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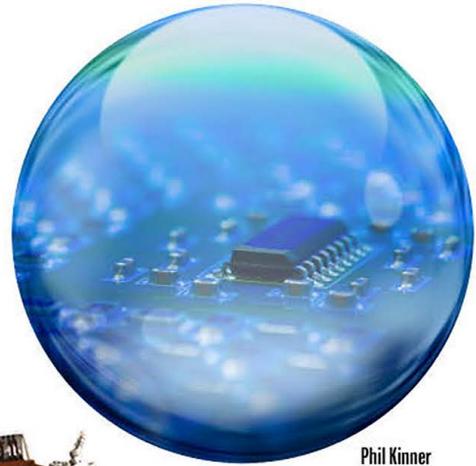
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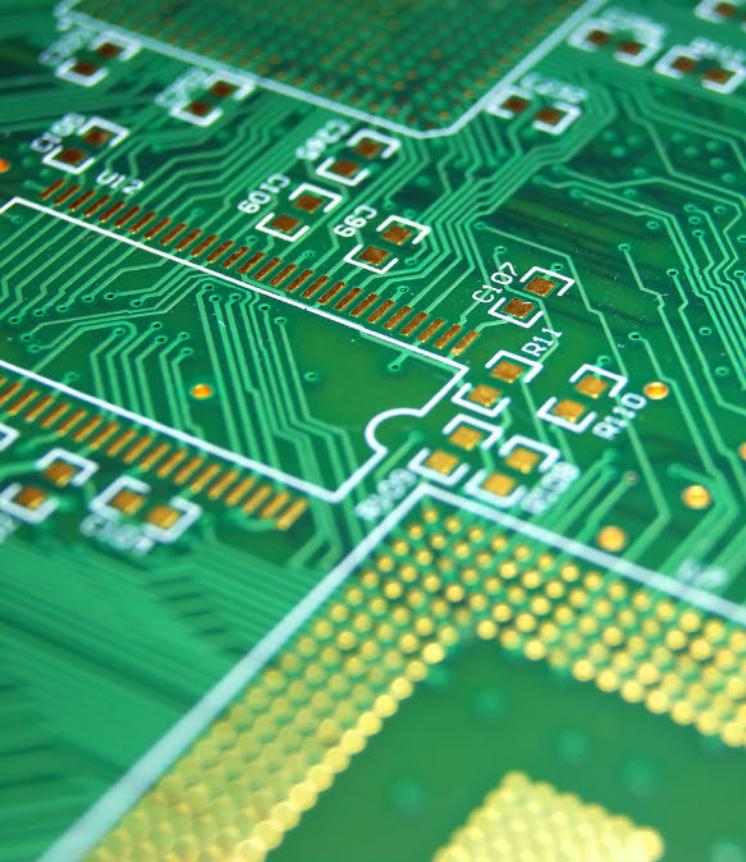
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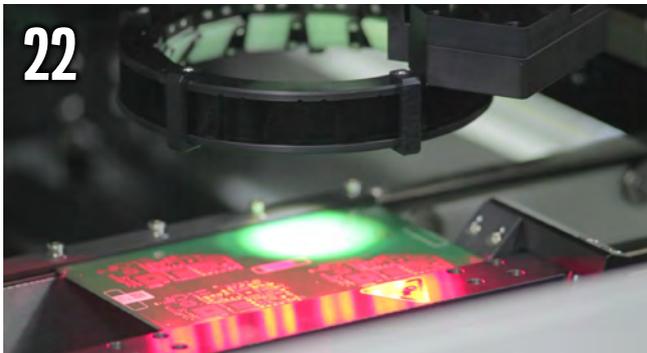
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Streamlining Assembly

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Streamlining, but Streamlining What?

Nolan's Notes

by Nolan Johnson, I-CONNECT007

Streamline, verb. 1. The path of a particle that is flowing steadily and without turbulence in a fluid past an object, 2. To make (an organization or system) more efficient and effective by employing faster or simpler working methods.

Electronics continue to grow in application areas, capabilities, and complexities. With such growth in the raw number of circuit boards being produced globally, the pressure is on to build more faster with higher quality and greater reliability. But I'm not telling you anything new. What is new is the thinking and problem-solving that will need to happen at the manufacturing floor level to deliver on this coming need. What do I mean by that? Let me give you an example.

In our ongoing coverage of 5G technology—and in other reports coming out of real-

world experiences with 5G—it's clear the world will need a bunch (technical term) of 5G transceiver hardware. The traditional hexagonal coverage areas mapped out by previous-generation cell networks simply won't work as 5G won't penetrate windows and walls. 5G is like Usain Bolt—the fastest ever seen, but only over short distances. But don't try to send it very far because the signal just won't make it there. This translates to a vast quantity of "sprint" hardware filling in what used to be covered by a single "marathon-runner" cell tower. Somebody's going to have to build all of that hardware. And you can bet that forecasts and build schedules will shift forward and backward with regularity.

Do we really think that we can speed up existing processes? Will faster workers or a new line with more throughput be enough to grow with the increased demand? Or does this new

market require thinking about the capacity problem in a completely new way?

Our investigation into streamlining assembly reminded us of the elephant in the room: facility downtime. Time and again, the point made by experts was that the easy solution isn't to automate a single thing on the floor. Instead, the easiest solution is simply to reduce factory down-



time. If your floor currently stands idle 70% of the time, you can triple your top-line revenue just by filling your floor until you're at 10% idle time. Now, if that objective means addressing spots of automation on the floor, great. But how do you get to that kind of productivity? Processes and data. Streamlining for us is about maximizing our current utilization first.

The tools you need aren't necessarily more or faster workers or more equipment. The tools you need take into account changing customer forecasts and route the builds through the shop in the most efficient manner possible. The tools you'll need allow for faster, more nimble corrections to what flows through the shop floor at any given moment.

Michael Ford, senior director of emerging industry strategy at Aegis Software, sets the tone in his conversation with Barry Matties. Ford makes a strong case that the easiest way to streamline your facility is to reduce downtime.

We follow with Brent Fischthal and Jenny Yuh discussing the role optical inspection can have in streamlining assembly both on the floor and as a process improvement. Yuh and Fischthal showcase Texas-based Suntronic and Senior Manager of Sales Janet Tomor.

Columnist Mike Fiorilla follows with his column discussing the importance of a great design when launching in-house assembly at your facility.

Next up is a conversation with KIC's Phil Kazmierowicz and MB Allen. KIC has been in the center of the CFX development process from the early stages. Kazmierowicz and Allen discuss with me the impacts and improvements that Industry 4.0 capable reflow processes have on overall efficiencies.

Mentor's Zac Elliot also gave me an update on his 2018 white paper, "A Generalized Approach Can Help All Manufacturers Move to Smart Factories." With more and more real-world adoptions of Industry 4.0, Zac discusses transition strategies for smaller facilities. Spoiler alert—nobody needs to be left out of the transition unless they choose to be.

Then, Barry Matties interviews Denis Barbini, general manager at Laserssel, where they've



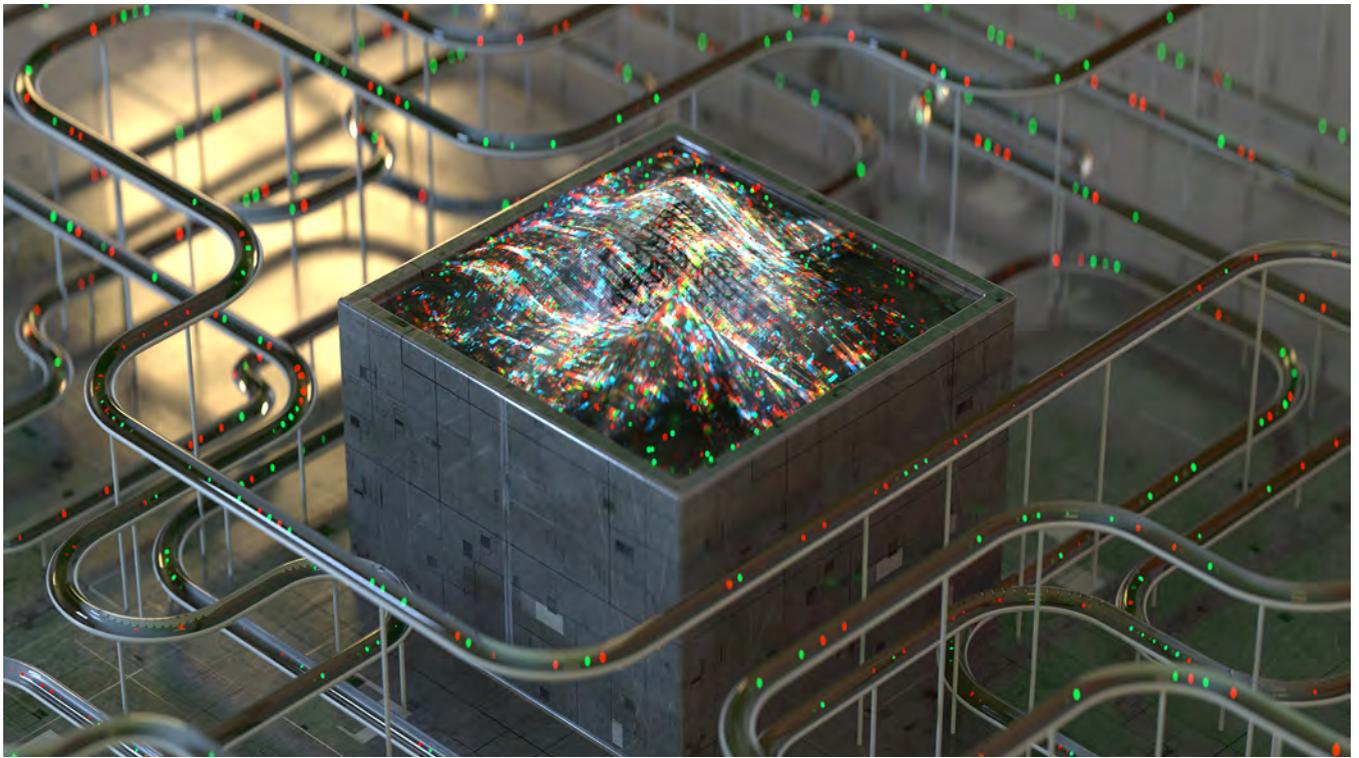
been raising awareness about their laser-based soldering technology.

Alfred Macha's column addresses how to become a preferred supplier and examines Lean Sigma. Closing out the issue is Ray Prasad's column on benchmarking defect levels in your products.

All of this should explain the poignancy of our cover image this month. As humanity becomes increasingly dependent on sophisticated electronics systems that need to work correctly all the time and in all kinds of conditions, our benefit will be the ability to move faster and more nimbly through our lives. There is payoff behind all these challenges we face. **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](#).



Data: Key to Automating Right the First Time

Feature Interview by Barry Matties

I-CONNECT007

In this interview, Michael Ford, senior director of emerging industry strategy, reflects on his first two years with Aegis Software Corporation and looks to the future of the data-driven manufacturing environment. It is imperative that manufacturers streamline their manufacturing process to stay competitive. Michael shares how the CFX and data collection model can play an important role in the streamlining processes, including Industry 4.0 and the supply chain.

Barry Matties: You've been at Aegis for two years now. How have the first two years been?

Michael Ford: It has been a great experience because I love that my work is related to global industry standards, which has been very fulfilling. Only a couple of years ago, everybody was competing against each other, trying to work out their advantages with data when it was in its infancy. Since then, I've enjoyed the opportunity to be a friend of the industry as more companies are coming together.

In my role, I've worked with hundreds of companies across the world—especially in China—where the Connected Factory Exchange (CFX) is becoming extremely popular. Manufacturers have been approaching, saying, “For the last five years of Industry 4.0, only 5% of companies in the world have started to adopt it.” And this was not part of their five-year plan. They wanted it to go much faster, but it simply didn't happen. Aegis has been providing the opportunity for the industry to understand what the standard means in terms of the defined data content, which is the first time this has ever been done.

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And people thought it was impossible because nobody would agree. If you brought three machine vendors in competition with each other on a phone call, were they going to agree on what the data is going to be? Well, they have. They were guided a little bit because we need to see the big picture and keep the context, but we went through them one by one, hundreds of times over, and the standard is now published.



Michael Ford

Matties: There's a lot of fear that they were giving away proprietary information, but that was dispelled.

Ford: Right. It's surprising that people would do that, considering the amount of antagonism that went on before because people differentiated themselves about what they could do. Now, we're telling people, "You all need to provide the same data so that your customers will understand it all." There are no hidden secrets anymore or proprietary pieces of data that can be used as we see in other formats; that doesn't exist in CFX. This standard represents a genuine step forward. The next phase of the story is starting because hundreds of machine vendors have been developing CFX, and we need to bring the context to that data because machines only know what happens inside.

What's in it for the machine vendors is the ability to see beyond the four walls of their machine or, in some machine vendors' case, the four walls of their software controlling the line. But they also want to know about the materials coming in from the warehouse. At some point, every vendor wants to know what's happening beyond—upstream or downstream on their line, what's blocking them; what their quality results are; where their materials are coming from; and their plans, schedules, and customers' needs. They want to optimize their machines automati-

cally and meet that customer demand for automated manufacturing.

Now, they realize they can do this, but don't know how because they are experts in machine software—not MES software. CFX becomes the bridge that connects the machines to the MES environment so that they don't need to understand about MES and we don't need to get involved with the machine side. We're clearly aligned and collaborating together through CFX.

