you're in the microwave business, you're going to open up anything that talks about RF and microwaves. It has to be very focused—magnetic marketing. It's about attracting people to you.

Matties: In larger companies, there are often defined roles, and they have a lot more resources. But when it comes to sales and marketing, often, you find that there is a sales manager or

a marketing manager—occasionally you find both. However, the role of marketing is a lot different than the role of sales, and I say that if you have a great marketer, then your salespeople become order takers. If you have salespeople out selling, then you're probably not marketing. The marketer has to take all of the value, put it in a story, and make sure that they're communicating that story to the right prospects. If you do that, with the idea of incorporating magnetic marketing, then your salespeople are truly just order taking and closing sales rather than selling and cold calling.

Beaulieu: Correct. What if you have some that are both? Those people should be coordinated well together. Today, I advise people to hire for passion, and you can teach the technology. Hire natural-born salespeople. That's where I



say marketing comes in because you're doing your training, teaching them the company story, and sending them out there.

Going back to magnetic marketing, if you talk about having something to offer, whether it's a webinar or seminar, it immediately puts you in the position of expert, so the customer wants to buy from you, which is what you're saying in terms of being the order taker. To a certain extent, you just have to get out there. They need to know who you are. Many times, people say, "I built this thing. Where is all the business?" It doesn't stop at that; you have to market and tell somebody.

Matties: We often build it and hire salespeople to go sell it, but we're not out marketing it because marketing is one of the areas that many companies struggle with. They may have a sales strategy, like hiring a rep or building a list, but they don't have a marketing strategy.

Beaulieu: Yes, because the things you mentioned aren't strategies, they're tactics. If you're going to describe it, marketing encompasses pretty much everything, and along the way, salespeople are the face and messengers of your company.

Another thing that happens is if you have a strong engineer and they're working in your manufacturing or PCB company, you might decide that you're going to send them out on the road as a salesperson. Unfortunately, when the title of "sales" goes on their business card, they lose credibility immediately. They'll walk into a company, and when it says "sales" on their card when they used to advise people on technology, they don't quite believe them anymore because the customer might think they are spinning the solutions to fit your company's shop. I've seen that happen where you're much better to have sales engineers than regular salespeople—especially as technology grows.

Matties: Circling back to where we started, education leads to sales. Content strategies are being implemented more and more because so many people are losing business to competitors who use them, so they're starting to adopt them. However, the problem now becomes that you then have to qualify the level of education that you're getting from that source. It's easy to say someone has been in plating for three years and is an expert versus a chemical engineer who's been doing it for 30 years. We now have to start validating the source of that knowledge.

Beaulieu: That's correct, and it's the same in medicine. My brother had a career in medicine and always told us to get the doctor who's just out of medical school because they know all

the latest techniques as opposed to the general practitioner who's been doing it for 30 years who hasn't kept up.

It's the same thing because when you have someone who's been plating for 30 years, what we find is as we deal with older companies, that plater knows that one company and hasn't experienced any other organization. I'd much rather hire a person who has worked for five companies in the last 15 years than one who's been at the same company for 30. I say this because the person who has been at five different companies has learned much more about the overall technology than the one who has been in the same house and learned the technology lore of that house.

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Matties: When it comes to selling your services, there's a process—a checklist of things—that you have to have to make sure you sell it properly. First, you see if all of the light bulbs are working. Second, you have to understand what your story is. Third, you have to craft that into a story and have alignment in your organization on that message—this is the value, this is how we want to present it—and bring continuity to that. Lastly, you have to look at the delivery methods. When you look at storytelling, you have to start looking at it in different ways. People throw out the term social media—which we need to be on such as posting on Facebook or having a blog—but after you have the story, you must have the discipline to implement it.

Beaulieu: You absolutely need the discipline. Everything you said is correct. When I work

with a company, I aim to answer these questions: “What are they good at? Who are their best customers? Why are they good with those customers? Why do they like those customers?”

Then, develop the ideal customer profile, which includes technology among other things. The next step identifies who fits that ideal customer profile; from there, you develop target accounts and account plans. The importance of those steps is that you’re not doing it alone. You’re making sure the whole organization and management team is behind it.

Everybody agrees to go after the same kinds of customers: “We’re targeting these types of customers because they have the right amount and type of business and the right attitude that we want.” From there, I make spreadsheets and capture all of the steps. So, if you picture this chart on a wall, you have customers on the left and can see the movement. People start saying, “I get it—the basic step is to contact the customer—but what’s the next step?” The next step is progress to providing a quote, and then win the order. It’s all about having a system.

Matties: Yes, you have to have the system and the discipline to hold your team to utilizing that system because if they start circumventing the system, then you have nowhere to go for improvement because you don’t know what’s going on.

Beaulieu: An example to prove your point is by circumventing the system by going off the account list and throwing out the system. Then, four months later, you’re chasing a whole fleet of customers who aren’t even what the company signed up for. Along the way, you have to make those decisions because you need everybody in agreement, and the only way to track that is with a system. I like the word discipline

because we’re all scatterbrained. You need a path, or you’re not going to do it.

Matties: Yes, and the system needs to be visible as well because if it’s invisible, then you and your colleagues don’t know where it is. My belief is to make your work as visible as possible.

Nolan Johnson: Methods and discipline go together. One of the things that affects teams and organizations is when they start falling off of their assigned methods. Usually, it’s because

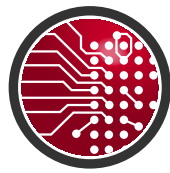
there’s either something about the official methods that are punishing, or there’s a reason that falling off seems to be more effective. It takes some digging to get down to that, but those are two things that tend to happen when you fall off of your processes and methods. Dan, what have you seen over the

past few years that may be methods that used to work, but don’t anymore?

Beaulieu: Like Barry was saying, you have to set the stage. You have to know what you’re going after. Years ago, you would buy a directory or get a disc and start calling. You checked out the Federal identification codes (FICs) and started “dialing for dollars.” That doesn’t work anymore. If people do not know who is calling them, then no one’s going to pick up the phone. It’s an intrusion on the customer’s time. It’s very black and white, and that method just doesn’t work anymore. That’s why you have to do touch marketing, and as Barry liked to call it, magnetic marketing.

The other thing that doesn’t work anymore is “winging it.” Every step of the way has to be coordinated and synchronized; you don’t just wing it anymore. If you get an appointment, you better know what you want to get out of that face-to-face conversation. Chances are you’re not going to make one order, but in-

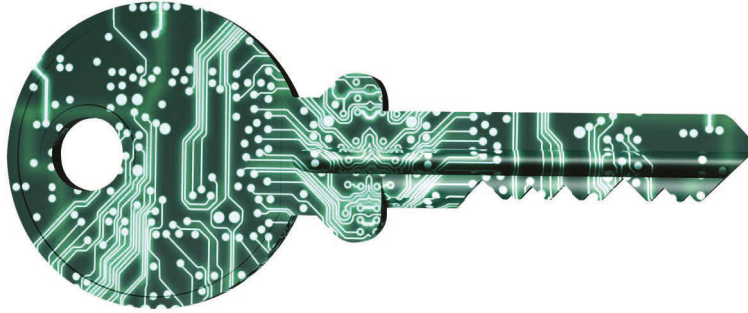




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stead you're in it for a process. The first meeting gets me this, the second meeting gets me this, and you have individual goals for each of those customer touches.

Matties: It's been stated that it takes somewhere on average of five contacts to close a sale.

Beaulieu: Yes, and it's becoming more.

Matties: If you're lucky enough to get a face-to-face appointment, that means that someone is really serious because time is so limited, and people are extremely selective as to who they are willing to spend their time with.

Beaulieu: They need something. They need you to be there. They don't want you there because you want to be there, they want you there because they want you to be there.

Matties: So, the best kind of appointment you can have is one that they call and invite you in rather than you calling in.

Beaulieu: Right, and that leads you back to marketing your story and content, telling people about your capability. You started this conversation by leading with delivery and quality. Everybody says that they have the best delivery and quality whether it's true or not. Meanwhile, we know that the quality and delivery of our American shops average 83%, and yet everybody has 98% quality. I don't quite understand that.

Matties: Here's another selling strategy that I recently witnessed at GreenSource Fabrication. Granted, the company started with a greenfield site in New Hampshire, but they've set up a manufacturing facility to produce the highest technology available at a low cost with zero waste—they're green. They also have the most control over process because it's completely hands-off and digital. GreenSource has so many positive attributes that they're creating a line of customers saying, "We want you to build our products."

I would call this a leap-frog strategy because everything else has become irrelevant with

this adaptation of PCB fabrication. Those that are left in the "red ocean" are just battling it out over those platitude attributes, whereas at GreenSource Fabrication, you walk in and measure everything. Things are being dealt with in a way that we've never seen before, at least in PCB fabrication in America and possibly in the world.

What does it take for a factory that's a brown-field site still working with cell or island manufacturing? You have plating department in one room, imaging across the hallway in another room, solder mask in another, and so on. How do they compete against a strategy like that?

Beaulieu: It's a very difficult thing to do. Even with trying to adapt some of those techniques, it's almost better to rip the whole thing apart and start over. Some equipment of the future is coming in—changes from the laser direct imaging (LDI) to the legend machine, to changes in the handling machines. To do that, it's going to take a while if you're talking about how to compete on a smaller change scale. There are probably things you can do, but they're more tactical than just starting from scratch. To answer your question, how does a 30-year-old shop compete against that? I'm not sure. It's almost overwhelming.

We all have friends in the industry who are chomping at the bit. I talked to a couple last week about GreenSource, and they said, "Why can't I do this here? Why doesn't any other owner have the vision to let me go at this?" One started talking for 20 minutes about all the things they could do. There is talent out there to do it, and maybe GreenSource will lead the way.

Matties: It also looks to GreenSource's roots, which started as a captive facility; as far as I know, it was the first captive shop opened in some time. Due to their results and capabilities, they are moving into an independent or job-shop model. Granted, they're not in full-pace production yet, but they're producing boards over there, and I think that many OEMs may find that staying at the captive facility might be a better way of going.

Beaulieu: I have a feeling that it's going to be non-U.S. companies that are more interested in this than U.S. companies. China, Taiwan, and Europe seem to be the most interested in what GreenSource is doing.

When contacts from the countries I've mentioned talk to us, they discuss building a shop in the U.S. to do some product-leader stuff, particularly in automotive. As you know, the automotive pre-production orders are very big for our country, and international firms are looking. I have one in particular who is looking at building a shop that will cost \$40 million to deliver automotive work with 25 people. In the U.S., I hope we'll have companies who look at this and have it create an impetus for them to move forward in that direction too.

Matties: When you look at the way that they approached it, GreenSource picked their path. They said, "Here's what we're going to do, how we're going to do it, and how we're going to win with this strategy and leave everybody else behind." I think they've accomplished that and are at the beginning of that strategy in full production.

Beaulieu: Yes, and I'm really anxious to go there. Years ago, there was a company that was one of the first to nest many part numbers on a single panel. Their marketing and advertising was all by hand. They would send out postcards. If you placed an order with the company, you never got rid of them. Their competitors were up in arms about this like they were cheating somehow, but they were just doing it a differently—not the way that GreenSource is doing it, but on a much smaller scale. For years, people complained that they dared to advertise and complained that they were putting many part numbers on a panel, which a lot of people do now.

Again, that was a game-changer that people didn't like.

Matties: Yes, and that's good; when you're in a crowded space, create a new strategy that makes everybody else irrelevant. We've talked about GreenSource Fabrication, but not everybody is going to be a GreenSource customer. There's certainly a lot of business still for those that are not competing head-to-head with GreenSource and that technology.

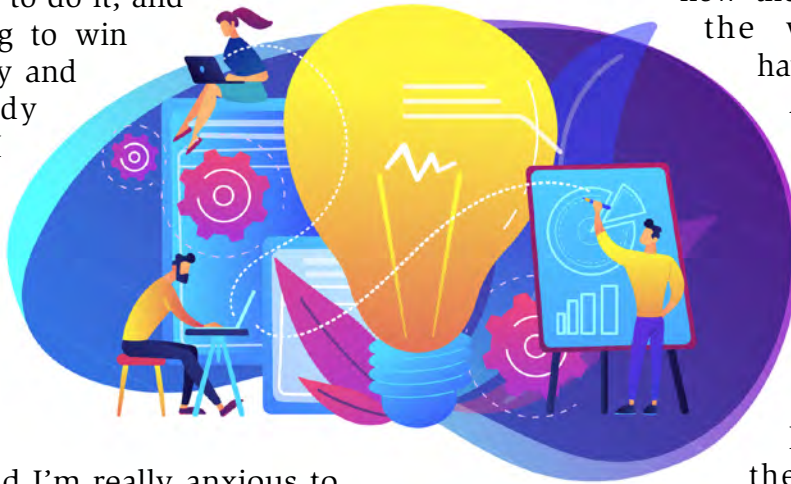
Beaulieu: Find a way. So many times, we'll come up with an idea for somebody, and the first instinct is to come up with 50 reasons why that idea won't work. Well, try it. I'm sure GreenSource didn't get it right the first time. They had to think, go to their drawing board, and figure things out; now, they have this gem, but you have to try it first. I'm sure some people said it wouldn't work or questioned how they would do it. That's the wrong attitude to have. That's not a good American attitude because that's not the way we made this country.