The stage we're at right now is hundreds of machine vendors are saying, "Let's do something. What should we do? How are we going to do this?"

Matties: Putting the infrastructure in place is one thing, but implementation is another issue. There's not necessarily a manual out there that says, "Here's step one through to the final step." The challenges include how do you choose, where do you start, what's the right strategy?

Ford: Yes, because if you get it right the first time, you have very little cost or risk and a lot of gain.

Matties: And there's a lot of fear because we know if we get it wrong the first time, the opposite of all that you just said happens.

Ford: We're aiming to gather a few case studies from customers and machine vendors to show how achievable and easy it is to put something together. Signs are coming up already. There's a lot of scope in the pipeline to see these things, and IPC is supporting the exchange of information. We're setting up "A" teams to focus on different application areas, software development kits, and even a manual to help people get started. It's all coming together through cooperation.

Matties: We're looking at streamlining processes. Automation is a part of that, but what thought process should they follow?

Ford: I've always been suspicious about anybody who says, "Optimize your process," because nobody defined the process. If you think about your process as a machine, it's easy to do that. You bring in your Lean experts and start to analyze the waste and the value stream mapping, etc., but the process has dependencies. You have a machine before and after as well as materials coming in, so is that part of the process? I would say it is because, without those under control, you can't do anything else. That has been the fundamental concept of manufacturing for quite a long time.

Your final assembly line does not stop no matter what, and to guarantee that process continues in the most efficient way, all of your dependencies have to be controlled to supply in time. I see all of this optimization as being a part of that. That's where Aegis comes in because we have this unique, holistic program where we have one database over the entire manufacturing process—quality, materials, execution, everything. We can build the context of all of the different data points coming and provide that information as a tool for those who want to optimize their process, however they define it. They may want to do the machine, do a group of products on the line, or include all aspects of the factory, maintenance, and materials. The nice thing about it is you can do all of those with the data that we provide, and we're not going to tell you how to do it.

CFX doesn't say, "This is the way you do OEE and measure this." We're providing that contextual information from the machines. One thing that people don't understand with the analysis of data is that in manufacturing, it's not as simple as taking the data from the machine and analyzing it. That's the wrong thing to do because the machines aren't running most of the time.

The time that you're optimizing is 20% of the day, in which the machine was running. You improved that by 5%, but it doesn't make much difference. What you need to focus on is

the 80% of the time that the machine wasn't running, and that's the time that you don't get data from the machine, so how are you supposed to know? That's the value of the MES cycle because maybe the problem was the materials, a changeover, the schedule, or that the customer doesn't want anything or there's maintenance going on. How can we optimize that to reduce 10% of the 80%, which is so much more value than 10% of the 20%?

Matties: That makes a lot of sense. Then, you're down to 70% rather than 80% and keep driving that number to as low as possible.

Ford: Exactly. People come up to us and say, "Aegis helped produce CFX and have given away their machine interface technology. They're crazy." We have all of these software companies popping up now reading CFX and everything else. They haven't seen this big picture. This is the big picture that we started five years ago with our FactoryLogix software that is completely made from scratch for IIoT, data-specific purposes. We want to be a friend of the machine vendor and help and encourage this exchange of data collectively rather than competitively as we see other companies doing it.

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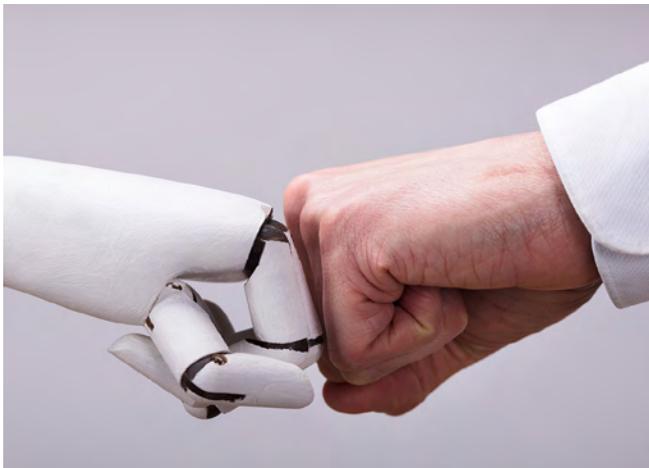
Matties: And people tend to think of automation as the machines, and that's the mechanization of a process. The automation is driven by the data, and what you're automating is the data. The machines just read the data.

Ford: That's very true. If you look at Industry 4.0 requirements, you're meant to make any product at any time for anybody in any quantity. To do that, you need to understand the impact that any decision is going to make on the optimization of the factory. That is quite a complicated challenge. We like to provide assistance to that by providing the data. Today, we're providing it to humans to help make those decisions. Some simple decisions are automated, but there's going to come a time when AI is going to start to control manufacturing.

Matties: And that time is coming rapidly.

Ford: It is. Some people have what I would call close-to-genuine AIs but are disconnected from manufacturing. We need to connect that kind of intelligence with manufacturing to make Industry 4.0 real. The other mistake that people make is they only consider the automated processes, which put in 80% of the materials in assembly. Let's say 80% of the pain comes from that other 20% of manual operation. We must never forget the human element of manufacturing. How should people understand what work they are supposed to do without any possibility of mistakes when they're assembling multiple products?

Normally, you have a learning curve, assistance, mentoring, and tutorials to build up people's understanding of what they should do; then, they do the same job every day without any mistakes. When you ask someone to do different things, that's a different concept.



We have an augmented reality solution now that uses the same data as you would give to somebody sitting in front of a computer about how to do assembly, but we put it in front of people's glasses so it's hands-free. It doubles the productivity because you have two times the number of hands. Plus, it gives you direct instructions for everything that you want to do. This is the revolution for people.

Consider the young person getting into manufacturing today. They have career opportunities everywhere, and you say, "Come into our company, which is great and prestigious. You can put that part in that board and do the same thing hour after hour, day after day. Would you like to join?" No, they won't be interested in doing that, and they won't like manufacturing; they may even think it's horrific. Meanwhile, if you ask, "Would you like to come into manufacturing utilizing augmented reality? You will do a variety of jobs with cool tools and devices, and you will be given the opportunity to use your creativity. We'll also take your feedback, and you will be a part of making the world's sexiest product." That sounds interesting.

Matties: It changes the perspective.

Ford: It does. And this is how the young people of today are being educated. This is what they expect. For us, wandering around with a headset on may sound a bit weird, but for them, it's natural.

Matties: That's what we're going to have to do to bring them in.

Ford: This is the real revolution. The machines are iterative generations to get better and cleverer, and they communicate and can take that to a new level. It's a given now, in my opinion. What is not yet a given is the inclusion of humans into that. We need to work to put together the human elements and automated elements, including robots, to meet somewhere in the middle. It all needs to be combined into this holistic view so that when you optimize the process, you're doing the entire process. Then, when a customer asks, "I want to make

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Matties: And the cycle time for training somebody on the task is minimized.

Ford: Yes, it should be.

Matties: It’s a visual show and tell.

Ford: If people have the basic skills of the job, then it should be zero, so you have to give basic training. Assuming people know how a screwdriver works, you can show them a picture of and point to what they’re supposed to do regarding the tool. Just by looking at it, it would automatically read the barcode, CFX data connects that tool. We have CFX in tools now and soldering irons that immediately records the traceability. I know this person is trained to use this tool and has the tool in their hand, and the tool has calibration that meets the criteria of the job, so when they use the tool, everything is recorded.

We have CFX in tools now and soldering irons that immediately records the traceability.

Matties: And every aspect of it is traceable.

Ford: Right, and some people are demanding this. When you’re working on satellites or radio telescopes, for example, you cannot afford one mistake; the same is true with airplanes and driverless cars. Redundancy is very expensive, and if you have redundancy of two or three systems, it’s still going to have redundancy after a while.

Matties: Giant companies have the resources where they can build a new factory, but for

somebody that’s established and doesn’t have quite that level, such as Tier 2s, this is a large undertaking. What you’re describing is wonderful, but it’s still a journey.

Ford: And most people associate that with cost. However, all of the things that we’ve talked about are a negative cost and a net benefit for the people who adopt them. That’s how we sell our software and how people sell machines and tools.

Matties: Again, I think it’s about the understanding of where, when, and how to start.

Ford: Absolutely. People like to see examples because then they know that they can repeat the same thing. The cold reality is that most manufacturing operations are different, and whereas you may be comfortable to see that this success has been done here, you wonder will be the same with you, knowing that you have slightly different processes, products, and materials and completely different people.

Matties: If somebody is looking to streamline their process, for me, it starts at the sales level because if a machine is sitting 80% of the time, my first thought is there should be more sales (laughs). It’s the data that comes in from the salesperson that drives everything subsequent to that.

Ford: What we used to see was a horrific situation in ERP, and it wasn’t ERP’s fault. Over a long period of time, ERP was designed to optimize supply and demand for the customer. However, the cost of stocking the distribution chain became very difficult and people wanted to reduce it, so they started to reduce that stock. Now, when you reduce the stock, you end up hitting zero and not having goods on the shelves, and salespeople hate that because they can’t sell anymore if there are no goods to sell. As a result, they would inflate their predictions in the ERP, realize they were wrong and would revise. Instead of a steady pattern of smooth demand, it was a square wave. Some companies have charted this toward the

end of life of a product; you see a square wave demand where the factory is absolutely flat out, and then the next week, it's zero.

ERP is not the right tool to use anymore; it simply cannot work fast enough. But that doesn't mean ERP has to be replaced; it has to be augmented and have help. If you go onto Amazon or eBay, for example, you are buying something from a seller who doesn't even own that product yet and is simply taking your order and passing it to a factory that directs you. That is the way people are ordering today, and this is a brilliant model because they never had to buy that. They don't have cash out, and they have no risk because they only get your money with markup and then pass it back. This is the future of B2B business, so how can we allow that business model without bankrupting our manufacturing operations because they're boom and bust?

This is a look ahead to what Industry 4.0 represents in its truest form. The ability for manufacturing and the supply chain to react to that level of volatility without resulting to the increase of stock, which would simply be moving the stock from one place to another, has no net effect. How do we make them truly responsive and keep their productivity? This is similar to "built to order" on a mass production basis. It has been impossible in the past, but this is where intelligence—artificial or otherwise—is needed within manufacturing. And the decisions that intelligence makes are based on the data. The data coming from the customer demand and makeup of the product; the understanding of the availability of materials at short notice and optimization of automated processes; and the ability of humans to adapt and work on something different come together and are all linked with the data.

The way that the linkage is done is through modern MES technology, so this is not the MES technology of the past where you get a plan and follow it step by step like a piece of clockwork machinery. This is adaptive planning, so we haven't done long-term simulations or plans. We are going to wing it day by day in an intelligent way.

Matties: That is a new strategy, but it optimizes everything. I know you said you didn't like the word optimize necessarily, but that's what you're doing.

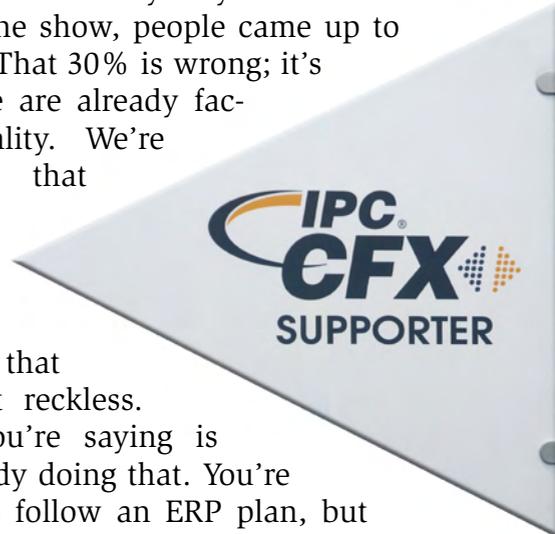
Ford: And that is what people are doing right now. I went to one show in Sweden and jokingly, but not so jokingly, said, "You're probably only getting about 30% productivity in your factory," and everybody looked at each other. After the show, people came up to me, saying, "That 30% is wrong; it's 10%." People are already facing that reality. We're not saying that you have to make the plan up as you go along because that sounds a bit reckless. But what you're saying is you are already doing that. You're pretending to follow an ERP plan, but you're not. Let's optimize what you're doing right now in practice rather than trying to get this archaic infrastructure to predict or simulate more, which is irrelevant given that the demand changes day by day.

Matties: And if you have all of the data coming in, it's not a difficult task.

Ford: Right, because people in manufacturing have a lot of experience—they know what to do in a particular set of circumstances—but what holds them back is not having information.

Matties: AI is the place, and we're going to see where this flourishes. There's a big race between China right now and the U.S. for AI and China is quite vocal about it.

Ford: We are on the cusp of creating true AI. IBM's Watson is an excellent example; it's similar to a car engine that could be put in many different cars. Let's get in the car that is manufacturing.



Matties: I'm quite surprised that we haven't had more of a noticeable impact from Watson.

Ford: There are two elements to that. It's the connection of the intelligence to the problem. If you think about a human, we have a fantastic brain that's naturally intelligent. But when you imagine the number of connections that you have and senses on your body to feel, touch, see, hear, etc., it's extremely complicated. Sometimes, people underestimate how easy it is to apply AI to an actual problem because you need to define what the problem is and enable the AI to feel, see, and understand opportunities for improvement. That's the problem that we've not had until now because the data has not been there, but we just said the data is here, so a revolution is about to happen.

Matties: For somebody that's looking at streamlining their factory, a common thought is how to move and work through the factory as well as process elimination. How does CFX and the data collection model help with that?

Ford: It helps with the analysis of what everything has been used to do. There are choices where you can have separate individual steps—maybe you can combine steps in a certain machine that makes more sense—but if you combine too much, it becomes more dedicated to a certain task, and you end up not using most of the machine capability. The depth in which we go within CFX to analyze the internal functioning of each device means that you can do that level of optimization.

For example, a machine vendor can say “I have a line solution or a solution that does two kinds of placement and inspection.” In which circumstance would that be relevant? In which circumstance would that potentially not make the most of the equipment? And you could use something much cheaper much more effectively. The analysis of the real-world environment within production will lead to successful choices of that equipment.

And the result is going to be indefinite. With our software, we don't bring a product in and

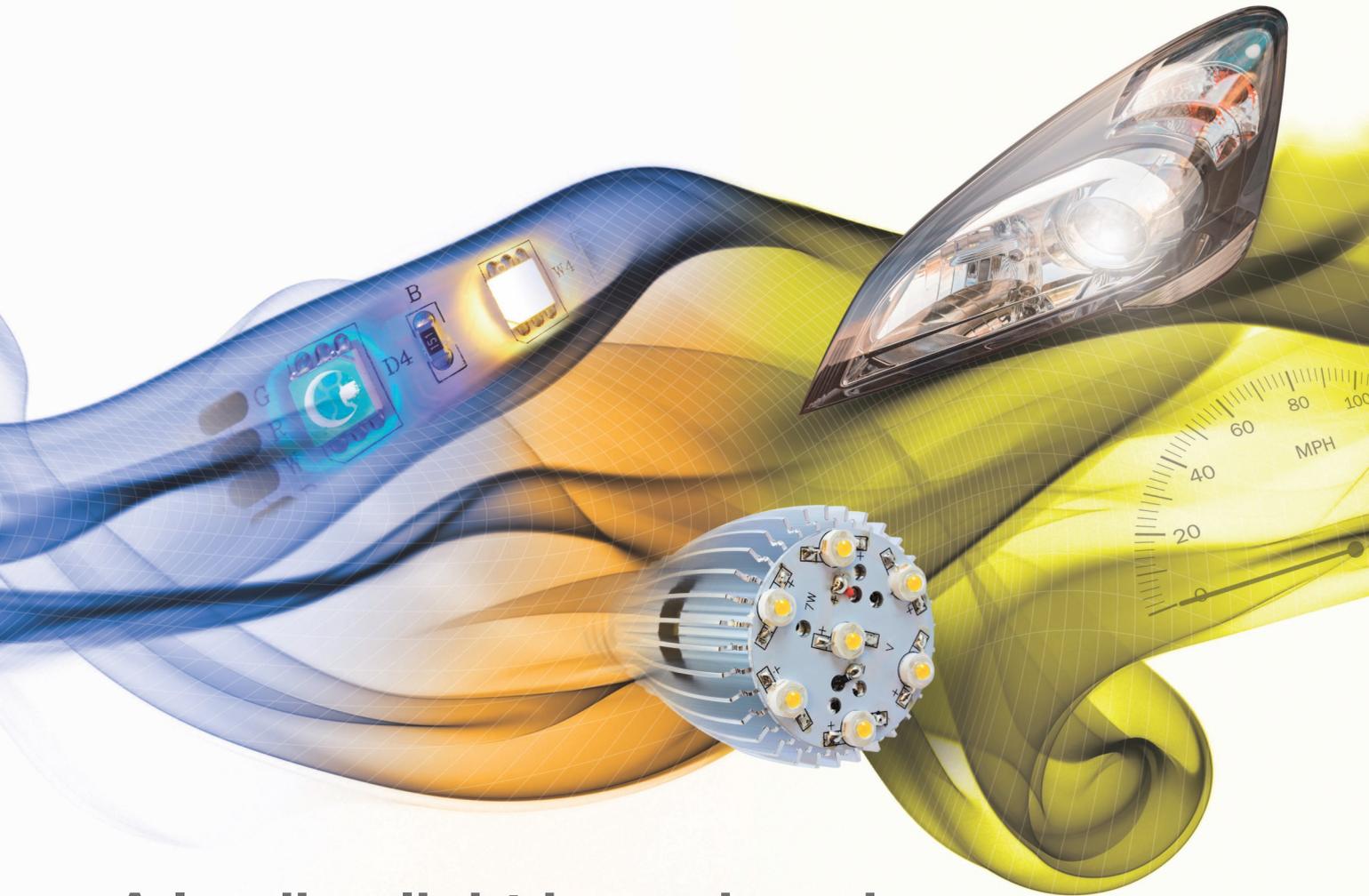
say, “This is going to be made on this line forever,” because that's old-school thinking. We say, “We have this product. Where do you want it now? Do you want it on this configuration?” because this is a digital, adaptable model that's not presupposed to be in a specific place, which gives the flexibility for Industry 4.0.

This is a standard feature in our software, but it's a revolution in that people are not allocating a product forever to a line and then realizing that line is running at 10% capacity. It may be the customer only wants 10%, but if you can move it to a line that runs at that quantity at 100%, why not? Bring the faster line for another customer. And these changes can be executed seamlessly without reworking, re-engineering, and making all of the programs again. You can do it without all of the pain because you have that central product model.

Again, we're working with IPC on that with the IPC-2581 standard that defines the digital product model. It is essential that we get all of that information and pass it to all of the machine vendors through CFX so that they can understand it immediately. We want people to understand the board perfectly, apply the optimization program, and be ready with a change-over of three minutes instead of three hours.

Matties: The depth of knowledge that the machine vendors extract from their equipment becomes a purchase consideration because if I'm buying a piece of equipment, I don't want something that doesn't have all of the data capturing capabilities.

Ford: Right. This is a big step forward in terms of opportunity for machine vendors. And those who have been working with us with CFX understand this 100%. Now, they're planning to have features available on their machines that are increasingly smarter through the internal processing of external information and collaboration with other machines without needing to talk to them in a business sense—no NDAs, contracts, or development teams. Simply, “I'll utilize information and finish the job.” Everybody who participates benefits, from the lowliest machine vendors and manufacturers



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all the way up to Tier 1s. That makes it sustainable. Nobody is going to turn their back on it and say, “That was yesterday’s fad. What’s tomorrow?” because we are all getting direct business benefits.

Matties: Let’s talk about supply chain 4.0 further because I think that’s part of why I mentioned sales; that’s where it starts.

Ford: It is. The focus of Industry 4.0 over the years has all been on manufacturing, but manufacturing has a god, and that god’s name is supply chain. You can’t do anything if you don’t have the materials. If you’re short of one of the lowliest, tiniest resistors, you don’t ship that product. The value of every component is not the cents that you used to buy it, but the value of the shipped product.

The value of every component is not the cents that you used to buy it, but the value of the shipped product.

With that in mind, with Industry 4.0 telling us we need to make a quick response to the customer, how are we supposed to communicate that through ancient technology like MRP and ERP on through to component supplies? It doesn’t work because it was never designed to do that. Do we want to get rid of MRP and ERP? No, we want to augment it. We want to provide ERP and MRP with the eyes and ears of the Digital Age.

What we’ve done with supply chain 4.0 is to link manufacturing with a tool called BOM Connector, which can take a BOM at a moment’s notice and find components. If a customer wants 100 of a given product, you don’t order the ones you already have because that would be silly. From our FactoryLogix software, I know how many materials you have, including spare materials, and how much is commit-

ted to other projects. That can be utilized, or you can find everything else new. If they need a particular lead time and I want to make sure the quality is right, I want to make sure I buy it from a trusted source so that I don’t get counterfeits. I also want to ensure that the part I buy is consistent with the one I was originally intending to use in the design. All of that is supply chain 4.0.

Instead of having to do all of that manually—as they have been doing for years—the purchasing people can just run this function. It searches and finds all of the parts on the internet and gives you a new BOM. I’m going to put that into my production system, so we didn’t change anything about those systems; we simply augmented them by providing them with the right information.

Matties: That backs all the way up into the point of sales because this is something you don’t have to wait until it’s ordered to run this report.

Ford: Correct. There was a study done, which I found fascinating, where if you look at the life cycle of a product in the market, you see a curve that starts out gradually because nobody’s aware of the product. Then, people become aware of it, and all want it. Suddenly, you start to saturate the demand, and competitors come in, and everything S curves. Those used to be measured in years and then in months. However, you can analyze the demand on the S curve on that short, initial area and predict the exact quantity of when you’re going to sell that product and how many. You can put that prediction, albeit for three months or one, as your demand for your factory and give them a heads up. I don’t know the day people are going to buy it, but I know within one week, and I know the quantity. This is my Industry 4.0 input through the factory and supply chain.

Matties: It changes everything, and it’s all driven from data. Data is what we’re automating. When we say automation, we’re automating data.

Ford: That's true. And the real key here is that the cost of data has to be near zero because we're looking at so much data, if there was a cost, it would be too expensive. You can't have people writing things down or typing them out.

Matties: It must be a result of their work.

Ford: Yes, it has to be an integral part of their standard operation. With our AR, for example, you look at the barcode, and it reads. How easy could that be? And you have voice feedback, telling you what to do, and there's no cost.

Matties: A lot of shops say, "We're too small for this," or, "That's not for us." I think this reaches into any level of manufacturing scales.

Ford: Scalability is always the issue because mom-and-pop shops are the backbone of the U.S. and Germany as well. And middle-sized companies shy away from stickers that have high prices, saying that it's not for them. We've intentionally created CFX, for example, with no cost. An end manufacturer could purchase the standard for a few dollars. Get someone out of university who knows about software programming and wants a little bit of experience. We've seen examples where they can make dashboards within a couple of days. They're not getting the full value of CFX, but they're getting enough. They are getting an excellent return on their investment, and that takes them to the next level to say, "Well, I'd like a little bit more. Then, they build step by step.

You'd think it would be different on the opposite end of the scale, but it's not. The biggest companies in the world have so many machines that they cannot even understand what they have. The first step for them is a very small step. "Give me a dashboard that shows me all of the machines that I have in the world. I just want to see if they're working or not. How hard can it be?" Then, they get that and say, "Now, I want to break that down. I want to see the performance, OEE, etc." They start to want more.



All of this is approached by value-driven steps for the largest or smallest customers. We've made our software like that because we believe that that's how it should scale. You scale the cost with the value and you'll always make sure that the return on investment is within a few months and no more than a year in any circumstance. Then, there is no reason why people would not want to buy it because, at the end of the year, they're going to be in a positive situation. How can they refuse to use it? They may have some issues about how to change their operations or make best practices, and that's where we help them.

They have to be confident that they can do this. At Aegis, we can work with a lot of key influencers within the industry, including some of the largest companies and IPC, and we are 100% dedicated and focused to driving this improvement in the industry. Our larger competitors can't say that. They have tiny groups of people who are lost in the big corporation of things that have little opportunity to engage with customers and machine vendors. But we see that as a sweet spot because we know that we are creating genuine value for whoever comes in at any level. And that has been the most rewarding part of being at Aegis for the last two years. We are completely reliable with not just our interest at heart but also the interest of the industry.

Matties: Congratulations on your two years, and thank you for your time today.

Ford: Thank you very much. SMT007

3D Optical Inspection Provides “Eyes” for Process Improvements in Industry 4.0



Feature by Jenny Yuh, KOH YOUNG TECHNOLOGY, and Brent Fischthal, KOH YOUNG AMERICA

Automated 3D solder paste inspection (SPI) and 3D automated optical inspection (AOI) systems have become an integral part of the printed circuit board assembly (PCBA) process because they help ensure high-quality production. As today’s board complexity is increasing, inspection technology becomes even more critical.

For example, while talking with Janet Tomor, senior business development manager at Suntronic Inc.—a contract manufacturer with facilities in Richardson and Houston, Texas—I-Connect007 Managing Editor, Nolan Johnson asked, “Streamlining must be something you talk about a lot [at Suntronic].” Tomor replied, “The biggest impact for us has been automating almost everything except for putting your through-hole connector on the board by hand. We’ve automated most of our inspection and have improved quality. We went from 60% yield on our PCBA lines to 98.9% by adding automated 3D inspection from Koh Young.”

Tomor’s team also added 3D SPI equipment, continuing, “I’ll give you an example. We have a solder paste inspection machine on every line. We once put on a stencil, and it wouldn’t pass. The cause was that the stencil was too thick and applied too much solder paste. We would have had parts sliding all over the board because of the excess solder paste. That was a huge discovery and a change we made thanks to our SPI.”

While most manufacturers base quality decisions on a “good-bad” comparison of reference images, these decisions are easily influenced by variables like surface finish, board condition, component proximity, and more. However, data generated from 3D measurement systems provides meaningful insights about the process and helps manufacturers identify and eliminate the root causes of a defect. When manufacturers trust the data from the system, this helps to transform their operations and accurately control and monitor the PCBA process. What are the requirements of an inspection system to move from inspection to measurement, and ultimately to process control

PCB ASSEMBLY *for* SMARTIES



Part 4 of 4

That's a Wrap!

Our **For Smarties** series concludes with the fun part – PCB assembly. It is time to stuff the bare board with components and put it to work. You've successfully navigated the process from board design through manufacturing, but even experienced makers can hit a snag at assembly.

This paper will offer strategies for ensuring a smooth assembly process that produces a quality product.