Matties: Great advice, Dan. When it comes down to it, people have to look at the value that they bring, identify how it's unique and how they can separate themselves apart from the competition bringing value, and communicate that story. Thank you very much for your time.

Beaulieu: Thank you. SMT007

Dan Beaulieu is president of D.B. Management Group and an I-Connect007 columnist. To read past columns or contact Beaulieu, [click here](#).

Read more about GreenSource Fabrication; see our coverage in the October 2018 issue of *PCB007 Magazine*. [Click here](#).





Nate Ramanathan on Choosing a Prototype Partner and Production Supplier

Feature Interview by Nolan Johnson
I-CONNECT007

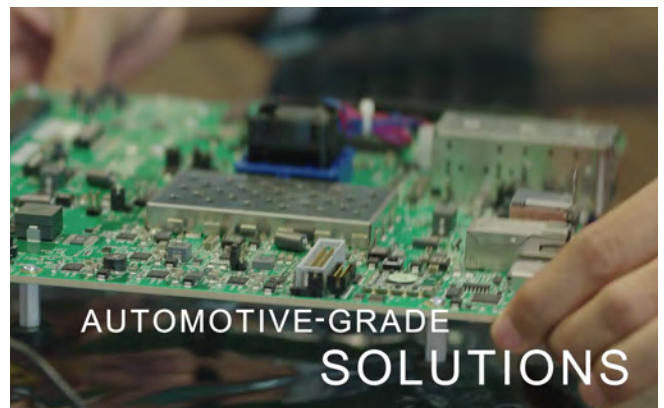
Nate Ramanathan is the VP of operations at AEye, a developer of perception systems for autonomous vehicles. AEye has transitioned from initial engineering development into the final design for production and manufacturing of very large quantities. Because the boards will be particularly complex once assembled and must withstand extremes in temperature and humidity, AEye's designs must be robust and high yield.

As I spoke with Ramanathan, AEye is in the sweet spot where the PCB manufacturers like to come onboard with a startup—beyond prototyping, just finishing designs, and holding a forecast for product sales. As such, Ramanathan's criteria and perspective on selecting vendors speak for the general trends in the industry. In other words, his thinking is similar to most every prospective new customer that a CM will encounter. I found Ramanathan's perspective to be specific and creative.

Nolan Johnson: As we start this conversation, can you tell us about your role at AEye and what AEye does?

Nate Ramanathan: Sure. As the VP of operations at AEye, I cover manufacturing, pilot, supply chain sourcing, procurement, facilities, quality, regulatory, and everything else. AEye is a perception company—robotic perception in particular—focused on iDAR, or intelligent detection and ranging. Our system uses solid-state agile LiDAR fused and boresighted with a low-light HD camera and embedded. And all of it is software definable, allowing customizable data collected based on the customer's needs. Our differentiator is our architecture.

Johnson: Before this interview, we were talking about where AEye is in your go-to-market plan. You're a startup and also moving from proto-





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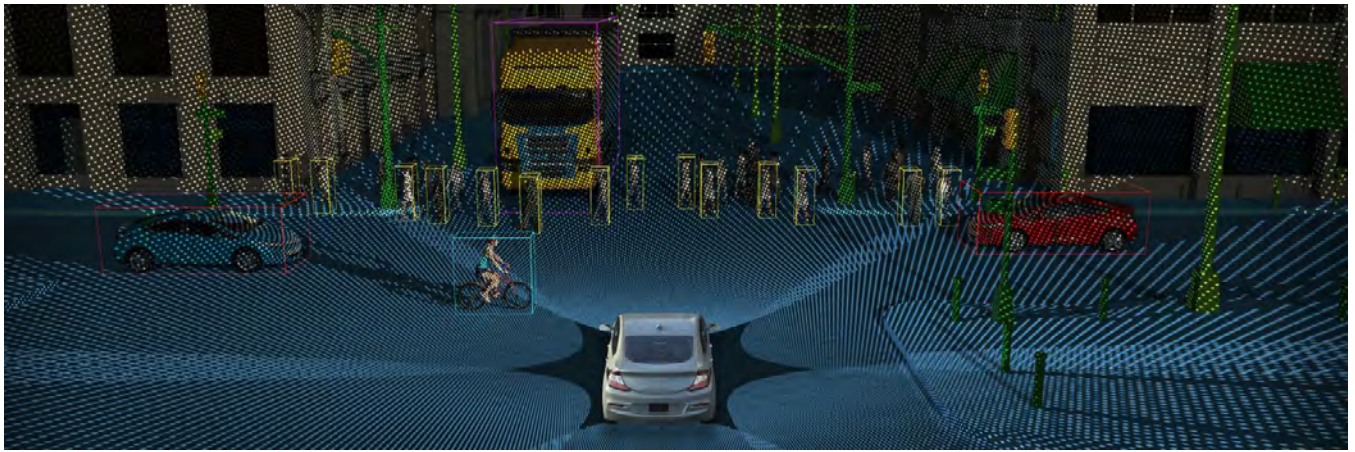


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type to preparing your components for volume manufacturing. What are the immediate types of challenges you're facing as you transition to optimizing for production and selecting manufacturing sources?

Ramanathan: This industry is going through the early stages of an “ah-ha” moment—the next big thing. Everybody wants to go there, but the proof is, “Can you do the volumes?” Not just volumes, but at automotive quality. One or two pieces for prototyping is great because you can tinker with it and fine tune it. But when you go to the 100,000, 200,000 units, or a million units and you have a small flaw, it just blows up the market. So, how do we get this technology over to that level, like everyday use, where everybody gets in and out of an autonomous vehicle and feels confident.

When I came on board, the very first question when I talked to AEye was, “Are you going to manufacture in-house?” They said, “No, we don't have that core competency.” “Thank you. I'm on board.” That's all it took me because I've dealt with a lot of manufacturers. I have been on both sides of the aisle. I was with a large medical company—\$80 billion—being a customer to most CMs. Then, I switched places and came over to CM for four years, and I saw on both sides there is a communication gap. When I came on board with AEye, I said the first thing is design for manufacturability (DFM), design for cost (DFC), design for supply chain efficiency, and design for quality (DFQ). Everything starts at the design. If you are going to make it in the millions, think and act like that.

For CMs, play the game early. If you do not know the technology and are not keeping up to speed with what is needed in your manufacturing, you won't have the setup to attract companies like us. When I talk to any CM right now, I tell them the same message: “I'll give you the list. There is no hide and seek. I want the supply chain to become large enough that we can achieve cost efficiency.” If it's micro and there are only very few players, we don't get the cost efficiency. The message is, “If you want to play this game, invest some time in the technology and follow us.”

Johnson: It sounds a little bit like, “Build it, and they will come.”

Ramanathan: It's not build anything, and they will come, but build what is needed. They will come. I've already opened the door to some of the CMs and told them, “If you are interested in earning the business, here is what you need to have for capabilities, and then we'll talk.” I'm not going to wait for you to build a factory after I am ready with a product; it will be too late. Walk with me from the beginning. This is the technology that is growing by the day. I want somebody to be ready when I'm showing these things as concepts. I show the timeline and the brick wall. It's just 11 months out, that's it, and they look at me like, “Oh my gosh.” It is aggressive, and we know it. If you want to play this game, you have to be ready. That means you cannot have that, “We will wait for them to give me an RFI, RFP, or RFQ, and then I will shop for equipment.”

No, these are technologies you have to have in-house. Some understand better than others, and some are going to learn when they miss the boat.

Every time I meet with a CM or a potential supplier, I say, “These are the few things you need to look at. I’m not going to spell it out; it’s not rocket science.” What is this LiDAR technology? There is laser, and there are optics, cameras, and boards. Like most technology products, the size is going to get smaller and smaller. In addition, what kind of certifications do you need to have? That’s most of the questions. They have to sit down and have a task team and ask these questions. Some CMs have started thinking, “We have to get in the game!”

Johnson: Which is much better for them.

Ramanathan: Exactly.

Johnson: It’s worth the preparation. You mentioned where the brick wall is on the timeline. By that you mean that’s the point in the schedule where you’re pitching it over the wall to production, and they have to be able to manufacture it or not.

Ramanathan: Yes, and not just manufacturing, but manufacturing an automotive-grade product. To elaborate, our mantra is very simple: QCDC—quality, capacity to scale, deliver on time, and cost. Cost is the last piece at this point. It’s going to shift, but it’s never going to exceed the quality because it’s about people’s safety. Quality is first, and the capacity to scale is next because if you prove something small, you have to take it to the market in volume. For example, for a phone launch, if you get out to market with 100,000 or 200,000 units, and then you stop shipment for two months, it will be a disaster.

Instead, once you get it right, scale it to the maximum—you make the most out of that market—and then you can do iterations after iterations to improve the product because now you have the market. If you cannot increase the capacity of your production at the right quality, you will not hit the volume delivery.

Your cost will increase and you will have all kinds of problems. For us, if a vendor who participates in the quality and scalable capacity and can deliver on time at the right cost, they are the partner I want to go with.

Johnson: That makes sense. Can you tell me a little bit about the kinds of technologies you’ve incorporated in the PCBs in your products?

Ramanathan: I cannot give out details. Predominantly, we use FR-4 boards in the first generation. I can tell you it’s all going to get smaller in size, even micro/micro-e and automotive grade that withstands high temperatures, shocks, and vibrations.

Also, the major area where CMs will have to learn is the technologies on the laser side because the laser also has to get smaller in the near future. And 905 is not eye safe, so they have to take a lot of precautions (1550 is eye safe). Thus, before the 1550nm supply chain grows bigger, CMs should get on the boat early on by doing the right investments.

The message I want to pass on to CMs is this: Take early-stage growth companies seriously. If an early-stage company has series B funding, then they are getting some good work done. If the same company has products with OEMs and is talking to large players in the industry, take them seriously. A lot of CMs will ignore early-stage companies. Don’t ignore them because Facebook, Uber, Google, and many other companies were at that stage not too long ago.

Johnson: For my readers who work in the PCB fabrication side of things, could you give them a benchmark? When you’re finishing your prototype and getting ready to go to production, what kinds of geometries, sizes, and layer counts do you work with now? Where do you think you’re going to be three to five years? In other words, if you’re talking to them about wanting to be ready when you get to the brick wall on the schedule, where do they need to be with capabilities to even start?

Ramanathan: Right now, we are developing our next-generation product. It is 50% smaller



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than our current product. I can shrink almost all of the components that go in it. The board would be my first target. Right now, any example of a medical device (e.g., pacemakers) has shrunk in size by several orders of magnitude in the last two decades. We are on the same path. We are looking at three to five layers, and it has to be automotive grade and withstand harsh-environment testing. Additionally, we have to be ASIL-B certified, which means you have to have an automotive-grade board. Thus, our next-generation product will be ASIL-B certified.

Johnson: I take it you mean off of regular FR-4 and onto some of the other, more robust materials.

Ramanathan: Exactly. Right now, we use FR-4 high-temperature boards, and we are always looking for technology that can make our product better with regards to performance and cost. From a layers perspective, I would like to use five or more layers if that helps us reduce the board footprint down. Like all other automotive products, our products must withstand high-temperature variations, shocks, vibrations, etc., in case somebody has it in their truck and wants to off-road it. Early-stage companies are not the experts in DFM. Offer that service, put a design guideline to support us, and that's how you show that you are a partner. For example, help us design it correctly right out of the gate. Provide us with design guidelines. Be a partner.

Show an early-stage company how if they do it right, they will come into the RFI/RFQ

phase with a leg up against their competition already because they used your design guidelines. A lot of people don't get it. I cannot explicitly say that because I am talking to five or six companies and waiting for them to come back and say, "Here is my design guideline or best practice. I'm giving it to you, and I want to partner with you. Instead of the old-school mentality, I will do the DFM after

I get the business." Build the relationship, and they will come to you.

Johnson: What you're saying is, "Stop being so transactional. Instead, be more relational."

Ramanathan: Yes, because everything is about the relationship. The investors and customers trust you because they have the relationship with you in the initial stage; you're not making a lot of money, nor are you revenue driven at this point. CMs always think, "If they make money, then I make money. If they don't make money, I lose it." Don't think that way. They might not make money now, but they will soon. Become a partner and start working with them at an early stage.

That doesn't mean you should act blindly and just forget about the whole bottom line. Look at the long term. When you invest in something, it's all about long-term growth. Nobody thought that the phone industry was going to be so big. Autonomous driving is on the same path now; it may not be tomorrow, but it's coming. Air taxis are coming.

Johnson: AEye is a U.S. company based out of the Bay Area. Is there a preference to stay in the U.S. with your manufacturing?

Ramanathan: Yes. I'm very open about it and have been vocal for the past 15 years. Intellectual property is what puts us in a better spot. I wouldn't do anything that would compromise our intellectual property. However, I want cost savings, and I also look at the total cost of supplier ownership. If I make it in the



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Bay Area, how much is it going to cost me versus if I make it in Malaysia, Thailand, or Taiwan? In short, what financial resources do I need to spend on the overall cost of supplier management? I might be worried about my IP, so I would not go to certain IP risk areas for manufacturing.

Companies always say there is an IP screening wall, but things can go bad very quickly on the IP side. We are not big enough or resourceful enough to fight that right now. What we want to do right now for the next two to three years is keep it within the U.S., and then slowly migrate into countries with safe harbor where we can be careful about our IP. I don't have time to worry about my IP being safe. For initial manufacturing, anywhere in the U.S. is fine, and then have a plan for cost reduction to safe, low-cost countries.

Johnson: It sounds to me like the size of the company you work with is not that important as long as they can hit your four criteria.

Ramanathan: Yeah. The size of the CM doesn't matter, but their technology matters—what they have and their talent pool. Another thing is the ability to scale the capacity, which is where the size comes in—if somebody is large enough to throw in \$10 million into a first factory to launch and not worry about getting money from me is a huge advantage. I don't

want to be in a position to fund a CM to expand their operation.

Johnson: I'm going to ask a pretty pointed question right now if you don't mind regarding sales strategies.

Ramanathan: No problem.

Johnson: How should PCB manufacturers and assemblers sell their services to you? You represent the kind of customer that my readers are looking for.

Ramanathan: While a product is in prototyping, speed is very important. Most small CMs work based on advances. You pay them 50% before they even touch anything, but then they can turn it around in 10 days or less. Speed is what was driving the selection. If a salesperson from a CM comes to the engineer and offers to deliver faster than anyone else in the market, you are in. I hate to say this, but the most common entry into an early-stage company is through their engineers because there is no operations or sourcing team.

When an operations team is in place, you need to be connected with them and not avoid them. The first thing sourcing people want to know is, "How are you going to give a quality product on time that costs less than what we pay now?" They want to have an open book

and a cost-plus model. That is not possible at a prototype level, and most sourcing teams would understand that. It is your job as a CM to make them feel comfortable. That cost reduction will follow volume and product maturity, or even better, give them ideas on where they can save money (design for cost, or DFC).

The bottom line is get in the door. Sometimes, that's as simple as cold calling. Being best is not



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enough. In addition, try to add value to your customer. Know the business as far as what they offer. Give me something that catches my eye. Tell me what differentiates you from your competitors.

Johnson: A Google advertisement from a potential supplier is not doing it for you.

Ramanathan: I have other investments and business that use Google ads, but this is not a Google-ad model. I don't go to Google ads to pick my suppliers, at least not for a long-term production need. Most of the early-stage companies and large companies do use Google search, but if CMs reach out first, you're most likely going to get the business with an early-stage company faster than with a large, matured company. With early-stage companies, come with the right attitude. We know you are in the early stages, we know you will grow, and we want to be there with you during this journey. It's about taking the risk and being that seed investor that believes in an entrepreneur. That doesn't mean you have to go to a two-person company who doesn't have anything except a lofty idea. Balance the risk.

**We know you are in the
early stages, we know you
will grow, and we want
to be there with you
during this journey.**

You have to understand and do the homework. It's not like selling things. It's more about research and saying, "I see your product and the form factor of this size. You are an automotive business, and here is the automotive grade we do." The moment you say you're doing automotive-grade boards or have the technology to do it and can build a prototype, I'll

give you everything to scale it up if your model is a prototype only. You could also say, "I can build you a prototype and volume, and we can negotiate the price. I'll compete with others." The moment that the comfort zone kicks in, people will order. Prototypes are all about speed. If you can get it to seven days instead of 10 on the prototype side, that's good.

Johnson: And is being on schedule paramount once you're in production?

Ramanathan: Schedule is important at all stages. At the production stage, it not only affects us but also our customers. Automotive customers are far less forgiving when it comes to schedule slips. If things are not going as planned at a vendor, everyone panics. The unknown is scary for them. Most importantly, if you are going to miss a schedule, please give advance notice, and come up with a quick recovery plan. Don't compromise on the quality of the product. Early-stage companies are always in a race against time, and you're also taking a higher risk than usual. Do that knowingly because if you don't, you're going to hurt yourself. You're going to have a bitter taste toward startups as a whole. CMs need to understand that it is important to treat an early-stage company the same way they treat a matured company. It is also important to be a partner.

Johnson: When is AEye's target date for the New Product Introduction?

Ramanathan: Our next-generation mobility products will be available at the end of this year, and our ADAS-integrated product will be available for the 2021–2022 model year. We also have a few surprise products in between that are in the pipeline. So, it is really important for us to work very closely with partners. Come be a partner with us in this exciting journey!

Johnson: Fantastic. Thank you.

Ramanathan: Thank you very much. **SMT007**

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MilAero007 Highlights



SMT Electrolytic Capacitor Solder Joint Criteria and Integrity Investigation ►

The body configuration of SMT electrolytic capacitors results in the solder joints being only partially visible for optical inspection purposes. Therefore, the use of adequate reflow soldering processes is critical for producing solder joints that are acceptable for their end-product use environment.

Defense Speak Interpreted: PERM—Pb-free Electronics Risk Management ►

In this column, we explore PERM—the Pb-free Electronics Risk Management Consortium. No, the group members do not all have curly hair! The name was chosen around 2008 by a group of engineers from aerospace, defense, and harsh environment (ADHE) organizations.

Top 10 Most-read MilAero News ►

Every year, we like to take a look back at the most popular military/aerospace news and articles. These are the top 10 most-read milaero news items from the past year. Check them out.

Sanmina's New DTA Status Supports Make in India initiative ►

Sanmina Corporation has been granted Domestic Tariff Area (DTA) status at its manufacturing facility in the Hi-Tech SEZ (Special Economic Zone) in Oragadam, Chennai, India. This enables Sanmina to support the Make in India initiative, an effort driven by the Government of India to encourage the manufacturing of more products in India.

Electrolube Achieves Global Aerospace Standard AS 9100 ►

The AS 9100 standard recognizes Electrolube's excellent manufacturing and service capabilities

that address the aerospace industry's demands for safe, reliable products that meet, and wherever possible, exceed the requirements of customers and all regulatory authorities.

Sparton Issued Two U.S. Patents on Electronics ►

Sparton Corporation announced the issuance of two patents to the Company by the United States Patent and Trademark Office.

DDC Recognized for Flawless Manufacturing Execution by Harris Electronic Systems ►

Data Device Corp. (DDC) received the 2018 Flawless Execution Award for exceptional quality and delivery performance from Harris Electronic Systems, Melbourne, Florida.

National Circuit Assembly Renews AS9100D Certification ►

National Circuit Assembly, a provider of PCB, cable, and electro/mechanical manufacturing and test services to leading OEMs announced that it successfully completed the recertification audit for its AS9100D certification.

Nortech Systems Unveils Leadership Changes ►

Nortech Systems Incorporated released several leadership changes that went into effect on January 1, 2019.

Libra Industries Adds Robotic Conformal Coating Capability ►

Libra Industries purchased a Delta 6 robotic conformal coating/dispensing system from PVA. The system was installed at Libra's Mentor facility last month.

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Eureka Park: Chock Full of New Customers for a Market-maker

Feature by Nolan Johnson
I-CONNECT007

Elsewhere in this issue, we interviewed Nate Ramanathan, director of manufacturing at AEye. In that conversation, Ramanathan makes the point that fabs and CMs should look for startups, and that manufacturing firms should build relationships early on with startups.

There is, of course, the perception that it takes a large amount of work to find those startups. The sales team can't afford to go to a bunch of industry shows not to mention that startup-oriented expos rarely specialize in electronics. The result is that a sales team can spend a lot of unproductive time trying to find electronics startups.

Eureka Park at CES, it would seem, is the exception to that rule. Occupying the ground floor of the Sands Expo, Eureka Park provides small, compact booth space for startups. The place is packed with all sorts of companies; by my unofficial count, nearly 1,250 exhibitors, representing more than 30 countries of origin. Not all exhibitors are developing hardware; many are software

only or integrating off-the-shelf components, at least for the time being.

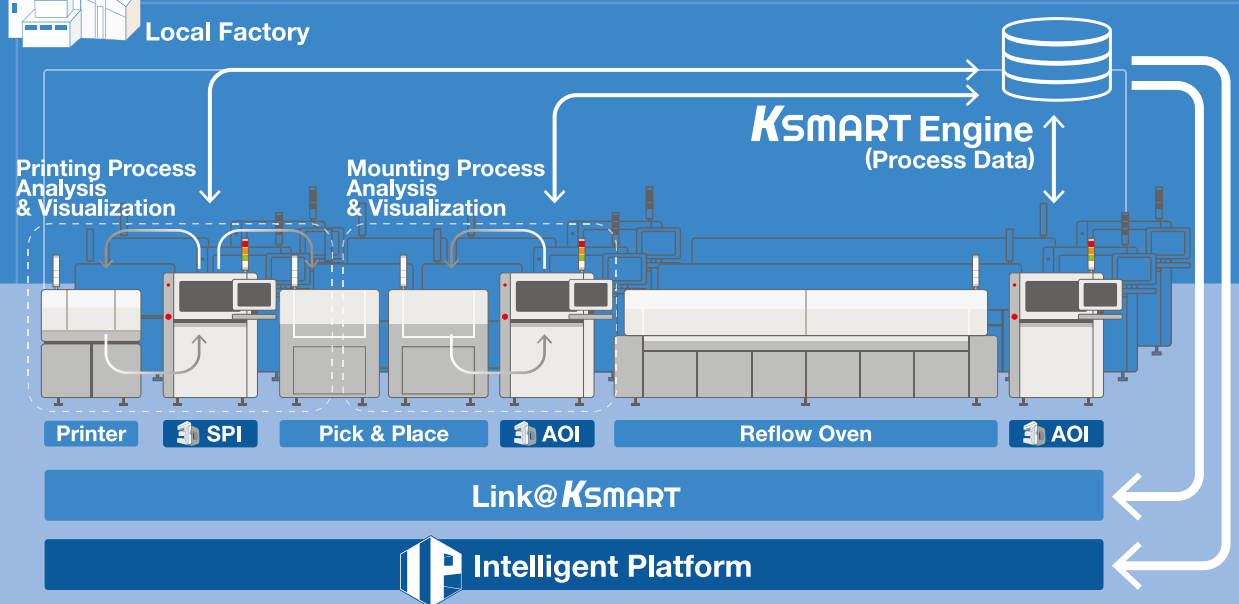
Equally as numerous at Eureka Park were the visitors. The floor was often packed like rush hour on a big-city subway. If a fabricator or contract manufacturer were taking Nate Ramanathan's advice seriously, they would be here, talking to electronics startups in the throes of making the jump from prototype to production. With that in mind, I spent a couple of hours testing Ramanathan's claim by talking to some hardware-oriented startups.

MintT

First on tour was MintT, a Brussels-based company focused on medically intelligent technologies. The tagline on their show brochure



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promoted “Intelligent Sensors for Ageing.” MintT’s ISA product detects all falls and irregular night-time activity occurring in the sensor’s field of vision, and measures actimetric data. All of this leads to some measurable understanding of a patient’s real-time activity in their living environment.

I spoke with Jerome Laurent-Michel, a nurse on the company staff. Jerome helpfully informed me that the ISA product is shipping and currently watches over about one million people in hospitals, flats, and other housing. Laurent-Michel confirmed that his team had met with potential investors at Eureka Park, though not with manufacturing opportunities.

As a nurse, Laurent-Michel was hesitant to talk technology with me. He was, however, content to discuss the product’s applications. And yet, there were no significant inquiries about ramping up production from any manufacturers.

Norm Glasses

The Norm Glasses product is an AR smart glasses design that looks and wears like nor-

mal sunglasses. Developed by Human Capable Inc. from Weston, Florida, Norm Glasses are described in the product collateral as “Google Glass and Alexa in a stylish form factor.” This is not too bold a claim given that Norm Glasses look very similar to a pair of Wayfarer-style frames—not the bulky, multi-part, bulbous AR glasses form factor to which we’re accustomed. Norm Glasses were not allowing actual demonstrations, so user experience could not be determined yet.

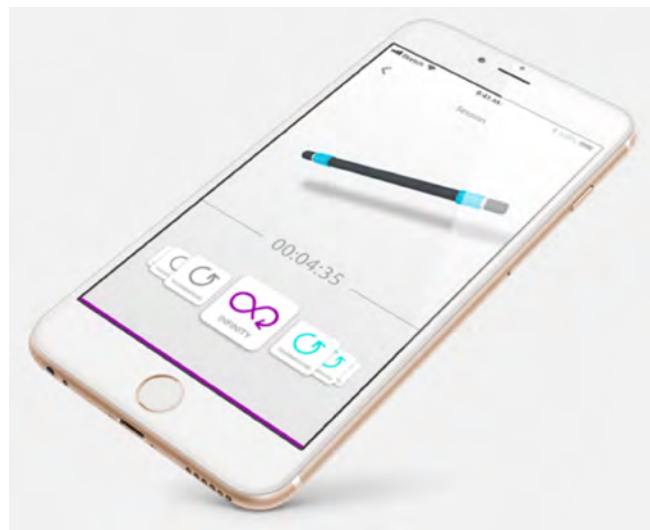
I asked QiLun Sun, managing director of the company, what his CES objectives were, and he said, “Brand awareness, user feedback on use cases that we haven’t thought about, and potential manufacturing suppliers.” Sun isn’t looking for funding at this time. When I asked if any suppliers had approached him, he shook his head no and gave a little shrug. They were certainly drawing a large amount of attention for their product, however.