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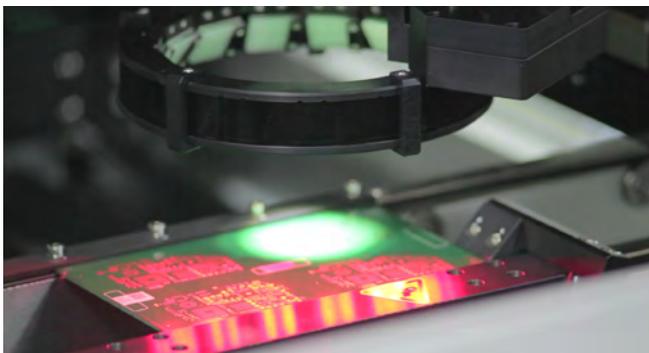
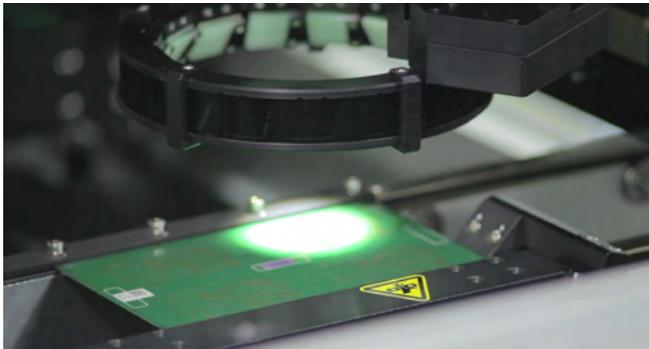
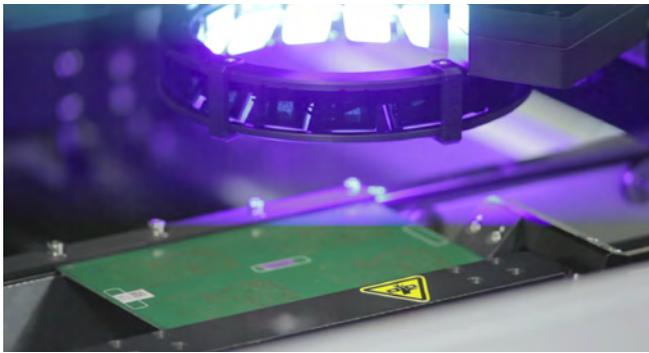
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and optimization? Simply stated, the systems must satisfy the three “Rs” for measurement data: reliable, repeatable, and relatable.

When Johnson asked Tomor which equipment they were using to automate inspection, her answer was straightforward: “Koh Young.”

Reliable

Koh Young’s implementation of full 3D coverage monitors performance to detect common defects, such as missing or wrong components, and accurately identifies other issues, such as coplanarity and lead bridging. By measuring components and solder joints, and then offering critical height information to the inspection algorithms, contract manufacturers can use reliable measurements to identify errors during the production process. For example, after Suntronic adopted Koh Young

3D inspection solutions, their yields increased into the high 90% range, which has helped to transform their operations. But what’s next? How can they continue to improve?

Tomor further commented, “We also have a post-reflow AOI after the oven tells us if anything shifted. It uses true 3D technology, so it can measure if the part is skewed, missing, shifted, tombstoned, etc. Between the Koh Young SPI and AOI solutions, we increased our yield.” When asked what else helps with streamlining the assembly process, Tomor simply stated, “New equipment helps a lot.”

That new equipment solution, though, pays off by prioritizing data over raw throughput. Global competition means that manufacturers place challenging demands on process solutions. Manufacturers want to monitor and adapt the process to achieve zero defects by accessing all of the data anytime, anywhere. Moreover, manufacturers want process optimization. 3D inspection solutions have been instrumental in providing better data in the form of body and lead tip measurement, allowing the new equipment to quantify shape, coplanarity, solder amount, etc.

Koh Young 3D inspection solutions, for example, measure the component and solder joint per the IPC-A-610 standard, generating a significant set of reliable measurement data. This data is the foundation for Industry 4.0. Consequently, advanced inspection systems must evolve beyond simply judging “pass/fail” into functioning as highly intuitive, dynamic decision-making systems, which emphasizes the need for reliable data.

Of course, maintaining quality, repeatable measurement data is not enough to realize a smart factory. The system must also instantly analyze the data with relevant indicators, including yield rate, NG (no good) analysis, PPM analysis, gage R&R, offset analysis, and more metrics that allow manufacturers to compare board performance and identify process deviations. Artificial intelligence (AI) engines and machine learning can empower systems to help customers analyze and optimize the production process by managing the data from connected SPI and AOI systems.



printing information with SPI measurement data. More advanced software automatically performs design of experiment (DOE) intended to complete a detailed SPI result analysis using advanced diagnostic algorithms and noise filtering models, and then recommends the ideal print parameters.

Using advanced communication, the Koh Young AOI systems feed corrected mounting position values to mounters, which ensures the pick-and-place machines mount the components in the correct position. This feature improves process repeatability by automatically adjusting placements and identifying trends to make further positional corrections.

Creating the Real-time Feedback Loop

Connecting mounters and AOI provides obvious benefits, but when integrated with APC,

it can improve yields, especially in high-density boards. To do this, mounters use the data received from inspection to update the placement program, ensuring the components are placed onto the solder deposits rather than onto the substrate pads. This approach to placing components on the printed solder can increase production yields and reduce defects.

Connecting inspection systems with mounters can help achieve complete line communication and further enhance the value of the inspection process. For example, M2M connectivity optimizes the process by exchanging real-time measurement data between printers, SPI, mounters, and AOI systems. The systems feed offset and warning data to other systems while analyzing trends for process optimization and traceability. Combined, this process provides unsurpassed performance power.

Communication between equipment will improve process repeatability by automatically adjusting component placement to the solder deposit rather than to the pad location. This advanced process further improves microchip mounting reliability. Figure 2 charts dramatic improvement across five different defect types when a manufacturer uses advanced process control in production compared to a conventional placement approach with no communication between systems. Networked intelligent systems that allow real-time

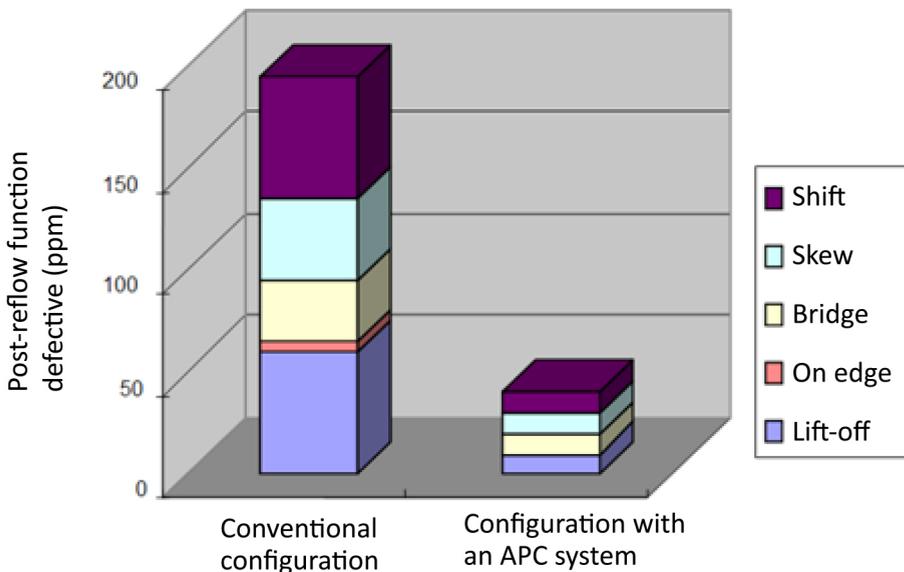
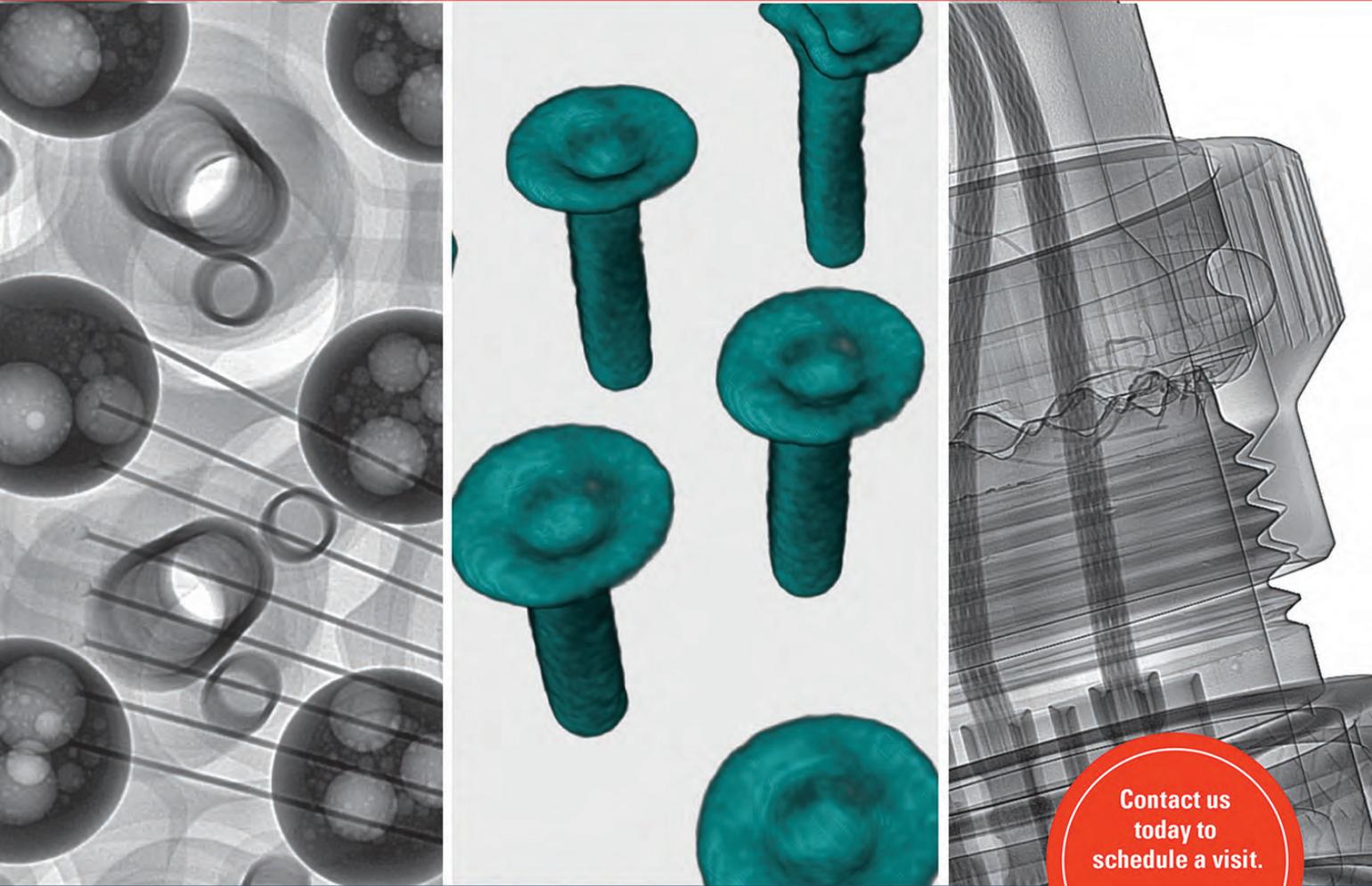


Figure 2: Post-reflow defect reduction effects with adaptive process control.

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results to be correlated, calculated, and visualized will become even more essential in the smart factory.

Freeing up the Front Office

Understanding the increasing importance of networked intelligent systems in the smart factory, Koh Young has been continuously testing its modular platforms with its KSMART partners. Thus, Koh Young designed the modular platform for future growth and expansion. When Koh Young releases new software modules, a manufacturer can implement the upgrades as needed. Harnessing the power of the Koh Young Intelligent Platform (IP), KSMART extends beyond automated adjustment towards a comprehensive infrastructure for autonomous process optimization. Indeed, a smart factory is within reach of any manufacturer.

Back at Suntronic, the question is posed to Janet Tomor, as to what their priorities are for

further streamlining their process and work flow. Tomor responds, “Working with the customer to produce a manufacturable board with well supported components.” With inspection systems optimized, and with a path toward the real-time adjustments that CFX, M2M communication, and advancements in AI and knowledge modeling from companies like Koh Young, Tomor’s attention isn’t focused on the data from the shop floor; it’s focused on the customer’s supplied data. **SMT007**



Jenny Yuh is marketing assistant at Koh Young Technology.



Brent Fischthal is senior marketing manager at Koh Young America.

Gesture Recognition Using Ultrasound

A research team at the Fraunhofer Institute for Photonic Microsystems (IPMS) have used a new class of ultrasonic transducers to reliably detect distance changes, movement patterns, and gestures in ranges of up to half a meter.

For this development, researchers are implementing electrostatic microelectromechanical bending actuators that have been continuously advanced for generating sound in micro-loudspeakers and micropumps since 2016. The Fraunhofer IPMS proprietary nano-e-drive (NED) principle utilizes the high forces of electrostatic fields in nano-meter-sized electrode gaps to allow for mechanical movements with displacements in ranges of several microns. The chip surface, as well as the complete component volume, is used for sound generation.

Group leader Sandro Koch explains, “Using the entire chip volume for sound generation enables us to produce very small components. Because hundreds of such devices can fit on a single wafer—and multiple wafers

can be simultaneously processed in single process steps—the cost of manufacturing large volumes is potentially low.”

Fraunhofer researchers expect that high air volume flows that have been converted into high sound pressure will support further development to provide an increased signal-to-noise ratio for low-frequency ultrasonic transducers. The resonance frequency and thus the detection range and spatial resolution can then be defined by the geometry of the NED bending actuators.