STYL

Zacharie Chapuset, co-founder and CTO of STYL, was definitely there to find investors. Paris-based STYL has a skills game platform for pen-spinning (spinning the pen around your thumb or between your fingers) that uses hardware in a game stylus and smartphone app software.



Norm Glasses from Human Capable. AR/VR glasses on display in the Eureka Park pavilion at CES.



An image of the smartphone app supporting STYL’s hardware-software combination game for pen-spinning.

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The Robbox smart Modular Driver handle with various tool attachments.

The STYL booth was full to bursting with staffers eagerly talking to lots of visitors. The smartphone app software talks to a custom-designed baton that the player uses as a pen, spinning it around the hand in any one of the many possible tricks. The app tracks the pen's motion, enabling any number of games, challenges, and videos to be made available to the online community within the app.

A crowdfunding project is planned to go live within the month. Still, Chapuset would like the opportunity to find additional (more traditional) investors. His team is also looking to build a list of potential distribution partners. Chapuset is going to need manufacturing, but so far, he's made no significant manufacturing contacts at CES.

Robbox

Andrei Matei gave me a tour of the Robbox products based out of Vancouver, British Columbia. He said, "We're here to revolutionize the power tool industry. We're taking the technology that's already out there today and integrating it to give you much more use out of your tools. We have two lines. One is a modular line, and the idea behind that is to reduce the number of batteries, chargers, and cables in the home. You have one unit, one battery, and one charger, and then you purchase whatever attachment heads you need for jobs around the house—the garden, garage, you name it."

When I asked if the individual tool heads identify themselves to the base unit, he nodded and continued, "Each tool attachment has different features. You connect the head, and the features are accessed through the touchscreen interface on the base handle unit."

Robbox's primary objective for exhibiting at Eureka Park included, "Building our brand awareness. We knew from the first year that people loved our product. We want to stay in touch with the big competitors like Stanley, Black & Decker, and TTI. We want to keep them up to date and let them know we're still here. We open those doors and continue that conversation to see where it leads us."

The Robbox products are working models, and Robbox is looking for investors. Robbox is working with a company that specializes in mergers and acquisitions, allowing the Robbox team to concentrate on product and channel development. I sensed that Robbox also sees a purchase by one of the large tool companies as an option as well, though Matei did not say so outright.

I asked about the components in the electronics, and Andrei answered, "I'm in charge of the business development side, so I'm not exactly the most knowledgeable on design. I do know everything is built in-house. We do the software and all of the firmware. We purchase the components separately." Matei confirmed that Robbox is looking to talk to manufacturing partners

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Andrei Matei with the Robbox Robotic Drill. The drill includes a wide range of built-in features including laser measurement, leveler guides and drill speed based on selected material.

while at CES, “we’re always open to talking to any possible people who want to collaborate.”

I asked if Matei had been approached by any manufacturers looking to partner, and his response was more circumspect. He explained, “I don’t know exactly who these partners are yet; they gave me a brief spiel about what they do and leave me their contact information. That’s something for me to go back to the office and research, but we have met a few.”

Matei wrapped up that thought with, “We’ll see where that takes us from here.” And, as if on cue, just at that moment, I was courteously shouldered aside by a tour guide with a group of 10–15 people following him, all wearing headphone receivers tuned to the tour guide’s microphone. The guide identified his group as representatives from United Rentals, a U.S.-based national commercial equipment rental company. The likely conclusion is that United Rentals is looking for new products to add to their inventory.

All of this begged the question: Why wouldn’t manufacturers be looking for this kind of relationship?

Become a Market-maker

Admittedly, a four-conversation sample size out of 1,250 exhibitors is not statistically valid, but statisticians will tell you that overwhelming trends become visible very early in the data set. If that’s the case, then it seems quite feasible that most Eureka Park exhibitors with a hardware product 1) have a prototype that is demonstrable, 2) are looking to move into production, 3) do not yet have a manufacturing chain established, and 4) could use all the partnership help and mentoring they can find.

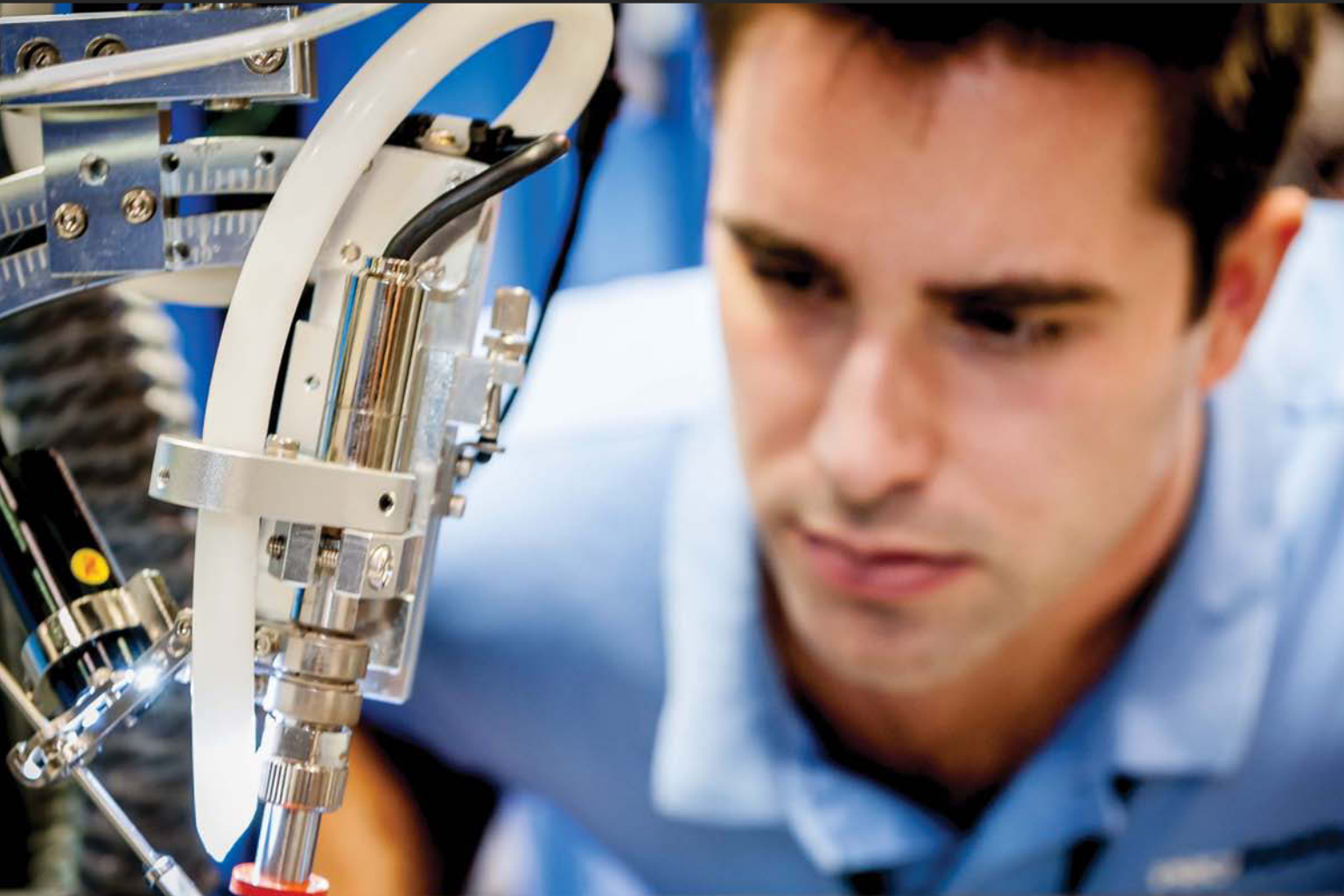
In fact, Robbox seems to be an ideal candidate at exactly the right time. Their product is beyond prototype and ready for production, the company is building out the manufacturing supply chain right now, and customers interested in quantity purchases are lining up at their booth to learn the latest. Especially in Robbox’s case, the risk seems pretty minimal.

Nate Ramanathan’s proposal that a manufacturing partner should consider investing in a startup company considered to be a promising prospect seems to hold water in this sample size. Three of four would have welcomed manufacturing help, including the prospect that it came with an investment in the company as well.

There is risk involved investing in a startup, but the relationship between startup and vendor, structured as a partnership, creates more commitment—skin in the game, if you will—than a simple transactional arrangement. When I followed up with AEye on this story, they observed, “The investment of dollars and expertise [from a manufacturing partner, in this case] accelerates an early-stage growth company’s ability to succeed and beat its competitors on quality and velocity versus merely trying to beat them on cost.” This could be the difference between the startups’ success or failure, and a long-term manufacturing customer or a handful of prototype orders.

By targeting a densely-packed, target-rich environment like Eureka Park, sales teams could make effective use of their prospecting time. Yes, it would seem that Ramanathan may be onto something: Manufacturers as market-makers. **SMT007**

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The Truth Behind AI

Accelerating Tech—Insights from the Smarter Factory
by Michael Ford, AEGIS SOFTWARE

The term “artificial intelligence” or “AI” has become a source of confusion for many—heralded as part of Industry 4.0, yet associated with the threat of automation replacing human workers. AI is software rather than hardware, and not yet the entity that destroys civilization, as Hollywood movies would have us believe. It’s time to put these elements of AI into context, enabling us as an industry to embrace the opportunities that so-called AI represents without being drawn in, or pushed away, by the hype.

What is AI to You and Me?

There are two distinct flavors of AI in people’s minds. The first came in for many as plotlines in Hollywood movies where futuristic machines would take over the world. The criti-

cal element of the story is not the machines that do harm, but the software that drives them where a sophisticated algorithm became able to think for itself in a way that was likely not intended. It is this aspect of achieving thought without the specific coding of such thought processes that define true intelligence. Humans are credited with having intelligence already, though there may be exceptions. Machines, on the other hand, are guided only by their software, which is limited to being reactive to events that take place and are communicated to them today. They follow a set of rules designed to achieve the desired result.

It is claimed that general human behavior can also be modelled, albeit by a far more sophisticated and evolved process. The achievement of, or at least the perception of intelligence,





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could well be simply an extension of the ways computer software algorithms work, which would have to be the case if machines were ever to think for themselves. This allows many to claim “intelligence” in our current assembly machines and related software. Such claims are designed to set customer expectation that newer products are much cleverer than before, creating more value and performance, which in most cases, is a neat and accurate description of new machines and robots we see coming into the market.

Becoming smarter and more intelligent step by step is great, but how many steps are there left to take before we reach a truly artificially intelligent process that can think for itself? The continuous investment in AI is bankrolled from sales of continuously enhanced machines and software. With things moving so fast, when is the best time to invest in smart solutions when the next step may be just around the corner? If an investment is made into state-of-the-art smart software solutions today, would it become obsolete in the very near term?

If an investment is made into state-of-the-art smart software solutions today, would it become obsolete in the very near term?

No, and the reason is that there is a growing distinct difference between the hardware and software elements of smart solutions. The difference has so far been hidden, as most physical tools that we purchase for use in assembly manufacturing consist of a package of both hardware and software. To evolve hardware requires a long lead time due to physical product development cycle constraints, whether mechanical or electronic. Meanwhile, evolving software can be done orders of magnitude faster. We all have experience with devices, ranging from smartphones and PCs to the latest SMT placement or inspection machines, to

find that there are frequent software updates that change and (usually) enhance the operation of the hardware device. Don't think that the machine vendor missed the opportunity to add value at the start, or that there was any problem with the original machine or device software; those days are largely passed.

As software is not a physical entity, it evolves more as a flow rather than large step by step iterations of hardware, so new values can be introduced as they become available. This fundamentally changes the way we invest in software solutions. We see today that Microsoft has stopped releasing new versions of Windows, and instead, is providing incremental updates continuously to customers who see what they use as being Windows 10. If each change to Windows had a major release, we would probably be running something like Windows 42 by now with each new release bringing with it costs and concerns. Instead, improvements are introduced gradually, with minimal impact on usage. Hardware has a limited rate of evolution seen as products evolving in discrete steps, whereas software is free to roam in a far more flexible way, delivering greater flexibility and greater opportunity for becoming smarter and faster. This all comes for an initial investment, or preferably these days, a subscription that allows us to pick and choose exactly what software we would like to use as time progresses. This is quite critical as the pace towards AI in software picks up momentum.