The tiny components are inexpensive to produce, allow for high sound pressure, and provide a flexible frequency design for an optimal balance of distance and sensitivity. Possible fields of applications include uses in automation, safety, and medical technology as well as the automotive, entertainment, and household electronics industries.

(Source: Fraunhofer Institute for Photonic Microsystems)



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First Time With **In-house** SMT Assembly? Start With a Great Design

The Manifest
Feature Column by Mike Fiorilla, MANNCORP INC.

When you handle your SMT work in-house, it's up to you to navigate any complications you may have with the design process. One of the best ways to eliminate possible production issues is to ensure that you have a manufacturable design. Thus, there are several factors to keep in mind when reviewing your designs before bringing your production in-house or starting your first run of in-house prototypes.

One of the first things to consider when bringing your production in-house is the maximum size of your boards. Ensure that the machines you're looking into can accommodate the design that you have in mind, or be ready to adapt that design if you find that to be the more cost-effective option. Most manufacturers recommend at least 3 mm of edge

clearance, so be certain to consider that when working on your boards' layout. Consider using edge rails on the boards if your components are up to or close to the edge of the boards. Taking care of anticipated issues in the initial steps of the design process can save you from headaches down the line.

When designing double-sided boards, include fiducial marks on both sides of your board. These markers will give your machines' imaging systems a point of reference to work off of when assembling your boards ensuring accurate placements for fewer defects. For the best results, stick to the standard round fiducials of 1-1.3 mm and try to keep away from any marks or via holes on the board that look similar. It's also best to keep these marks on the





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opposite corners of your board, diagonal from one another, for the highest degree of accuracy.

If you're designing a mixed technology board using through-hole parts and SMT, it's best to keep the SMT on a single side of the board and to have the through-hole parts protrude through the bottom of the board to allow for wave or dip soldering. If you're running a double-sided design, keep in mind you will have to solder the through-hole parts with a selective solder, hand solder them, or get specialized pallets to run that assembly through a wave solder machine. Double-sided boards offer some other challenges, many of which were addressed in my [last column](#), but a key part of double-sided design is ensuring that lighter components are on the bottom of the board during the double-sided reflow process.

The size and shape of your board itself can also have an impact on how your boards are transported through the SMT process. If your board is round or odd shaped, it can be difficult to plan out exactly how it will travel through your SMT line. Find a way to ensure that the edges of your board are square for ease of transport through the SMT line. If not, you'll need to find a solution, such as incorporating fixturing pallets for the board to be processed through the SMT line, or a removable frame portion in your design to be depanelized later.

If your final product is small boards, you may want to consider panelization of the boards as an option to increase your production throughput and minimize handling. Provided that you optimize your placement order, this process can cut down on your pick-and-place time, organizing all parts of a type to be placed one after another across multiple boards to cut down on the number of nozzle changes. In addition to those benefits, panelization is also great for freeing up operator time for other tasks as they can dedicate less time removing individual finished boards and reloading the line itself.

It may seem obvious that design is the first step in producing a quality SMT product, but it's essential to get your production started on the right foot, especially if you're transitioning to in-house PCBA work. Rather than being the concern of an outside contractor, issues and challenges with your design become your own and can become overwhelming quickly. Taking the time to ensure that you have a workable, stable design upfront can alleviate a world of stress in the long run. **SMT007**



Mike Fiorilla is a writer at Manncorp Inc. To read past columns or contact Fiorilla, [click here](#).

Incoming CEO Steve Pudles on the Acquisition of Zentech

Zentech Manufacturing Inc. was recently acquired by BlackBern Partners LLC in partnership with Zentech Management and incoming CEO Steve Pudles. Pudles has a



30-year track record building EMS businesses with industry-leading technology, process, quality and customer service. He is a 20-year member and past chairman of the Board of Directors of the IPC (Association Connecting Electronics Industries). Outgoing Zentech CEO and President, Matt Turpin, will remain with Zentech as an advisor and investor. All members of the senior management team will remain with Zentech post acquisition.

In an interview with I-Connect007, Pudles discusses the deal, his new role, changes to management, and the company's plans post-sale. Coming out of his semi-retirement, Pudles also talks about what led him back to the business, especially the EMS sector.

To read the full interview, [click here](#).

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Reflow Your Solder and Your Data for Industry 4.0

A Conversation with Phil Kazmierowicz and MB Allen
KIC

I-Connect007 Managing Editor Nolan Johnson recently spoke with KIC President and Founder Phil Kazmierowicz and Manager of Applications and Sales MB “Marybeth” Allen as they each transitioned into [new roles in the KIC leadership team](#). The conversation ultimately turned to the current dynamics in the industry, particularly Industry 4.0 and streamlining processes.

To kick off the discussion, Johnson posed this question: “Generally speaking, there are two key parts to improving the efficiencies: faster, more accurate throughput, and increased uptime. From your perspective, watching the reflow process, what do you see as the greatest activity in the market for reducing the likelihood of the reflow process becoming the facility’s bottleneck?”

Kazmierowicz, Allen, and Johnson then delved into this question throughout a series

of conversations and emails, which have been edited into the discussion that follows.

Faster, More Accurate Throughput

On the topic of throughput, Allen wrote, “A key component to an efficient manufacturing operation is optimization throughout the factory. One of the most effective ways to optimize is via software. Trial and error are a thing of the past. Optimization software not only assists with productivity but also defines and improves the process for the highest quality result. The optimization process for reflow starts in the early stages of setting up a product for solder reflow.”

Allen continued, “Finding the correct recipe for a reflow oven to produce a PCB within the current, very tight, lead-free process windows could take significant amounts of both resources and time. Our predictive software tools assist a customer to find this recipe very quickly, likely in just two passes, which significantly reduces the amount of time just to set up a profile. In addition, our predictive soft-

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ware can give a customer an in-spec profile without even running a trial PCB. These two functions alone provide solutions for fast profiling for a high-quality product and within the specifications of the factory's requirements, which include faster throughput, lower energy costs, and, of course, difficult and challenging assemblies with a variety of process windows between components and solder paste."

Phil Kazmierowicz explained the details. "Once the specification was defined mathematically, we invented the process window index, or PWI, which represents profile quality with a single number. In this way, oven recipes could be compared, allowing us to develop a software tool that we called Auto-Predict (now known as Navigator). This completely eliminates the guesswork as the software automatically finds an oven recipe that will process the board in spec.

"Our next group of products is used once you're ready to start production," said Kazmierowicz. "How do you know boards or parts were processed correctly? We monitor the temperature and speed along the oven conveyor during production. We can say, 'Based on these inputs, your output is still within the range that is going to work, and your boards are being processed in spec.' Or we can identify problems, such as if zone eight and nine changed significantly. Our setup tools help the

Our setup tools help the customer find the correct oven recipe and our automatic systems continuously monitor production.

customer find the correct oven recipe and our automatic systems continuously monitor production. Simply trusting that no changes to the oven have occurred since you last attached thermocouples to your board or silicon—how-

ever long ago—is just not enough. Now, more customers want our monitoring capabilities."

Less Downtime

Allen summarized downtime as follows. "We all know that one of the worst things to hear in a factory is 'downtime' because this has a direct link to lost money/profits, delay in delivery, unhappy managers, owners, and most importantly, customers. With so much automation, there still tends to be the possibility of downtime in the reflow process. A reflow-related defect found by an AOI machine requires immediate action, for example. One of the investigative steps may be to run a profile to determine if there was any change in the reflow oven to determine if the fault is due to a process change, human intervention, or something else entirely."

"This downtime may be significantly reduced if a reflow process inspection (RPI) system is in use," explained Allen. "This RPI system will continuously monitor the conditions at the product level, provide the customer with data for each reflowed PCB, and notify the customer if a change is taking place and to what degree. If the current conditions are changing to a point where product entering the oven would not be in spec, a notification will take place and be automatically documented, and defective assemblies may be avoided. If there's a defect found at AOI, you can rule out the oven.

Allen further detailed, "Planning for change-over downtime plays a role in optimization. With the knowledge of what products will be run on a given day, shift, oven, and their related profiles, the software can assist with the optimized plan to limit this changeover time in the reflow oven. An example is starting with SnPb assemblies and/or lower temperature profiles and working up to higher temperatures rather than the reverse, which takes time for oven cool down."

Kazmierowicz added a few numbers. "Talking about automatic systems that monitor every board, our last estimate was that 7–8% of all of the ovens out there have one of these systems. There are a lot of upsides." This makes

a larger point about Industry 4.0. For facilities with pre-existing equipment, not everything needs to be purchased new. Controller or software updates may, for the right equipment, bring the current machines into the smart factory data exchange conversation. And that is the same value proposition for KIC customers. With facility idle time making up a large percentage of each month's available manufacturing capacity, changeover and recalibration become a critical part of the reflow department's contribution to increased efficiency.

"When the industry switched to forced convection oven technology, it was much better, as long as the oven was set correctly," said Kazmierowicz. "Different boards, more often than not, required different oven recipes, and the setup process was very labor-intensive. The engineer would run a profile, adjust the oven recipe, wait for the oven to stabilize, and then run another profile. Each iteration could take 30 minutes or more. We were the first to invent a system where the computer could model the oven environment, dramatically reducing the number of profiles required to find the correct oven recipe."

That begs the question: How does such a system provide that benefit? In the current Industry 4.0 environment, how does KIC change the 30-minute iteration steps?

"The key benefit to Industry 4.0 or the smart factory is information," said Allen. "Information is imperative to making knowledgeable decisions and most important for learning. From the information operators can correct, change, and optimize processes to achieve the highest quality products at the lowest cost and in the shortest amount of time. When automation is implemented—along with connectivity for usable, accurate data collection—software will provide answers to 'how' and 'why' to make these changes."

"With an RPI system, the process data can be output for each reflowed assembly, even to a specific barcode for traceability," Allen added. "This data is quickly and easily accessible, so a company has the information at their fingertips from anywhere. They can search produc-

tion runs for quality information, troubleshoot, optimize, and improve processes for better line utilization and productivity."

Using Information as Feedback for Efficiencies

As the conversation moved toward data, it shifted gears into a discussion of current data interchange formats.

Johnson: Aren't CFX, Hermes, Jara, etc., creating an infrastructure for you, so you can take that information and use it somewhere else?

Kazmierowicz: Exactly. And once you have the information and start really studying it and using it, you realize that there is a change. Connecting to various manufacturing execution systems (MES) allows customers to have valuable data, which they may use to improve their processes, improve their quality, and save money. We are actively involved in Industry 4.0 and smart factory solutions for our customers.



Phil Kazmierowicz

Johnson: Because an investment in your product, it could be argued, is about operational efficiency and a margin boost.

Kazmierowicz: Yes, especially for a contract manufacturer trying to get business in an area, such as automotive, high reliability, safety, or medical where the customers are savvy enough to know when something is being processed correctly. The shops that they're competing with use our equipment, saying, "I have to compete with that company who has KIC equipment, so I better buy KIC too." Also, savvy companies are continuously looking at ways to save money and improve their quality. These are also our customers.

Johnson: But that's not all. Mil-aero, automotive, and medical are pushing on the industry to dramatically improve reliability by more

than an order of magnitude while also increasing output by multiple magnitudes. That's a lot of pressure.

Allen: Product reliability for CMs is tremendously important, and they are being pushed more and more to prove this. This is particularly true for high-reliability products like automotive, medical, aerospace, and military. Automated traceability and live process control satisfy the requirements to prove that reliable product has been produced. The assurance of knowing exactly what's going on when a product has gone through a high-heat process is a huge benefit, or as one customer said, "It lets me sleep at night."



MB Allen

Johnson: What are some examples of other areas in the assembly process where the CFX data from KIC is useful? Who else in the manufacturing line is a customer of KIC's CFX contributions? How does KIC's data help increase the throughput elsewhere?

Allen: KIC was ahead of its time with reflow, curing and wave solder continuous monitoring, traceability, and output of data. We have thousands of systems in the field. Now, with Industry 4.0, customers are rapidly installing process inspection systems in their ovens.

There are several formats for the output of data, but there also has been, for many suppliers and customers, costly customized software development over the years. We work with many partners—MES companies, AOI, and others—to share our data. The new IPC-2591 CFX standard has been released, and KIC also provides our data in accordance with that standard. We've been involved in this project since the initial meeting and are very pleased to see the growing interest in adopting this. It is quite an advantage for companies to limit costs and still be able to start on the path to Industry 4.0.

Don't Forget Traceability

A side effect of process efficiency also seems to be increased traceability—another key service that manufacturers will be required to provide as electronics OEMs specify more strict reliability requirements for their increasingly complex board designs. **SMT007**

New Technique Could Pave the Way for New-generation Flexible Electronic Components

A team of engineering experts at the University of Exeter have pioneered a new way to ease the production of van der Waals heterostructures with high-K dielectrics—semblies of atomically thin two-dimensional (2D) crystalline materials.

One such 2D material is graphene, which is comprised of a honeycomb-shaped structure of carbon atoms just one atom thick.