The Origin of Digital Intelligence

The chicken-and-egg discussion of whether hardware development leads to software or vice versa is more interesting now that we see software evolution as a flow compared to the stepped changes in hardware. However, software enhancement has begun to break away from the hardware where AI applications and smart operations are concerned. An interesting example, historical to many, is the evolution of the smart warehouse. Without software, the typical original warehouse model was to organize locations by part number with some sort of bin allocated for each. These were arranged in alphabetical order so that human materials



operators could easily find materials to create kits. Unfortunately, this has never been an efficient use of space in a warehouse. As new part numbers were introduced and others became obsolete, gaps would need to be physically created or closed up. Many bins would overflow or go for long periods of little utilization as consumption rates varied over time. Changing bin sizes and moving the bins around represents a major physical challenge, creating significant temptation to simply work around the exceptions and rely on human flexibility to cope.

The first simple warehouse management software came to the rescue, as it was realized that computers were usually far better than humans at remembering where materials had been stored to the extent that alphabetized order was no longer required. Materials could be put away anywhere usually into any unused bin—which was a model known as random storage. The selected location would be recorded against the part number and quantity so the software would later direct material operators when the materials were needed.

On the hardware side, this triggered the step change in the development of automated logistics with things such as automated guided vehicles and cranes. Knowing exactly where materials were, and the adoption of standard bins or racks, made automation viable. The

evolution of the hardware has been progressive ever since to the state of the art we currently see in the warehouses of the largest online retailers. This hardware replaces the work that many people used to do. This is mechanical automation based on standardization, effectively Industry 3.0. However, it is true that the control mechanisms within such machines have become smarter based again on hardware development; specifically, sensors mimicking our own innate senses and connectivity allow the machines to make a wider variety of automated decisions. These are not necessarily smart in themselves until the addition of AI in terms of software.

The Digital Sixth Sense

The evolution of smart software is dependent on the availability of understandable data. As humans, we have a huge amount of data input to process through our already evolved five senses continuously. A sixth sense may need to be artificially introduced if people wish to become connected such as to the internet directly without the need to see, hear, speak, or type in the future. Unlike people, machines today are acquiring and evolving their sixth sense very quickly, with, for example, the revolutionary IPC's Connected Factory Exchange (CFX) now in place that enables machines and systems

of all types and from all vendors to talk freely with each other through a commonly defined language. As human intelligence came out of data from the five senses, digital intelligence starts primarily with the evolution of the sixth.

The Evolution of Digital Intelligence

Continuing with the smart warehouse solution, once the Industry 3.0 hardware was in place, software AI stepped in with Industry 4.0. The idea of the word random immediately puts a question in many people's minds as to how efficient a system can be based on anything that is random. Having operators searching around for an available empty location to put materials is quite a major waste. The intelligence of digital warehouse systems comes from the need to address that. The warehouse solution software knows the content of each location and can direct putting away materials, either by human or machine, to specifically chosen locations.

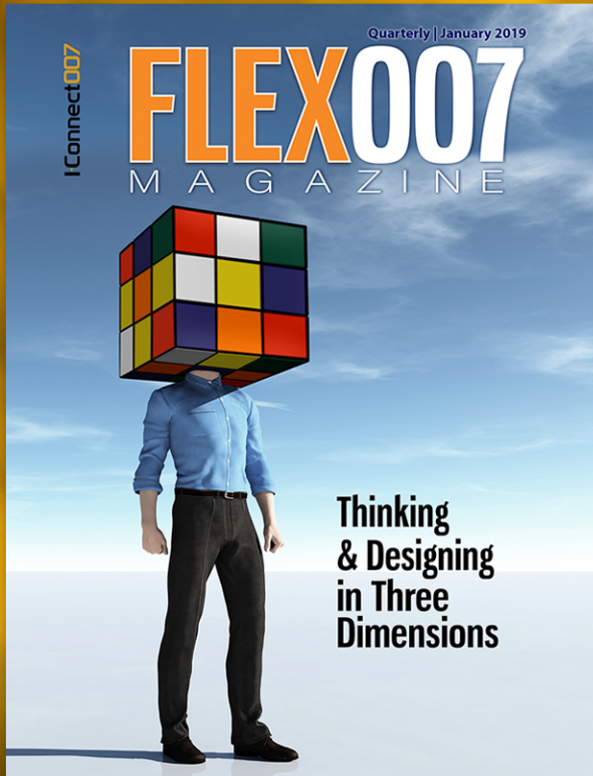
The warehouse solution software knows the content of each location and can direct putting away materials, either by human or machine, to specifically chosen locations.

The cleverness comes with the selection of the location. If the software developer knows the travelling distance between bins and the material checkout point is an issue, the software can be developed to look at which materials are more commonly used and locate them closer to the checkout, for example; it can even start to optimize the path of travel to collect sets of materials as needed. This speeds up the access of materials, decreasing the material replenishment cycle times. The size, type, and form of materials can be considered as well as whether the materials have specific storage

constraints, such as electrostatic or moisture sensitivity. Material storage location decisions may also be affected by the ownership of the material, cost, whether new or used, whether on a carrier such as a feeder, tax exemption, or critical for specific industry sectors, etc. Materials are being stored optimally rather than randomly—an automated process performed by an AI—but is just a software algorithm where decisions are based on the knowledge of the programmer to make certain things happen in certain ways.

Discrete software algorithms for the majority optimization application were originally developed to mimic the ways that humans would approach a problem, and then do it faster and more accurately. Over time, as humans no longer wanted to approach increasingly complex optimization problems in this discrete fashion, digital modelling of operations took over. Rather than create a specific logical procedure in software to follow, starting with so-called “genetic” algorithms, the software was developed to define a set of rules that would measure the effectiveness of a solution through a process of scoring what worked and what didn't against the targets.

Random combinations of solutions criteria were set up, each of which was measured by the software. This was then repeated with different combinations, often millions of times, until the best result was found, which was very much a trial-and-error process. This method was found to be less suitable than expected for more complex problems because with each additional element to the problem, the number of iterations required to reach the best result increased exponentially. However, on the measurement side, software became easier to develop an application of these kinds of algorithms to different problems simply meant the alteration of the measurement system. Techniques were created to reduce the randomness of the criteria arrangement in attempts to speed up the process. Even so, the best optimization of an SMT machine program would take hours. Compromises to finish early were introduced to allow the customer to accept a fairly good optimization in a reasonable time.



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Frustratingly State of the Art

In the warehouse, we cannot wait hours, minutes, or even seconds for any smart software to make decisions, even with the addition of tons of digital horsepower in the computer hardware to make things appear in real time. The decision-making needed with Industry 4.0 such as guiding materials to be put away in a warehouse, analyze the result of a visual inspection, etc., requires us to take a different approach, potentially combining the discrete algorithms and those based on the trial-and-error approach. We are still a few steps away from seeing the software making fast and complex intelligent decisions in automated Industry 4.0 for the whole factory. The levels of investment into doing so have to be reasonable and based on incremental added customer value.

True Digital Intelligence

To achieve the state where software developers can once again relax and let the truly intelligent software take over is something that perhaps can be learned from humans, specifically, very young humans. As children develop, it is through a natural process of trial and error. Our five senses are there to communicate pain and pleasure. Our human algorithms prefer the latter in most cases, and we continuously learn and modify our actions built on the experience gained.

**As children develop, it is
through a natural process
of trial and error.**

With software having access to more and more data, utilizing their sixth sense connection of connectivity, there is the potential to start to do similar activities. Creating the will to try things in different ways, to see whether “pleasure” can be gained by doing something new, is the genesis of the true AI algorithm. AI software developers need to define what defines pain and pleasure, that is, the reward structure for any given digital solution. Facto-

ry managers around the world already have a wealth of this experience, and if we are truthful, will have earned it based on many cases of trial and error. The cool thing about AIs in the digital age is that unlike the human manager, there is no need to relearn experiences as people rotate in and out of roles. Even though it may seem crazy to put the intelligence of a baby in charge of a factory at the start, it only needs to happen once. It may not even need to start off in the physical world.

Conclusion

Being a part of the AI evolution journey is beneficial to factory operations and interesting. Evolution towards cleverer software algorithms, and even to real AI, is already unlike that of hardware in terms of the way value is added. Investment into a progressive, digital MES software package provides way more value than generic MES solutions. Being a subscriber to digital MES today will prove to be the most rewarding investment a factory could make as we see the dawn of intelligence applied into more and more aspects of factory operational decision-making as well as operator process augmentation.

Solutions with such capability need to be chosen with care, looking towards those who lead the industry in terms of the vision of such technologies. With the advent of technologies such as IPC CFX, it may just seem like a smarter and more cost-effective way to do interfacing to many. However, in reality, CFX opens up the potential for a far greater step forward in AI, for which some of us are prepared. This is a clear differentiator between entities that have been key contributors and leaders throughout the development of CFX and those who will simply provide a new interface for their old software. It is not hard to see which path leads to a greater reward. **SMT007**



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

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ein Electronics Industry News and Market Highlights



Indian Mobile Components Manufacturing and Assembly Market to Reach \$62.8 Billion by 2023 ▶

The Indian mobile components manufacturing and assembly market was worth \$20.7 billion in 2017 and is projected to reach a value of \$62.8 billion by 2023 at a CAGR of 19.9% during 2018–2023.

EMS Transactions Down in Q3 2018 ▶

In Q3 2018, there was one vertical/horizontal convergence—the same amount recorded in Q2 2018, or roughly 17% of total activity for this quarter. There were three private equity investment transactions, or 50% of total activity, representing an increase over the previous quarter where no private equity transactions were recorded.

EMS Market Expected to Grow \$675 Billion by 2024 ▶

The EMS market is expected to exceed more than \$675 billion by 2024 at a CAGR of 7.5%.

Power Transmission and Distribution Conductors Update ▶

China and India are two prime emerging economies whose power sector trends are influencing the global power market, due to the scale of initiatives undertaken. In the forecast period, China and India are projected to hold an aggregate value of \$13.7 billion between 2018 and 2022.

New Zealand PC Market Bounces Back ▶

New Zealand PC shipments grew 1.6% year-on-year in the third quarter of 2018 with shipments reaching 168 thousand units, according to research company International Data Corporation (IDC).

DRAM Growth Tops Industry Ranking in 2018; Outlook Dims for 2019 ▶

Topping the chart of fastest-growing products for 2018 is DRAM, which comes as no surprise given the strong rise of average selling prices in this segment over the past two years. The 2018 DRAM market is expected to show an increase of 39%—a solid follow-up to the 77% growth in 2017.

Total Fab Equipment Spending Reverses Course, Growth Outlook Revised Downward ▶

Total fab equipment spending in 2019 is projected to drop 8%, a sharp reversal from the previously forecast increase of 7% as fab investment growth has been revised downward for 2018 to 10% from the 14% predicted in August.

Impressive Growth Opportunities Identified for AR, VR and Security Analytics Markets ▶

The year 2018 was a significant one for augmented reality (AR) and virtual reality (VR) with new entrants in the market including smart glasses launched, improved platforms and portfolios, and generally more enthusiasm and curiosity from the public to explore the technology.

EMEA Server Spending Increased by 24.5% Year Over Year in 3Q18 ▶

International Data Corporation's (IDC) EMEA Server Tracker shows that in the third quarter of 2018, the EMEA server market reported a year-over-year increase in vendor revenues of 24.5% to \$4.0 billion and a year-over-year increase of 2.9% in units shipped to 551,000.



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Tom Lavoie on Career Planning and Professional Development



Feature Interview by Nolan Johnson I-CONNECT007

Tom Lavoie is a former HP D-level executive now president of Consensia IT Partners and a certified Focal Point business coach. In this interview at the IEEE Rising Stars Conference, Lavoie discusses why he attended the conference, how he helps entry-level technical stars get their careers started with a plan, and helps experienced executives enhance their professional skills.

Nolan Johnson: I'm talking with Tom Lavoie, and you've been talking to the attendees who are college students and recently graduated young professionals. Can you tell us about what you do and what brings you here?

Tom Lavoie: I franchised with FocalPoint Business Coaching early last year and one of my former HP colleagues, Bill Gris, reached out to me to do a presentation at a Riverside event about six weeks ago for a similar audience as here, and that went extremely well. I was approached by one of the national IEEE leads af-

ter the presentation; he asked me if I would be interested in coming to this event. Initially, we tried to get a presentation spot, but there just wasn't enough time so I agreed to attend and sponsor this year, and I've committed to present next year.

I have a passion for coaching both senior-level and entry-level employees. I like to help the younger generation get into the workforce and know what to do to get the right job because it's different today compared to the mid-'80s when I graduated from college.

Johnson: What are some of the things you might do for an entry-level professional talking with you?

Lavoie: My son is a sophomore at the University of California, Santa Barbara, so I've been coaching him a lot. What's interesting about entry-level employees is they're extremely bright. They study very hard at college. Most of them are straight-A students in engineering and computer science—technical degrees—but they don't necessarily do their homework as far as learning what to do to get the job. What



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I find is they have a haphazard “apply to random jobs that are out there” mentality, and if they’re lucky, they get a job—the key point being “if they’re lucky.” Most struggle to get a job because they don’t have a plan. They don’t know the process to get a job. It’s very different today compared to the mid-‘80s.

If you don’t understand the game with how managers hire, you’re going to have a hard time being the one who gets selected. I feel there’s a lot that they can learn from coaching. There are many resources on the internet that they can be told to go out and research, but most importantly for me is that they must have a plan.

There are many resources on the internet that they can be told to go out and research, but most importantly for me is that they must have a plan.

One of the main services that I provide is building a strategic plan—both short-term and long-term—for their career. That will be something they evolve every year because things change, and if you don’t have a business or life plan, you’re not necessarily going to achieve your goals, so that’s the key deliverable.

Another service I provide includes interviewing technique and skills. There are a lot of people who will coach behavioral interviewing, and I was trained at HP to interview based on behavioral patterns in the past, but it’s more than that. I also provide an assessment—which I heard one of the other coaches talk about yesterday—about knowing what behavioral style you are, and whether the person you’re interviewing with has a different style. That’s huge knowledge because if you don’t recognize that, a lot of people fail the interview based on just having a disconnect between behavioral styles; they don’t understand why the

hiring manager appears to be acting indifferent or inconsiderate.

We help them identify the four different types of people and how to spot which they are and which others are, so that’s a key deliverable. We train them on that so they can recognize the manager or the person they’re interviewing with and turn their answers into A+ responses. A lot of it is how to interview properly, and the whole game of getting a job. Most young aspiring entrepreneurs don’t know that most jobs are filled via the network and then recruiters. Very few jobs today are filled with the traditional method of sending a résumé and cover letter, hoping you get the job. They must understand that, and leverage not only their network but also their network’s network, and I can help them with that.

Johnson: Excellent. So, you have extensive experience including time at HP. What else is different now?

Lavoie: There are a lot of differences. Just from the standpoint of getting a job and career, it is so much more competitive now. When I came out of college in ‘85, I was fortunate; jobs were exploding for the computer science field. I was getting offers without even trying. I didn’t have to perfect my résumé. There was no such thing as LinkedIn at the time, but now—with the number of students who have straight As at top universities—a big change is the competitiveness of getting that job.

Johnson: That statement does seem a little bit at odds with the very low unemployment numbers that we see at this time. Can you compare and contrast that?

Lavoie: That’s a good point. This is another exercise I work with the customers on is that, yes, there are a lot of jobs out there, but what a lot of people don’t understand is the distinction in job differences. Take tech, for example; I know of three college hires who all had computer science degrees with similar grades from top-notch universities and all got jobs in the last 12 months. One ended up at Google for



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Electronics Enabling Technologies
June 4-6, 2019
Markham, ON, Canada

Symposium on Counterfeit
Parts & Materials
June 25-27, 2019
College Park, MD

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Electronics Manufacturing
Conference & Expo
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\$120,000 working in an engineering product-related opportunity. The second one works for Intel—a great company—for \$85,000 in their R&D design for their chips. And then the third one went to an IT department at a very large, successful corporation for \$65,000.

A couple things of that I teach and coach on is you don't want to get into a job that's going to be a commodity or is already a commodity, and a lot of people don't know what that means. What it means in the tech field is if that skill is pervasive. For example, Microsoft skills for SQL Server is a commodity skill. Those skills exist in India and China, so those can be all offshore. If they get a job working in IT for SQL Server, what they don't realize is six months from now, they could lose that job to a resource making one-tenth of their salary overseas.

So, yes, there are jobs, but it's about getting the right job. Think about what can be offshored. For example, there are trends in IT of offshored jobs such as the procurement of servers (or any type of procurement), which used to be IT jobs but are now turning into AI solutions. Those jobs are going away. Meanwhile, cybersecurity, AI, and anything related to big data and driving business decisions are three big areas where jobs are hot, highly paid, and not going to be offshored anytime soon. Then, you won't lose your job in six months, and you'll start at a high salary that will only go up over time. Again, you have a plan to get the right job from the start, and they're more competitive.

Johnson: You need to be smart about that.

Lavoie: Absolutely.

Johnson: The whole shotgun approach of sending out 100 résumés to companies whose name you happen to know isn't very productive.

Lavoie: And I see that on two spectrums. Many of my friends and colleagues who have been in the industry for 20–25 years get laid off. They become so desperate to get the next job that they will take literally anything that they can get without really realizing the implications of not choosing the right one. Yesterday, I heard

some similar points that they have to spend a lot of time considering their values and the company culture.

I stayed at HP for 29 years because the HP values completely aligned with mine. It was all about customer satisfaction. They treated employees very well. It wasn't about years of service; 25-year veterans didn't automatically get more than a two-year employee. If you were a top performer at the age of 22 and had the highest rank, you'd get the biggest salary increase. Again, a key part is having a plan, so you don't just take any job, and there's data out there to help such as reviews on Glassdoor. If they're going to accept a job at a certain company and the reviews say, "The managers treat employees poorly. We haven't gotten a raise in five years, and they don't value our work," don't go work for them. Do your research.

Johnson: What kind of background do you specialize in?

Lavoie: I work with two ends of the spectrum. I was a senior leader at HP, so I coach a lot of senior IT leaders that want to be chief information officers on the C level. I also coach the other end—the resources coming into the workforce. I have a passion for both, so I have the credibility, background, and the value proposition to help both audiences. I won't make nearly the money with entry-level positions like the people here, but I love to help the younger generation. I really enjoy doing it. It's less about the money. To help somebody and have them come back and thank me for helping them get a job is a reward for me.

Johnson: Some people might joke that to coach a senior-level person with a lot of years of experience, you're going to need to charge more money because your client needs to unlearn some things to move forward.

Lavoie: There's a lot more work to do for somebody like that because there's the unlearning part, and then there's a lot to do, especially on the soft skills side. That's where most C-levels fall short. They've been very technical in their

career, but have never taken classes on executive presentations and the whole soft skills side of their job such as how to network better with other CIOs. A lot of it is giving them a plan that they have to execute before they're even going to get that job, so it's a lot of work. For entry-level jobs, it's some homework for them, but they can just take care of it on their own on the internet. There's not as much work.

Johnson: How would someone contact you?

Lavoie: They can visit the FocalPoint or Consenia IT Partners websites, or submit their contact information to TLavoie@focalpointcoaching.com.

Johnson: How commonplace is it for you to have people you're coaching who were referred by their employer?

Lavoie: There are two parts that I'm actually exploring quite diligently because I think they're great opportunities. One part of that is a lot of large tech firms like HP are still laying off thousands of employees. Qualcomm laid off 1,200 IT professionals in San Diego just two months ago. Large corporations who have significant layoffs like that typically give those employees three months of coaching from a local firm. I'm working with HP, Intel, and some other large firms to be a preferred supplier, so when they lay off employees anywhere in the U.S., I can be their coach for the three-month period. That's one part of it.

The second part is that there are a lot of trends for slashing of HR in various firms. So, there are a lot fewer local resources in the company to help for coaching employees on their development plans and career. Thus, I'm also working with them on an offering that, since those employees are not getting that internally like I used to get in HP. Management wants to develop their people; they just don't have the tools to do it today. They have the money, so they're using outside suppliers to help.

Johnson: Is there anything that we need to cover that I haven't asked about yet?

Lavoie: One of the benefits and attractions I had for FocalPoint is they have been around for about 15 years. A lot of people know Brian Tracy, the original founder. He writes about seven books a year on leadership and other topics as well as does presentations around the globe. He's in his 70s but is still very active. A lot of customers will hire FocalPoint coaches based on Brian Tracy's technique, IP, and methods, but beyond that, FocalPoint is one of the rare brands that guarantees our service. If I'm coaching somebody and they're not satisfied with the ROI, they don't pay. Not many companies are willing to put that in a contract when you sign.

If I'm coaching somebody and they're not satisfied with the ROI, they don't pay.

It's results-oriented coaching, and if you don't see the value, you don't pay. I have never had anyone call me on that. It shows that I have the value, and at HP, we also had that culture of customer satisfaction—unlike some of our competitors. If we were working on a project for AT&T or another large account and there was a problem in the project, we owned it. A lot of times, it wasn't our problem; it might have been our partner's issue or whatever else the case might have been—but we would own it and solve it for the customer until they were satisfied without asking them for more money. I saw it at HP, and I see it at FocalPoint. I believe that if you're willing to make that commitment to the client, there's more trust and you're going to provide more value to them.

Johnson: Super. Well, thank you for your time. I appreciate this.

Lavoie: You're welcome. SMT007



Supplier Highlights



Smart Factories Are Smart With Their Components: Are You? ►

Have you ever been in a situation where your production has stopped because you do not have the correct component? How about a significant unknown shortage in your stockroom that cannot be explained by production or the store's team? Maybe you have been in the difficult situation of trying to explain that the lead time of a product has increased to your end customer? Read on.

MIRTEC Partners with Southwest Systems Technology ►

MIRTEC has appointed Southwest Systems Technology Inc. as its manufacturers' representative. With offices in Texas and Mexico, Southwest Systems Technology will provide sales and support for MIRTEC's award-winning inspection systems in the states of Texas, Oklahoma, Arkansas, and Louisiana.

KIC and Mentor Partner on Integrated Thermal Process Technology for Industry 4.0 ►

KIC announces technology collaboration with Mentor, a Siemens Business, leveraging KIC's professional knowledge on thermal processes and Mentor's comprehensive expertise on SMT manufacturing towards Industry 4.0.

More Than Inspection: It's Process Improvement ►

Barry Matties speaks with Brian D'Amico, president of MIRTEC, about the current state of machine-to-machine communication in the industry, and how the inspection company is interfacing with the different manufacturing languages currently available to gather predictive data and feedback from every inspection step to eliminate future defects.

Rehm: From Challenges Come Opportunities ►

Strong connections bridge even the widest distances—whether spatially or technically in the case of the Hermes standard. By participating in this initiative, Rehm Thermal Systems is also contributing to making system networking within SMT manufacturing easier, quicker and more efficient in the future.

SMS Selects Metcal CV-500 System ►

Smart Made Simple's (SMS's) strategic capital equipment partner Metcal has selected them as the first company in the U.K. to trial the New Metcal CV-500 system, the latest addition to their connection Validation family of products.

EMS Installs Second MEK AOI Machine ►

Electronic Manufacturing Solutions (EMS) Limited has installed a new MEK PowerSpector GTAz + GDAz 550BTL CE 9 camera inline AOI machine.

IPC Commends Passage of FIRST STEP Act ►

John Mitchell, president and CEO of IPC, issued the following statement on the U.S. Senate's vote this week to enact a criminal justice reform bill called the FIRST STEP Act.

Powerful Prototypes: Eight PCB Assembly Tips for 2019 ►

It's now 2019, and all I'll say on the coming year is that we are in for a wild ride. The last few years have been pretty crazy, and 2019 looks to continue that trend but amped up. While predictions might be fun to muse upon, they really won't help you get your job done. So, here's my top eight pieces of PCB assembly advice for the coming year to make up for that.

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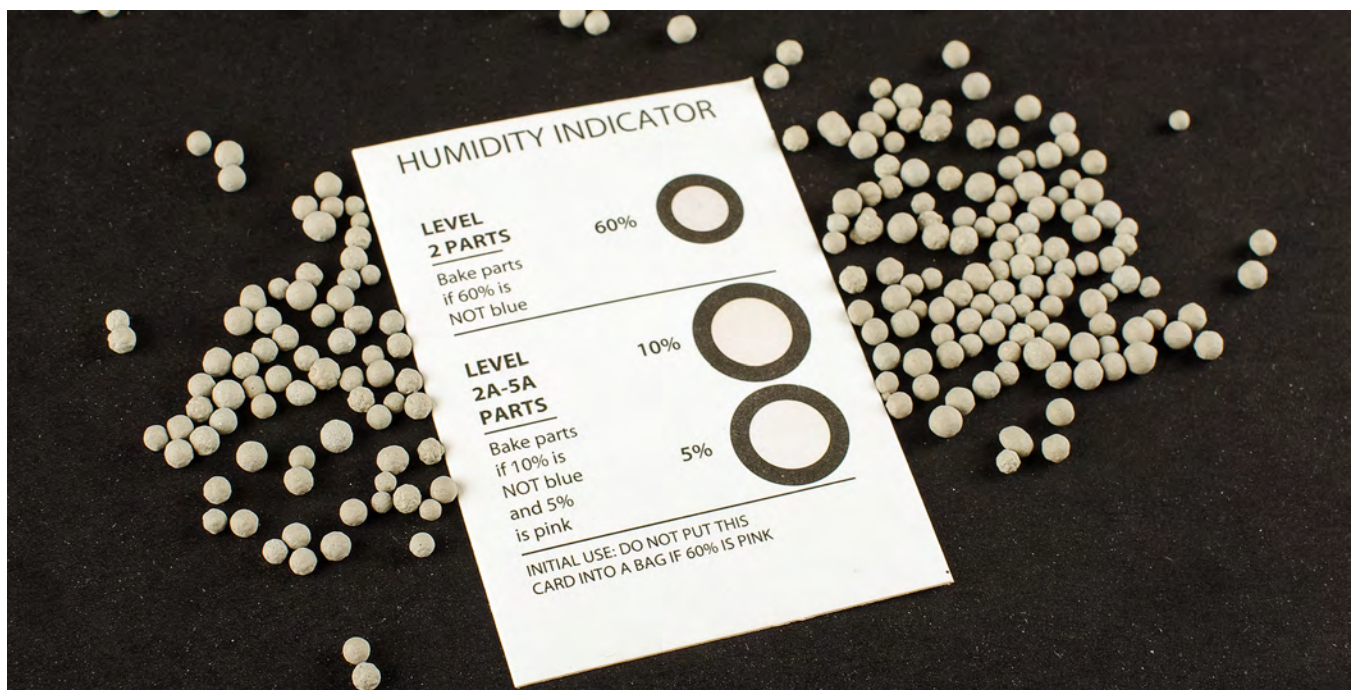
More Than Just Dry Air
by Richard Heimsch, SUPER DRY TOTECH