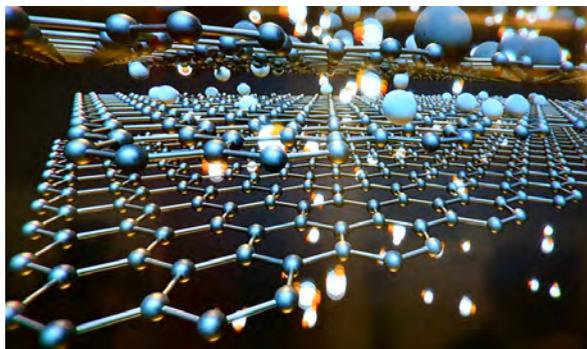
The research team has developed a technique that allows these structures to achieve suitable voltage scaling, improved performance, and the potential for added functionalities by embedding a high-K oxide dielectric. The research could pave the way

for a new generation of flexible fundamental electronic components.

The latest research outlines a new method to embed a multifunctional, nanoscaled high-K oxide—only a within van der Waals devices—without degrading the properties of the neighboring 2D materials. This technique allows for

the creation of a host of fundamental nanoelectronic and optoelectronic devices including dual-gated graphene transistors, and vertical light emitting and detecting tunneling transistors.

The research is published in the journal *Science Advances*. (Source: University of Exeter)



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Supplier Highlights



Ralf Wagenfuehr on Developing Rehm Thermal Systems' RDS Semico Oven ▶

Ralf Wagenfuehr, plant manager of Rehm Thermal Systems, describes Rehm's new oven—the RDS Semico—and gives an in-depth analysis about how it was designed specifically with the semiconductor industry in mind. Ralf also discusses the semiconductor industry as a whole and outlines the company's desire to gain market share in Taiwan and Korea in the upcoming year.

Impact of Stencil Foil Type on Solder Paste Transfer Efficiency for Laser-cut SMT Stencils (Part 1) ▶

As innovation and demand continue to drive miniaturization in electronics, manufacturers face the constant challenge of assembling smaller and smaller components with repeatable processes and high yields. Stencil printing is the first step in the PWB assembly process, and improvements to the SMT stencil can significantly improve yields, especially for more challenging miniaturized products.

AWS Electronics Invests in Latest Flying Probe Test System ▶

As part of a commitment to providing customers with the best technological systems and an unrivalled service, electronics manufacturing solutions provider AWS Electronics Group has recently invested in the high-specification SPEA 4050 flying probe test machine.

Tips and Tricks: Water Contamination and Flux Expiry ▶

Solder joints that form properly are not expected to exhibit reduced reliability. However, a higher number of defects created tends to lead to a higher chance that defective connections escape detection through inspection

and functional testing, and that's not a risk to be taken lightly.

East/West Manufacturing Partners with Mirtec for 3D AOI ▶

Mirtec is pleased to announce that East/West Manufacturing Enterprises, a Texas-based electronic contract manufacturer, has purchased an MV-6 OMNI 3D AOI system.

YXLON Demos Innovations at Control Show in Stuttgart ▶

In live presentations of the YXLON FF35 CT system, the new release of the Gemini-based, high-resolution computed tomography system family was presented. In addition, a brand-new automatic defect recognition (ADR) function on the YXLON Cheetah EVO Plus micro-focus X-ray system was demonstrated, which is intended to ensure reliable test results and greater efficiency, particularly in the electronics sector.

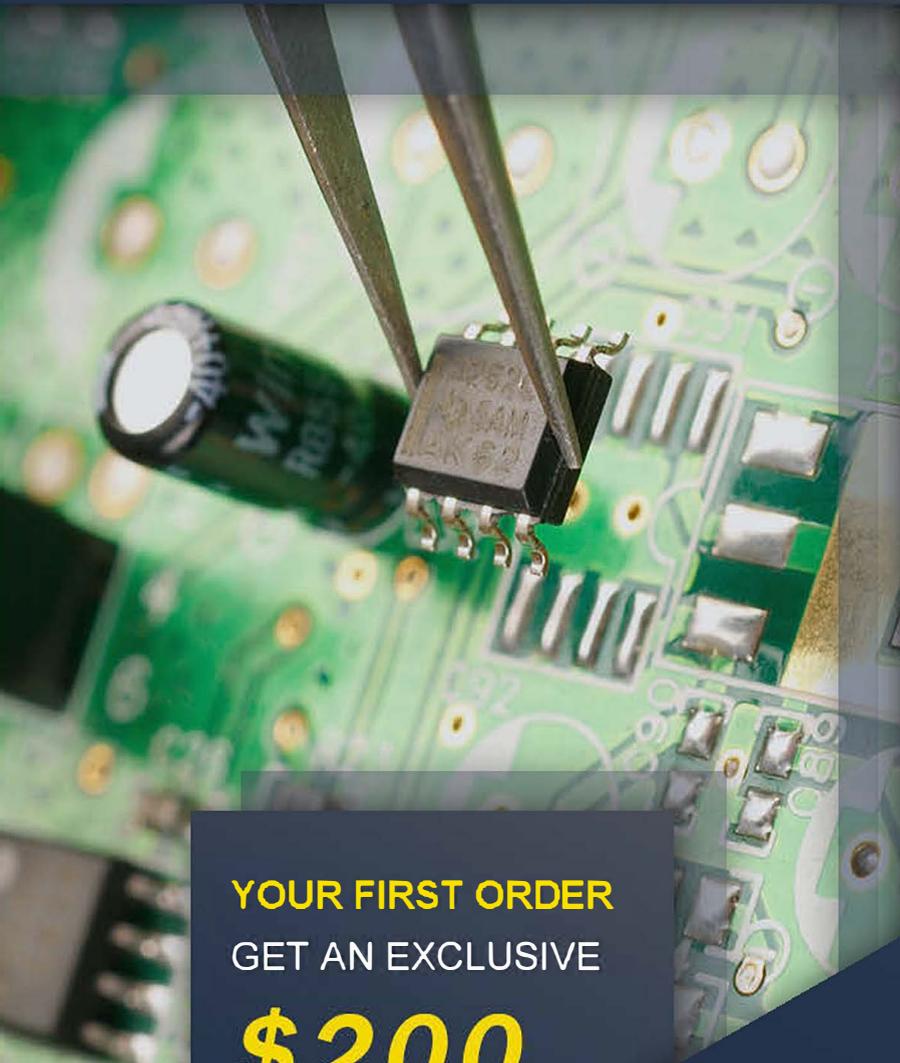
KIC Signs New Rep Agreement with DiversiTech Representatives ▶

KIC has signed on DiversiTech Representatives Inc. as its representative in Southern California. The DiversiTech team is an experienced manufacturers' representative company based in Southern California that provides world-class electronics assembly solutions with integrated tools and services.

Yamaha Motor USA Opens IM Division HQ in Georgia ▶

Yamaha Motor Corporation USA's Intelligent Machinery (IM) Division is pleased to announce the grand opening of its new sales, training, and demonstration facility in Marietta, Georgia, USA.

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Smart Factory **Transitions** Are Attainable—With a Plan

Feature interview by Nolan Johnson

I-CONNECT007

In his white paper *A Generalized Approach Can Help All Manufacturers Move to Smart Factories*, Zac Elliott, technical marketing engineer at Mentor, a Siemens company, outlines a structured organization for smart factory implementation. While there can be one set of challenges to overcome when building a smart factory on a greenfield site, firms restricted to pre-existing facilities face a different set of hurdles.

I-Connect007 Managing Editor Nolan Johnson caught up with Elliott to get his thoughts on how things have proceeded since the paper was published, and to talk strategies for smaller firms and brownfield companies.

Nolan Johnson: Zac, there are a lot of shops still using mostly manual processes, and facing a potential transition to becoming an Industry 4.0 facility? The first question is: are they too late to even participate?

Zac Elliott: It is not too late to participate in the smart factory transformation, but it is due time to start developing a strategy for your business. As discussed in the white paper, trends

in the electronics industry are accelerating the pace of change for manufacturers. As businesses are pushed to evolve, there are many opportunities to implement smart factory operational improvements. Having a sound strategy means embracing the change and moving the business further, faster.

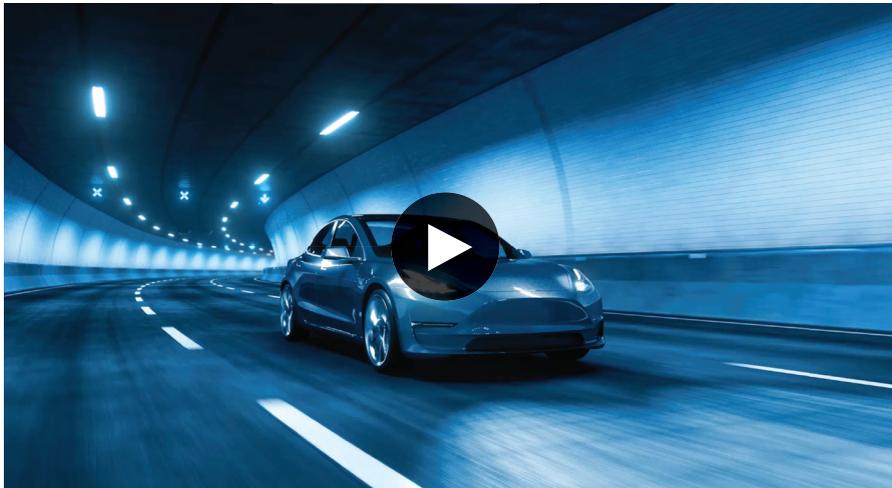
Johnson: That's good news for our colleagues, I'm sure. How do they get started on such a process? If a company has to wait until they've changed everything to get the pieces to provide a return, that's a daunting prospect. What's the best strategy? What do they do first? Do they concentrate on the equipment on the floor? The ERP? Something else?

Elliott: The best strategy will go after quick wins in order to gain traction and realized returns early in the overall smart factory evolution. While most businesses in the industry have similar challenges, every factory is unique in terms of expertise, equipment, existing capabilities, and so on. A proven methodology is to use lean manufacturing tools like value stream mapping to identify waste in business and manufacturing processes and then to define the improved future state.

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Once the future state is identified, a plan should be developed which prioritizes implementation phases based on the ROI of the various improvements. In the beginning, look at one-, three-, and five-year windows and focus on building a foundation which will consistently show a return along the way. Finally, adapt the plan over time as progress is made, technology improves, and challenges change.



Zac Elliott

As an example, consider the implementation of a manufacturing execution system on the shop floor. A phased approach could first address electronic work instructions as step towards a paperless factory. In this initial phase, some initial investment will be made in engineering effort, computer hardware, and implementation, but there is an immediate return realized by removing wasteful paper documentation. A next phase could be electronic data collection. Now, this added functionality is only an incremental improvement and investment that builds on what was implemented in the initial phase. Finally, machine data collection and process control may be implemented to complete the MES implementation. With this approach, each phase builds upon the previous with additional value and return.

Johnson: You wrote this white paper in 2018. A year or so on, how do you see the smaller shops plugging into your three-tiered factory infrastructure? For example, if I'm a single-facility shop, do I need enterprise-level apps? And how does that look different than a multi-location company?

Elliott: Do not get hung up on the top tier being "enterprise only." The top tier is simply where high-level business requirements are managed. Without the corporate overhead, smaller shops are actually enabled to adapt and change more quickly than their enterprise counterparts. Although technology budgets may not be as

large, smaller companies can eschew costly enterprise-grade solutions, which are usually more generalized, in lieu of purpose-built solutions streamlined for the electronics industry. Specialized solutions can offer SMB manufacturers a streamlined implementation, focus on their industry, and ultimately more return sooner. Best in breed solutions available today offer a mix both of flexibility for good coverage of business processes and specialization to simplify implementation.

Johnson: You talk to enterprise-level interest in factory up-time in the paper; some industry insiders make the point that reclaiming factory down-time is the most efficient way to increase efficiencies. For example, a company may spend a lot of money and design time in optimizing their ops by 5-10%, but when their factory floor is idle 70% of the time, even a 10% reduction in idle-time overshadows the line optimizations in terms of overall payback. What are your thoughts on that?

Elliott: These are areas that should be scrutinized for quick wins in the overall smart factory strategy. Most manufacturers can benefit from a scheduling solution to optimize the myriad of requirements present in electronics manufacturing, including materials, tooling, machines, and people. In general, optimizing the input to a manufacturing process—in this case the production schedule—is a fundamental first step to ensuring an optimal manufacturing flow. It's the old adage, "garbage in, garbage out."

In any case, I may be getting ahead of myself in suggesting a scheduling solution. In this example, we do not necessarily know why the line is idle so often. Is it a lack of material, or maintenance issues, or operator problems, or a mixed bag of all of these? Before embarking on an improvement project, it is important to understand the underlying root cause of the problem. Again, lean manufac-



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turing fundamentals such as DMAIC, can be used to approach the improvement effort in a methodical manner. DMAIC is an acronym which defines the phases of the improvement process: Define, Measure, Analyze, Improve, Control. So before we can improve the poor utilization, we must measure and analyze the current state.

Johnson: Were you considering CFX when you wrote this paper? Does the presence of CFX change your perspectives on a universal language? Why or why not?

Elliott: CFX is a universal communication protocol operating at the lowest level of the three-tier smart factory architecture. For PCB assembly, technologies like CFX and the Open Manufacturing Language (OML) provide a solution to the problem of machine-to-machine communication on the shop floor. This has been a major hurdle in the past, but now we are looking at the bigger picture: What to do with all of this data being generated? How to classify and make use of information coming from dis-

parate production processes? When and what action to take based on the data collection?

Our machines, systems, and people must seamlessly coexist. Communication is not sufficient, collaboration is necessary.

Answering these hard questions requires a new breed of technology focused on Big Data, Analytics, AI, and human-machine-interaction. CFX brings us a step closer, but these developing technologies will close the smart factory loop.