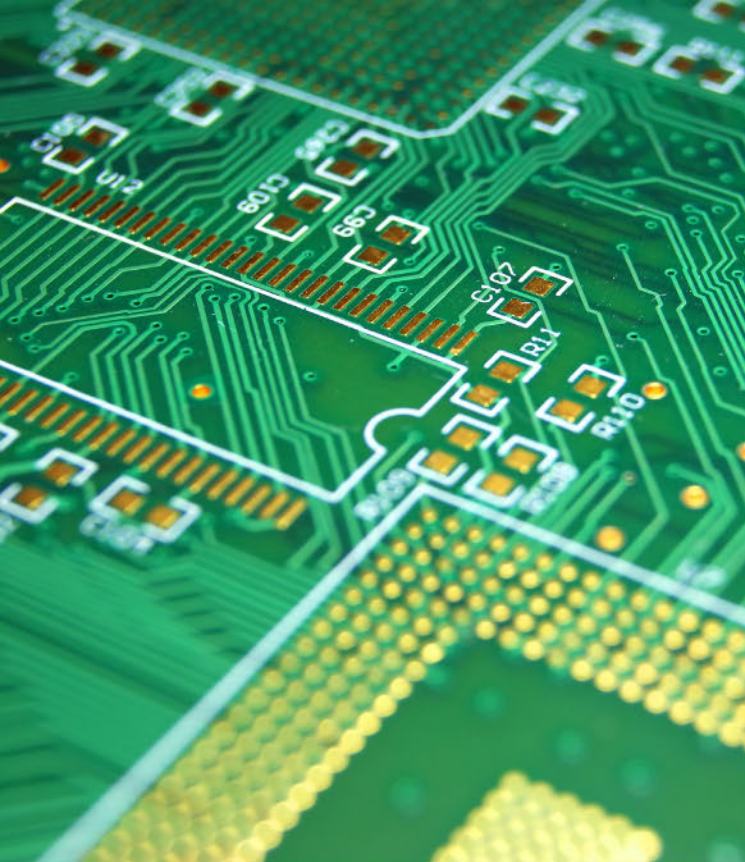
To avoid the damage of microcracks and delamination during the processing of electronic components, appropriate environmental storage is essential. The introduction of lead-free soldering and the associated higher processing temperatures involved makes moisture management even more important. Lead-free reflow increases the consequent saturated vapor pressure within components considerably (up to 30 bars). The same component that could be safely processed before lead-free becomes a moisture sensitive device with limited floor life. The difference is often two moisture sensitivity levels (MSLs) higher in classification, and shorter allowable exposure time (floor life).

Component suppliers should deliver these moisture sensitive components in effective protective packaging to avoid absorption of

humidity during transport and storage. These moisture barrier bags (MBBs) are made from multiple layers of plastic and aluminum. Properly prepared and sealed, they are also a protective packaging that can prevent oxidation. ESD bags or zippered plastic bags do not protect against moisture. After opening the package, the time begins during which the components absorb humidity. Depending on ambient humidity and temperature, the components can be safely used only within a limited time period. This time period is classified by the IPC/JEDEC J-STD-033D.

When a component has exceeded the allowed exposure time, the component can be dried and made safe again through a baking process, traditionally done at 125°C. The component should be processed especially carefully after that. Repeated absorption of humidity





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must be avoided because the baking process should not be repeated. Even one exposure to baking at these temperatures induces oxidation and intermetallic growth, which reduces the wetting ability of the connection surfaces. Intermetallic thickness has been shown to increase by approximately 50% when baking at 125°C for four days. Thicker intermetallic layers can lead to a reduction in solder joint integrity, and in extreme cases, reduce solderability.

To fight this well-known effect, many suppliers of baking ovens provide an additional reduction of oxygen by means of a nitrogen atmosphere or vacuum during the drying process. Setting the clock back to zero for the component can take in excess of 72 hours, inevitably bringing along considerable costs for nitrogen. Only a low-rest oxygen content of less than 13 ppm stops the oxidation.

Long-term Storage of Obsolete Components

Product lifecycles are very short with new models being released sooner than ever before. Many manufacturers in industries including automotive, aviation, military, and avionics must guarantee the availability of replacement parts (including PCBs) for 10 or even 20 years. This demands the advance purchase and extended storage of components and materials. Further complicating the problem is that most components cannot be stored for more than a few years without very special handling procedures. Oxidation, intermetallics, and embrittlement are just a few of the conditions that must be addressed.

IPC/JEDEC J-STD-033D addresses a broad range of fundamentals regarding moisture sensitive devices and their proper handling, but very long-term storage is not addressed.

Also, the obsolescence of components and ever-shortened product life cycles forces manufacturers to build up an appropriate stock for further production and spare parts supply. Various ageing processes on electronic components show that storage in dry packs (also under nitrogen atmosphere) cannot guarantee reliability in the future.

Besides temperature, humidity is the strongest negative influence on the surface oxidation of metals. Due to oxidation, the components are more difficult to wet and cause more soldering defects, which can lead to failure of the entire assembly.

Corrosion Protection Ensures Quality in the Long Term

Two conditions must always be met for metal corrosion to occur. An oxidizing agent must be present, which is provided by the 21 % oxygen content of the air. The second prerequisite is an aqueous solution that acts as an electrolyte. The electrolyte forms above a humidity of 10 % relative humidity in the form of a thin, invisible water film on the metal surface ^[1].

As soon as one of these components of the oxidation reaction is missing, the corrosion stops. Three processes are common for this. Storage in a dry pack and/or under nitrogen removes both the oxidant and electrolyte from the storage atmosphere. Storage in a dry atmosphere only removes the electrolyte. But what is the more effective protection against oxidation?

The dry pack is only suitable for short- to medium-term storage because there is a risk that outgassing will lead to corrosion effects on the contact surfaces. These are usually plasticizers and flame retardants, which can reach high concentrations within the bags. This effect does not occur with nitrogen and dry storage because the storage atmosphere is permanently filtered or replaced.

Direct Comparison of Nitrogen and Dry Storage

To determine the oxidation rate under the two storage conditions, a long-term test (over nine months) was carried out. At regular intervals (every four weeks) the samples were examined for oxidation by EDX analysis. In parallel, the same materials were stored as a reference under ambient air.

For each material, there is a diagram showing the development of the percentage oxygen peak height compared to the respective main peak as a function of the storage time. This



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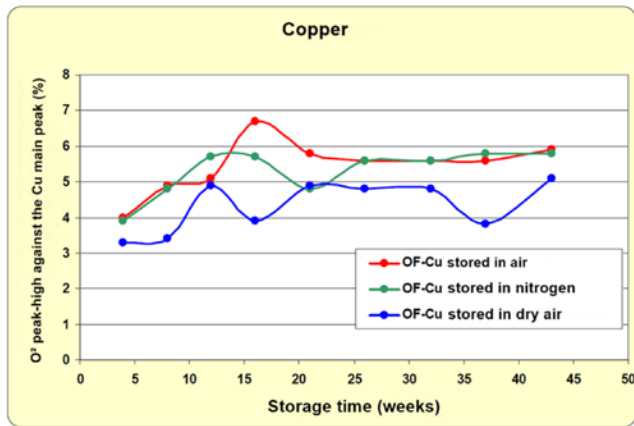


Figure 1. Ag sample.

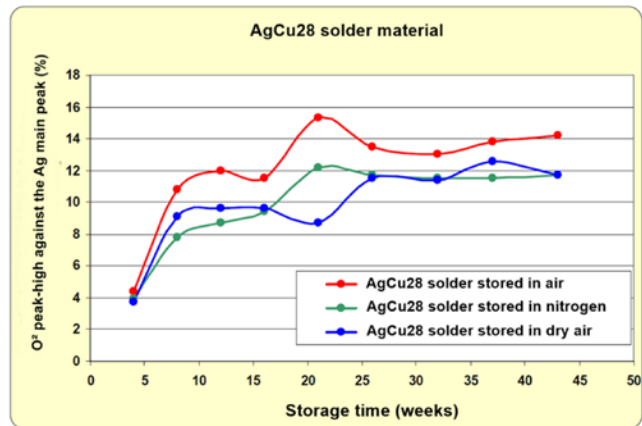


Figure 3: AgCu50.

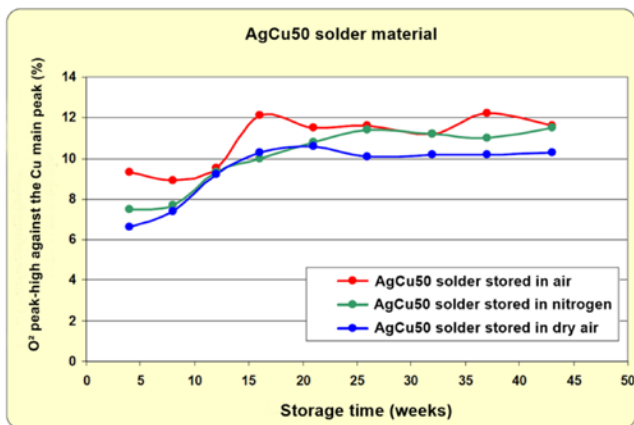


Figure 2: AgCu28.

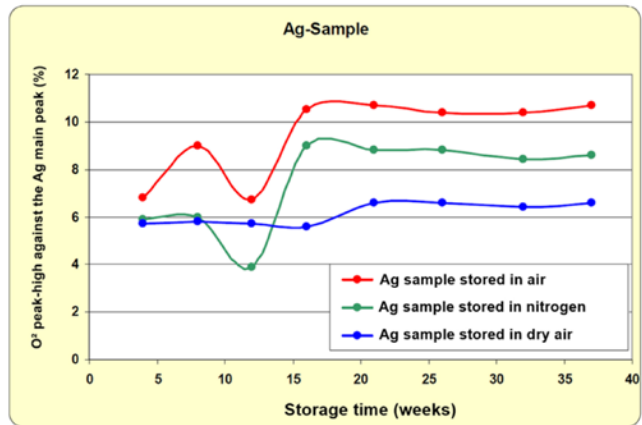


Figure 4: Copper.

comparison is permissible insofar as all EDX spectra were recorded under the same measuring conditions (high voltage, the running time of the analysis, the aperture setting, and the sample distance to the detector) [2-6].

Test Evaluation Storage Atmosphere

As expected, the highest O_2 peaks, and thus the highest surface oxidation, could be measured on the samples stored under air. When comparing the samples stored in N_2 and dry air, it is noticeable that the lowest O_2 peaks and surface oxidation occur during dry storage. The results of this long-term test prove that dry storage can be classified as very suitable for long-term storage due to its optimal oxidation protection [2-6]. Dry storage is preferable to ni-

trogen storage not only in terms of quality but also in terms of energy consumption [7].

Influence of Temperature on Ageing Rate

In addition to corrosion, the components age through diffusion processes at metallic boundary layers. Each temperature increase leads to an increase in the ageing rate due to an increase in the reaction rate. A rule of thumb predicts a doubling to quadrupling of the ageing rate with a temperature increase of $10^\circ K$. The physical and chemical processes are described in more detail with the Arrhenius equation. For this reason, it is recommended to reduce the storage temperature as much as possible during long-term storage. However, there are also negative effects such as whisker forma-



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tion and tin pest that increase with decreasing temperature. To avoid this, store components at 14°C above the critical temperature of 13.2°C. The temperature of the components is then reduced to a minimum. **SMT007**

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Richard Heimsch is a director of Super Dry Totech. To read past columns or contact Heimsch, [click here](#).

New Study on Low-noise, High-performance Transistors Could Bring Innovations in Electronics, Sensing

A research study led by Suprem Das, assistant professor of industrial and manufacturing systems engineering at Kansas State University, in collaboration with researchers at Purdue University, has demonstrated micro/nanoscale transistors made of two-dimensional atomically thin materials that show high performance and low noise. The devices are less than one-hundredth of the diameter of a single human hair and could be key to innovating electronics and precision sensing.

Many researchers worldwide are focusing attention on building the next generation of transistors from exotic atomic-scale 2D materials such as molybdenum di-selenide. These materials are promising because they show high-performance transistor action that may, in the future, replace today's silicon electronics. However, very few of them are looking at yet another important aspect—the inherent electronic noise in this new class of materials, which

is ubiquitous to all devices and circuits and only worsens when the material becomes atomic thin.

The study conducted by Das' research team has systematically shown that if one can control the layer thickness between 10 and 15 atomic-thin in a transistor, the device will not only show high performance—such as turning the switch on—but also experience very low electronic noise. This unique finding is essential to building several enabling technologies in electronics and sensing using a number of emerging 2D materials. This research is a comprehensive effort of a previous finding where Das' team conducted the first study on noise in MoSe₂ transistors.

A patent application has been filed by Kansas State University Research Foundation (KSURF) on this technology.

The research was published at *Physical Review Applied*.

(Source: Kansas State University)



Suprem Das



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TOP 10

Editor's Picks from SMT007.com

1 Powerful Prototypes: What Is Your Supply Chain Telling You About Components? ►

Right now, many, many parts are in short supply, or unavailable with extraordinarily long lead times. Allocation is the word of the day and substitutions are your friend. Sure, electronics components shortage happens every now and then in this industry. It's a periodic nuisance, but what should you do for the long term? Read on.

2 What Electronics Manufacturers Need to Know About RoHS 3 Compliance ►

On July 22, 2019, the latest incarnation of RoHS will come into full effect across the European Union. So, what has changed? And what exactly are the implications for U.K. electronics manufacturers? This article provides a recap of what RoHS is, why it matters, and the steps that OEMs will need to take to ensure compliance.

3 Tempo Automation Expands Team and Celebrates Momentum in 2018 ►

Tempo Automation announced key milestones at year-end, highlighting company growth, expansion in key markets, and its mission to transform the way technology manufacturers bring new products to market by reaching new levels of speed, precision, and innovation.



4 Jabil Expands Retail Innovation Ecosystem ►

Jabil Inc. expanded its ecosystem of innovation partners to speed the delivery of advanced retail automation solutions.



5 East West Manufacturing Acquires General Microcircuits ▶

East West Manufacturing LLC—a global design, manufacturing, and distribution business—acquired General Microcircuits Inc.—a large provider of specialized electronics manufacturing services, including advanced PCB assemblies, box-build assemblies, testing, and new product introduction services.



6 Cemtrex's EM Segment Reports 18% Revenue Drop in Fiscal 2018 ▶

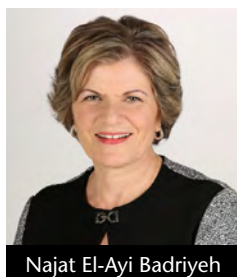
Fiscal 2018 was both a transformational and transitional year for Cemtrex.



While revenue in the electronics manufacturing (EM) segment decreased by 18% due to the loss of two customers, the EM segment currently has a \$52,000,000 backlog, which should boost revenue for fiscal 2019.

7 Naprotek CEO Named Founder of the Week ▶

Naprotek Inc. announced that Najat El-Ayi Badriyeh, founder and CEO, was recognized by DataBird as founder of the week.



8 HANZA Bags Electronic Control Systems Contract from Picadeli ▶

Food company Picadeli tapped HANZA for the manufacture of electronics for its salad bars.



9 AWS Electronics Achieves Successful Transition to Latest Medical Standard ISO 13485:2016 ▶

AWS Electronics, a leading European electronics manufacturing solutions (EMS) provider,



announced a successful transition to the latest revision of globally recognized quality standard—ISO 13485:2016—at its Newcastle-under-Lyme manufacturing facility.

10 Foresight and RH Electronics to Join Forces for a Strategic Alliance ▶

Foresight Autonomous Holdings Ltd. signed a non-binding development and investment agreement with RH Electronics Ltd., a primary contractor in the manufacturing and assembly of electronic systems.



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Barb Hockaday at barb@iconnect007.com or +1.916.608.0660 (-7 GMT)

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Technical Service Rep Waterbury, CT

Do you have what it takes? MacDermid Alpha Electronics Solutions is a leading supplier of specialty chemicals, providing application-specific solutions and unsurpassed technical support.

The position of the Technical Service Rep will be responsible for day to day support for fabricators using MacDermid Alpha's chemical products. The position requires a proactive self-starter that can work closely and independently with customers, sales group and management to ensure that customer expectations and company interests are served.

- Have a thorough understanding of the overall PCB business, and specifics in wet processing areas.
- Prepare action plans for identification of root cause of customer process issues.
- Provide feedback to management regarding performance.
- Creates and conducts customer technical presentations.
- Develop technical strategy for customers.
- Possess the ability to calm difficult situations with customers, initiate a step by step plan, and involve other technical help quickly to find resolution.

Hiring Profile

- Bachelor's Degree or 5-7 years' job related experience.
- Strong understanding of chemistry and chemical interaction within PCB manufacturing
- Excellent written and oral communication skills.
- Strong track record of navigating technically through complex organizations.
- Extensive experience in all aspects of Customer Relationship Management.
- Willingness to travel.

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Service Engineer USA

Limata GmbH, a provider of direct imaging system solutions for the global PCB manufacturing industry and adjacent markets, is looking for qualified candidates to fulfill the role of service engineer in the United States.

Duties:

- Assemble, install, service, and maintain our products
- Inspect the unit towards operating conditions
- Solve technical problems on-site
- Resolve problems with our customers and technical department
- Ability to support our customers in all technical questions

Qualifications:

- Proven experience in microelectronics is preferred
- Willingness to travel
- Strong verbal and written communication skills

To be part of our team, please click below and send your resume to karriere@limata.de.

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Career Opportunities



SMT Operator Huntingdon Valley, PA

Manncorp, a leader in the electronics assembly industry, is looking for a technician to operate our new in-house SMT LED assembly lines.

Duties and Responsibilities:

- Set up and operate automated SMT assembly equipment
- Prepare component kits for manufacturing
- Perform visual inspection of SMT assembly
- Participate in directing the expansion and further development of our SMT capabilities

Requirements and Qualifications:

- Prior experience with SMT equipment, or equivalent technical degree preferred
- Basic computer knowledge
- Proven strong mechanical and electrical troubleshooting skills
- Experience programming machinery or demonstrated willingness to learn
- Positive self-starter attitude with a good work ethic
- Ability to work with minimal supervision

We Offer:

- Paid training period
- Health and dental insurance
- Retirement fund matching
- Continuing training

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SMT Field Technician Huntingdon Valley, PA

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

Duties and Responsibilities:

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

Requirements and Qualifications:

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

We Offer:

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

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Career Opportunities



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Technical Support Engineer, Germany

We are looking for a technical support engineer to join our team at our German facility in Kirchheimbolanden. The successful candidate will assist potential and current customers in appreciating the benefits of using and optimizing the use of Ventec materials in their PCB manufacturing processes, enhance customer loyalty and satisfaction, spread the use of Ventec materials, and grow sales. The technical support engineer will provide a two-way channel of technical communication between Ventec's production facilities and U.K./European customers.

Skills and abilities required for the role:

- Scientific and technical educational background
- Experience in the PCB industry in engineering and/or manufacturing
- Strong communications skills (German and English) with the ability to write full technical reports for group or customer distribution
- Ability to work in an organized, proactive, and enthusiastic way
- Ability to work well both in a team as well as an individual
- Good user knowledge of common Microsoft Office programs
- A full driving license is essential
- Willingness to travel regularly throughout Europe and occasionally to Asia

We offer:

- Excellent salary and benefits commensurate with experience

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

Please forward your resume to
applytoventec@ventec-europe.com

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ventec
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Technical Sales Engineer, Germany

Want to advance your career by joining our globally successful and growing world-class CCL manufacturing company and help drive that success? Tasked with driving sales in the German-speaking markets, you will be a key member of the technical sales team. Your focus will be on Ventec's core market segments: military/aerospace, automotive, and medical offering a full range of high-reliability materials including polyimide, IMS, and thermal management products.

Skills and abilities required for the role:

- Seven to 10 years of experience in the PCB industry in engineering and/or manufacturing
- Strong communications skills (German and English)
- Project management experience
- Detail-oriented approach to tasks
- Ability to manage tasks and set goals independently as well as part of a team
- Knowledge of Microsoft Office products
- A full driving license is essential.
- Willingness to travel regularly throughout Europe and occasionally to Asia

We offer:

- Excellent salary and benefits commensurate with experience

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

Please forward your resume to
applytoventec@ventec-europe.com

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Career Opportunities



Field Service Engineer West Coast

Pluritec North America, Ltd., An innovative leader in drilling, routing and Automated Inspection in the Printed Circuit Board industry, is seeking a full-time Field Service Engineer, located on the West Coast.

This individual will support service for North America in Equipment installation, training, maintenance and repair. Candidate must be able to handle trouble shooting electronic and mechanical issues as well customer applications in the field. A technical degree is preferred, along with strong verbal and written communication skills. The position requires the ability to travel 2-3 weeks per month.

Please send your resume to:
Carolina.zeppieri@pluritec.org

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Sales Personnel, Japan

The Gardien Group is looking to expand the sales team in Tokyo, Japan, and seeking highly motivated team players with a positive attitude. Prior experience in the PCB industry is an advantage but not necessary for the right candidate.

The role involves working closely with the customer to identify their needs and deliver the right solution. The candidate should be able to offer a high level of customer satisfaction to ensure ongoing sales.

Training will be provided along with a competitive benefits package, excellent growth opportunities, and periodic bonuses.

Interested candidates, please contact us at careers.jp@gardien.com with your resume.

Kindly note only shortlisted candidates will be notified.

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Career Opportunities



U.S. CIRCUIT

Sales Representatives (Specific Territories)

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

- Florida
- Denver
- Washington
- Los Angeles

Experience:

- Candidates must have previous PCB sales experience.

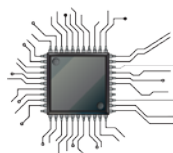
Compensation:

- 7% commission

Contact Mike Fariba for
more information.

mfariba@uscircuit.com

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Want to work for a fast-growing company? MivaTek Global may be the place for your next career move. 2018 has brought significant growth, increasing sales and revenue. And, we are just getting started! To support the current customer base and fuel further expansion, we are looking for bright and talented people who are energized by hard work in a supportive and flexible environment.

Open Positions:

- Technical Service Technicians
- Regional Sales Representatives
- Regional Leader for Asia Sales and Support

Proven experience in either PCB or Micro-electronics and willingness to travel required for all positions.

More About Us

MivaTek Global is a distributor of manufacturing equipment with an emphasis of Miva Technologies' Direct Imager, Mask Writer, Flatbed Photo-plotter imaging systems and Mach3 Labs X-Ray Drills. We currently have 45 installations in the Americas. Expansion into Asia during 2018 has led to machine installations in China, Singapore, Korea, and India.

To be part of our team, send your resume to n.hogan@kupertek.com for consideration of current and future opportunities.

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A fantastic opportunity has arisen within Electrolube, a progressive global electro-chemicals manufacturer. This prestigious new role is for a sales development manager with a strong technical sales background (electro-chemicals industry desirable) and great commercial awareness. The key focus of this role is to increase profitable sales of the Electrolube brand within the Midwest area of the United States; this is to be achieved via a strategic program of major account development and progression of new accounts/projects. Monitoring of competitor activity and recognition of new opportunities are also integral to this challenging role. Full product training to be provided.

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melanie.latham@hkw.co.uk
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Career Opportunities



A Siemens Business

PCB Manufacturing, Marketing Engineer

Use your knowledge of PCB assembly and process engineering to promote Mentor's Valor digital manufacturing solutions via industry articles, industry events, blogs, and relevant social networking sites. The Valor division is seeking a seasoned professional who has operated within the PCB manufacturing industry to be a leading voice in advocating our solutions through a variety of marketing platforms including digital, media, trade show, conferences, and forums.

The successful candidate is expected to have solid experience within the PCB assembly industry and the ability to represent the Valor solutions with authority and credibility. A solid background in PCB Process Engineering or Quality management to leverage in day-to-day activities is preferred. The candidate should be a good "storyteller" who can develop relatable content in an interesting and compelling manner, and who is comfortable in presenting in public as well as engaging in on-line forums; should have solid experience with professional social platforms such as LinkedIn.

Success will be measured quantitatively in terms of number of interactions, increase in digital engagements, measurement of sentiment, article placements, presentations delivered. Qualitatively, success will be measured by feedback from colleagues and relevant industry players.

This is an excellent opportunity for an industry professional who has a passion for marketing and public presentation.

Location flexible: Israel, UK or US

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

For more information, click below.

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Events Calendar

SMTA Pan Pacific Microelectronics Symposium ▶

February 11–14, 2019
Kauai, Hawaii, U.S.

EIPC 2019 Winter Conference ▶

February 14–15, 2019
Milan, Italy

China International PCB & Assembly Show (CPCA Show 2019) ▶

March 19–21, 2019
Shanghai, China

MicroTech 2019 ▶

April 4, 2019
Cambridge, U.K.

Medical Electronics Symposium 2019 ▶

May 21–22, 2019
Elyria, Ohio, U.S.

PCB Pavilion @ LCD EXPO Thailand ▶

June 27–29, 2019
Bangkok, Thailand

Additional Event Calendars



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