In summary, developing a smart factory strategy is the first step toward realizing operational improvement. Leveraging existing lean manufacturing methodologies like value stream mapping is a sensible way to analyze your business and begin planning the evolution. By focusing on incremental improvement, the complexity of the smart factory transformation can be deconstructed into manageable phases with returns coming along the way. My white paper provides a starting point to understand the challenges facing the industry and the key smart factory concepts used to address to challenges. **SMT007**

Simulations Identify Importance of Lattice Distortions in Ion-conducting Fuel Cell Materials

A multidisciplinary team from the U.S. Department of Energy's Oak Ridge National Laboratory (ORNL) developed a computational framework to process and analyze large datasets of materials to determine how to improve the ion conduction process.

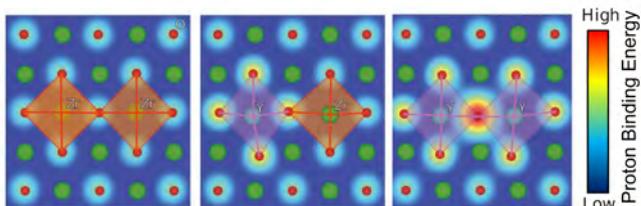
Using a dataset containing over 80 different compositions of perovskites, the researchers identified and optimized those with promising proton conduction capabilities. These materials could enable the production of more reliable and efficient proton-conducting solid oxide fuel cells, for uses such as powering vehicles.

Results from this work are published in *The Journal of Physical Chemistry and Chemistry of Materials*.

These simulations revealed that correlations between lattice distortions and proton binding energy can make protons heavier and slower, inhibiting optimal proton conduction. This revelation could help the researchers identify existing materials and develop new ones able to compete with acceptor dopant yttrium-doped BaZrO₃, or Y-BZO.

In addition to the practical benefits these results could have for energy applications, the team's newfound knowledge provides fundamental insights into scientific concepts. The researchers plan to expand their efforts beyond protons and perovskites to investigate the behavior of mobile ions in other categories of materials. Future findings could enhance the performance of other types of fuel cells as well as lithium-ion batteries.

(Source: Oak Ridge National Laboratory)



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Denis Barbini

Laserssel Brings High-speed Soldering to New Application Areas

Feature Interview by Barry Matties I-CONNECT007

Barry Matties spoke with Denis Barbini, general manager of Laserssel, about the Korean company's new laser-selective reflow solution aimed at reducing a typical reflow oven's 10-minute cycle down to just 10 seconds as well as the overall benefits manufacturers could see from streamlining this process.

Barry Matties: Denis, can you tell us a little bit about Laserssel?

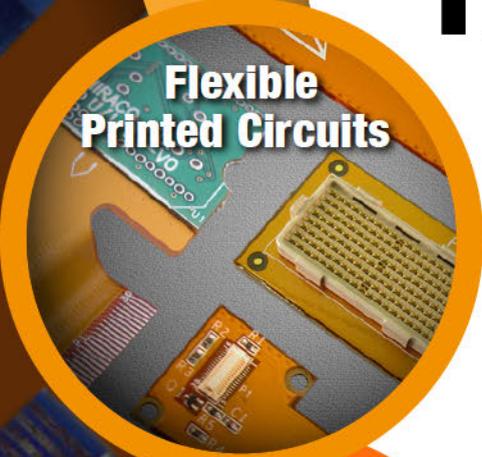
Denis Barbini: We are a soldering company focused on using laser technology in a novel way. We started in 2015 performing research and development for this revolutionary technique. We investigated the potential for integration into electronics assembly, and that's why we are serving the semiconductor, SMT, and rework markets today.

Matties: This is a specialty process. Is the idea that the machine streamlines the hand soldering process?

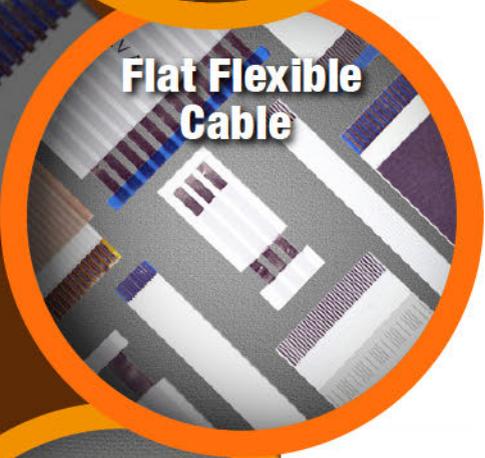
Barbini: We're addressing current customer problems with mass soldering, mass convection of reflow of soldering, and wave soldering. We're taking common defects, such as warpage for a fine-pitch assembly where it is increasingly challenging to achieve proper coalescence, and optimizing those processes to eliminate the warpage to get excellent yield and reliability. We're also able to process niche applications like flex-on-flex and flex-on-rigid in an automated, in-line process rather than having to utilize hand soldering.

We are identifying industry segments and applications to automate processes where assemblers have had problems over the last few years. The industry is undergoing an explosion of applications, such as new components and designs for IoT and wearables. This requires different ways

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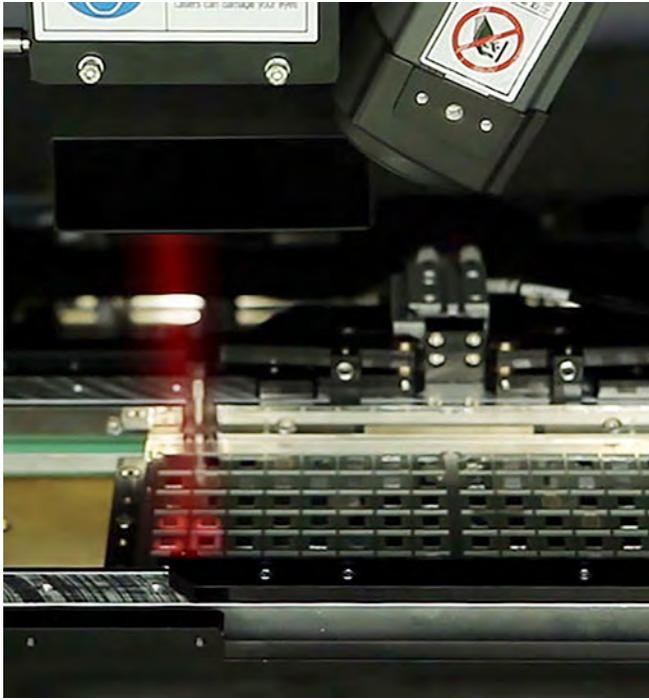
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of soldering. You can't just use a reflow oven or a wave soldering machine. This technique is very conducive to providing a solution to the current and future assembly challenges.

Matties: In terms of streamlining the process, what are some of the measurable benefits that people will get?

Barbini: Some benefits include improved quality of the soldering joint, reliability of the product, increased units per hour (UPH), and minimized defects with a lower cost of operation in terms of electricity and no inert atmosphere required compared to typical forced convection ovens. When I look at the work that we've done, it's primarily flex-on-flex and automotive batteries, semiconductor devices with pitches of less than 40 microns and die thickness less than 100 microns, and SMT assembly of temperature-sensitive components. While the industry is identifying the potential for low-temperature solders to address specific assembly challenges, this technique mitigates or even eliminates those challenges with SAC alloys. We are enabling them to get that into a mass production environment so that they don't have to worry about using all of the techniques that are slower and a little bit more cumbersome.

Matties: How long has this equipment been in the marketplace?

Barbini: For the past two and a half years.

Matties: How many installs do you have currently?

Barbini: Now, we have around 40 machines worldwide.

Matties: What has the feedback been?

Barbini: It's always too good to be true. When we look at semiconductor, their cycle of integrating new technology takes a couple of years. We started with them three years ago, and last week, we installed a new machine at a semiconductor fabrication house where they are now soldering their products in mass volume. We are very excited about that, but it takes time to integrate new technology into the marketplace because we're comparing joints that were formed by reflow soldering, which everyone knows really well. Today, we are enabling a paradigm shift using our area laser. We can still get high UPH and as good or better quality than reflow.

Matties: This is suitable for what volume of their work? Is 100% of their work running through this, or is it very selective and somewhat niche?

Barbini: Right now, Laserssel is targeting specific applications. However, we see that depending on the application itself, we can potentially solder an entire board in less time than a reflow process. While there is a way to solder the entire product, we're not out there to replace reflow soldering; we are here to provide customers with solutions to their current challenges and enable them to solder new types of applications that they never thought they could do before.

Matties: What are the general questions that people have about this technology?

Barbini: The first question is usually, "Is my joint quality that's being formed going to be better or

worse?” Because everyone’s used to a certain microstructure, intermetallics, and coalescence. Moreover, we’re taking a process that takes six minutes for reflow and turning it into less than 10 seconds. The next question is, “Are we getting the same dynamics?” about the physical operations taking place in reflow compared to our machine, which is why we’ve taken the time to conduct a two-year study to do just that.

Matties: Do their customers care that it’s going through this process versus a reflow?

Barbini: Initially, the questions come up, so yes, they do.

Matties: How do you satisfy those questions?

Barbini: We’re doing evaluations. Currently, we have two demo centers in the U.S. and one in South Korea. We’re doing a lot of evaluations to prove to the customer that we can do it in an automated fashion with quality.

Matties: Going back to what you just said earlier, it’s typically a 10-minute cycle versus 10 seconds.

Barbini: We’re using the AREA laser. Traditional spot lasers aim at a spot where it applies all of the energy and solders one lead at a time. That’s visible, right? But we’re not doing that. We’re taking that energy and distributing that over an area. It could be 80 by 80 mm or as small as 600 by 300 microns, and the uniform density of energy will solder all of those components equally in that area. By doing that, if you’re giving an 80 by 80 mm, there are a handful of applications that are much smaller than that—such as sensors or automotive or medical applications—so we can process that very quickly.

Matties: It sounds like this has a real opportunity to move into mass production.

Barbini: It does, and in terms of taking a process for mass reflow and turning that into a selective laser, we can do that by using the same

process development tools, such as recorders and thermal coupling. The same process windows to build up like you would a recipe in an oven that you would normally have for your materials. But the big difference is we’re going from six minutes down to 10 seconds plus transport time.

The big difference is we’re going from six minutes down to 10 seconds plus transport time.

Matties: Is there dwell time for machine startup and come up to temperature?

Barbini: No. For a reflow oven, you would turn the machine on in the morning. It would take about 30–150 minutes to get ready with the potential for using a nitrogen atmosphere as well. Laserssel’s machines have pre-heat options, but our observations are such that we don’t have to use preheat. Nitrogen is not required in even the most challenging of applications. These two main setup differences compared to mass convection reflow significantly reduces the cost of ownership. In addition, forced convection ovens remain on throughout the shift or day. Compared to Laserssel’s machine, the laser is only on when the soldering process requires it. The end user is only operating a laser for a couple of seconds and only when the product is in there. Meanwhile, a reflow oven is on all day long no matter what.

Matties: So, the cost of energy is substantially lower. Have you done any studies on that?

Barbini: Correct, and we have. Right now, Laserssel has characterized a 60–75% reduction compared to mass reflow. The footprint is also going to be smaller than an oven. If

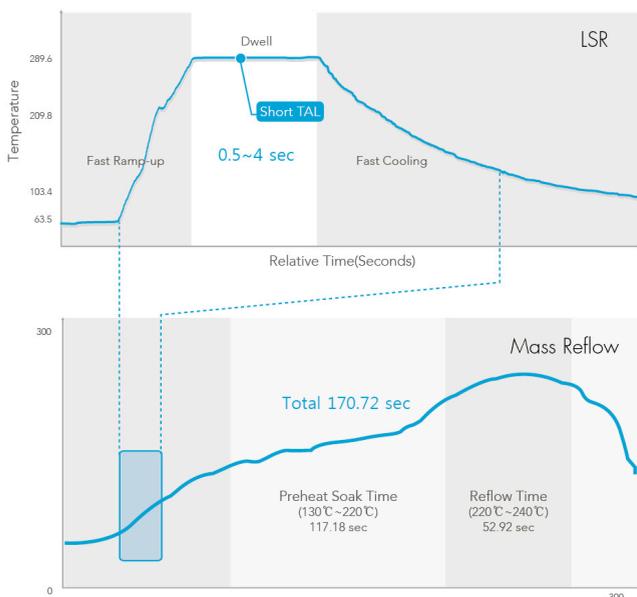
you take your average 10-zone oven for reflow, we'd be approximately 60% of that.

Matties: But currently, this isn't a displacement; it's an addition. It's augmenting the process rather than displacing a process.

Barbini: That's true. We're not displacing it. At this point, we're enabling customers to solve problems that they never could solve before. It's an add-on, but in another sense, it's enabling somebody to do something that they couldn't do.

Matties: The point being is that there will still be reflow cost until this scales.

Barbini: Correct. At the semiconductor level, we are replacing reflow ovens—not so much SMT, but at semiconductor—definitely due to product design, which they've done in the past using reflow or TCB. Due to tighter pitches going down to less than 50 microns or the thickness of the silicon going down to 50 microns, reflow is hitting its limitations without having lots of defects. Laserssel has demonstrated to have 100% yield. We are moving out the reflow ovens and putting in Laser Selective Reflow (LSR) instead.



With Laser Selective Reflow (LSR), every process is super accelerated. (Source: Laserssel.com)

Matties: How many currently are in the SMT world?

Barbini: In automotive, we have around 15 machines. Most of them are at one factory but scattered at different points. We're just starting up.

Matties: The fact that one factory has multiple machines is a testament. If you buy one and come back for another, the machines must work.

Barbini: Very true.

Matties: Where do you see Laserssel headed?

Barbini: We have very big plans, and the feedback so far from the industry is, "Wow." This is a new technique. This area of technology is unique and novel, so it's not too often where you're able to say or see something that hasn't been there. People have been coming to me and wanting to know more.

Matties: One of the concerns that people have when new equipment comes around is that the equipment manufacturer doesn't exist in a year or two, and that's a valid concern. We've seen this time and time again. What assurance would you give them here?

Barbini: I've been in soldering since 1999. I worked for Vitronics Soltec for 10 years, and then I went to Universal in the Advanced Process Laboratory, so I know about companies and what the pitfalls are in terms of service requirements, being local, having good quality, and manufacturing, and Laserssel is building up its resources. It's able to manufacture the equipment and design all the things that are our core competency, so there's a lot of motivation to do things right and take things at a pace that we can control.

Matties: Many great companies started out with those same principles, but they still failed. I don't mean that you're going too. A lot of

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startups in this situation have metrics that if you don't meet a certain metric, there's a kill switch. Have you passed that point?

Barbini: We're still growing to get to that point. There's a lot of optimism, and everything is moving forward in a very positive way.

There's a lot of optimism, and everything is moving forward in a very positive way.

Matties: You can't be in a startup company without optimism, right?

Barbini: Absolutely.

Matties: Where are you manufacturing?

Barbini: Right now, we're manufacturing in South Korea. This is a South Korean company, and I'm the general manager for operations in the U.S., Canada, and Mexico.

Matties: What sort of funding do you have behind this?

Barbini: We are an independent, startup company, per se. We have funding from investors, but we're also part of a larger company that's \$0.5 billion of revenue a year. We have a number of different sister companies that fall under the parent company. CrucialTec is our parent and has a proven track record; they've also been around for more than 10 years. They understand the commitment that's required for capital equipment. They were doing modules and other types of businesses, so this is their first capital equipment venture; it's a different one, and they've hired a lot of the right people to make it work out.

Matties: It's reasonable, and a company that purchases your process would expect a pretty quick ROI.

Barbini: The cost of ownership as well as the electricity and footprint. There are a lot of benefits to this technique.

Matties: Because when you take this technique, you're displacing a manual process. I don't know what a typical cycle time would be for that.

Barbini: They take people and train them to do it as fast as possible. Nonetheless, once the process is developed, UPH is going to be higher doing it automated.

Matties: The first step is probably to eliminate the manual process.

Barbini: Most people look for quality when examining our machines, but the UPH is going to be critical.

Matties: What about Industry 4.0? How does your machine plug into that?

Barbini: We're developing all of the protocols for that kind of information because we're passing it downstream and upstream to make sure everyone knows what the machine is doing and how it's doing it. In terms of what we're able to do to help customers, we can talk to the factory system and load up the process for each individual application. Then, if they need to do the traceability, it's available to them as well.

Matties: Right, because factory automation is a big deal, so they need to be able to take their data, put it in, and have your machine auto-adjust to whatever is coming in. And you're capable of doing that?

Barbini: We are. We're also able to do closed-loop controls, so if something misfires or a process is deviating in temperature, we have controls on that as well.

Matties: In terms of loading the machine, is this an automated process?

Barbini: This is all inline except for Laserssel's rework machine, but yes; this machine is for mass production.

Matties: And what about operator training?

Barbini: We have a facility in Korea. We also have onsite training, and by the end of this year, we're looking to develop our own demo center—The Center of Excellence—in the U.S.

Matties: I would think that the maintenance on this is pretty low, and the run time is pretty high.

Barbini: Definitely. The laser is rated to go for a certain number of hours, and that's in terms of years of use. We can also extract the fumes and flux, so we keep everything inside clean. We also have Mylar that protects the sample or the flux from getting to the optics, so there's minimal downtime.

Matties: In terms of material, you mentioned flux. Are there any special requirements for materials? Can they use whatever they're currently using?

Barbini: The end user can use current flux paste chemistries with the laser process; you don't need to change. What the user will have to do is understand that it's different timing, but the process can be optimized for that given material with a trial-and-error technique.

Matties: Congratulations. It sounds like a great addition to the equipment out there. Is there anything that we haven't talked about that you feel like we should include in this conversation?



Barbini: In our investigations in joint quality, all of the joints that we produced with the area laser were better than or equal to that of those produced by mass convection reflow oven. All the concerns and questions are whether the quality is going to be better, different, or worse. Laserssel has completed the research and development and analyzed the data that supports the conclusion that this technique is going to provide better quality.

Matties: And with your demo centers, it sounds like people who want to go to the next step and process some boards will have that opportunity as well.

Barbini: Yes, that's what we're doing right now. We're evaluating and giving the industry the opportunity to take a look at us.

Matties: Good for you. Thank you.

Barbini: Thank you so much. I appreciate it.



MilAero007 Highlights



The Government Circuit: IPC's D.C. Focus—Chemicals Regulations, Lead-Free, Export Controls ▶

From North America to Europe, Asia, and beyond, the future of the electronics manufacturing industry is shaped in many ways by government policies. That's why IPC maintains an active, multifaceted government relations program, including leadership and networking opportunities for member company executives.

Kitron Posts Strong Results for 1Q19 ▶

Kitron reported very strong growth as well as earnings improvement in the first quarter. Revenue, order backlog, and operating profit all reached record levels.

Aitech Leverages NASA cFS Linux for Space SBC ▶

Aitech and Embedded Flight Systems Inc. (EFSI) have partnered to integrate NASA's core Flight System (cFS) into Aitech's modular SP0-S space SBC.

Turkey Exceeds Defense Export Target as Industrial Capabilities Continue to Grow ▶

The latest analysis from Jane's Defense Budgets, a product from business information provider IHS Markit, highlights that Turkish defense exports have exceeded their \$2 billion target with sustained success in export markets aided by enhanced investment in defense research and development.

NASA 'Nose' Importance of Humans, Robots Exploring Together ▶

NASA is sending humans forward to the Moon, this time to stay. Upcoming expeditions to the

Moon will require making every moment of astronaut time outside the safety of the Gateway in orbit and lunar lander system on the surface count. Robotics will enable lunar crews to do more while minimizing their risk.

World's First Flight of Pioneering 'Lighter Than Air' UAV ▶

A new type of unmanned aerial vehicle (UAV) has made a successful maiden flight thanks, in part, to the expertise of engineers from the University of Southampton.

Saab to Open U.S. Site for Advanced Manufacturing ▶

Saab announces a new site for advanced manufacturing and production in West Lafayette, Indiana. The site will be located at the Purdue University-affiliated Discovery Park District. Saab intends to invest \$37 million over the coming years from 2020.

Zentech Manufacturing Acquired by BlackBern Partners ▶

BlackBern teams with Zentech Management and industry veteran Steve Pudles to accelerate the effort to build leading electronics manufacturing services provider for defense, aerospace, medical, and other high-reliability industries.

GE Aviation Brings Advanced Avionics Computing to Unmanned Vehicles ▶

GE Aviation has introduced a new advanced avionics computer specifically built for military and commercial unmanned vehicles. This new computer provides an open architecture design that integrates vehicle management and advanced mission processing into a compact, lightweight design.



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Becoming the Preferred Supplier, Phase 1: Transform Your Company's Culture With Lean Sigma

In Search of Operational Excellence
by Alfred Macha, AMT PARTNERS

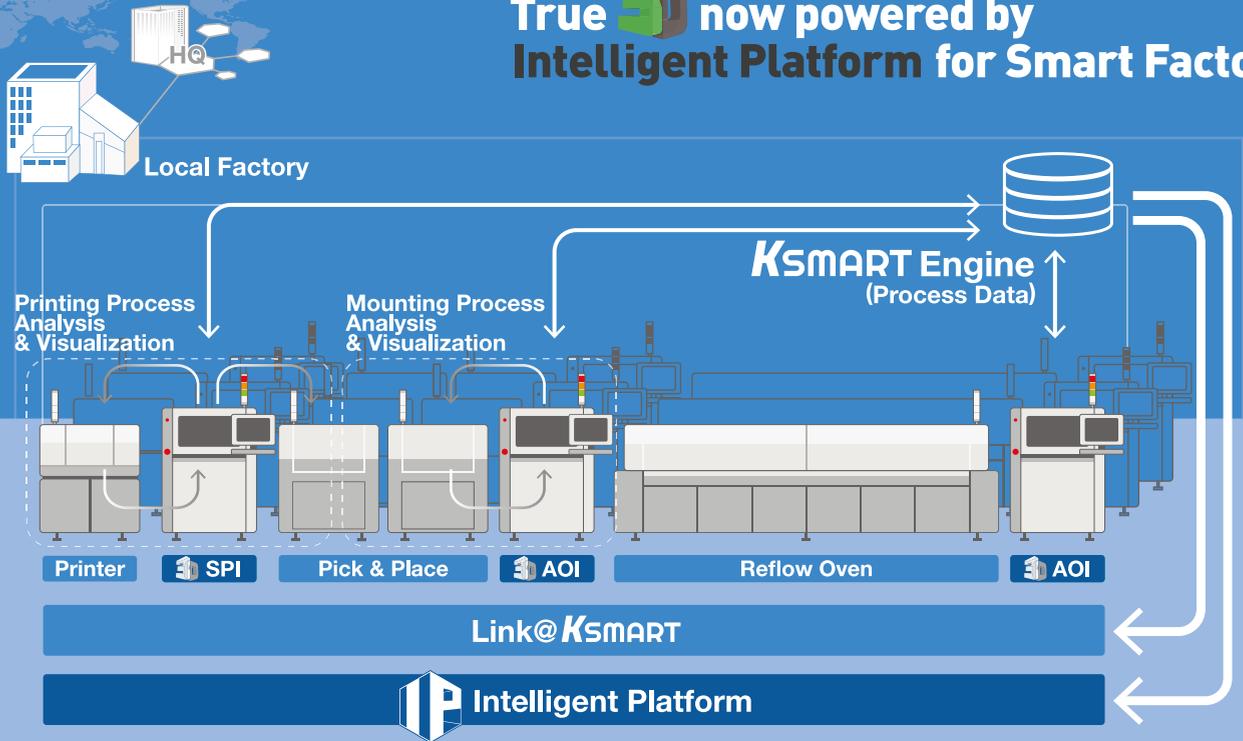
A strategic customer has just emailed you the quarterly supplier scorecard, and you gather your team to review it. Reviewing the performance scorecard results should not be a surprise to anyone in your team since you already know your on-time delivery; quality, technology, and cost-reduction initiatives; and customer-service responsiveness KPIs with that customer have not been stellar. The emotional roller coaster starts with the realization

of the impact the scorecard has on your future growth with that customer account. The knee-jerk reaction of some executives is to demand immediate improvements at all costs, which will create a stressful environment. The ability of the team to perform is in question. Confidence in your team falters, but an opportunity to transform your company arises.

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suppliers that provide consistent product quality and great service. Customers continuously evaluate their supply base; they have strategic initiatives to get the right suppliers in their AVL. As a supplier, you are confident that your technology and process capabilities will open doors for new programs. However, growing an account into a long-term engagement will require you to be a strategic and preferred supplier to your customer. Becoming a preferred supplier does not happen overnight; it requires a well-defined roadmap that will transform your organization over time.

In the next few monthly columns, I will provide the fundamental concepts to achieve the goal of becoming a preferred supplier to your customers. The first phase is to transform your company's culture with Lean Sigma. The approach introduced in this column can be adopted by any manufacturing organization through the following steps.

Leadership Commitment to Core Values

The executive team defines the vision of the company and the respective core values to support the vision. Unfortunately, most companies often specify values to satisfy customer expectations instead of representing values that are aligned with behaviors that employees can identify with. To initiate a culture transformation, the executive team needs to clearly establish values that drive the expected behaviors for its employees. Once these are established, the key to success is the commitment of company leaders to demonstrate behaviors and actions that support these values; it's a concerted effort that requires consistency. One initiative is to create a Lean Sigma mentality that supports your values.

Designate a Lean Sigma Champion

We must first understand the meaning of Lean Sigma. Lean Six Sigma is a series of methods that require team collaboration to improve performance by systematically removing waste and reducing variation. Many books provide guidance on how to implement these methods. One of my preferred books is Lean

Six Sigma: A Beginner's Guide to Understanding and Practicing Lean Six Sigma, authored by Jim Hall and Tina Scott. This book provides a practical approach to implementing the Lean Sigma journey.

Before starting this journey, the leadership team must designate a Lean Sigma champion that will be empowered to lead the transformation. From my experience, companies that have been successful with Lean Sigma designate an executive with decision-making authority to be the Lean Sigma champion. I advise not to assign this responsibility to the quality or engineering manager. Lean Sigma is a lot more involved than one departmental function, and it's best not to create the perception that only quality personnel and engineers work on Lean Sigma projects. Lean Sigma involves the entire organization working together to succeed.

The Lean Sigma champion does not have to be an expert in advanced quality tools, which are required in carrying out projects that support Lean Sigma. Instead, the Lean Sigma champion will create the roadmap, toolkit, and accountability system for engineers, managers, and individual contributors that will be trained as subject-matter experts in the methods to implement Lean Sigma. Various methods exist to support a Lean Sigma transformation. Figure 1 illustrates some of the most common methods.

Keep It Simple

This is the secret to Lean Sigma success. The complexity level of Lean Sigma implemented at Tier 1 companies will not work for Tier 3 or 4 manufacturing organizations. Your Lean Sigma champion needs to consider available resources to roll out a program that will be sustainable. A mistake often made is to make Lean Sigma a theoretical exercise instead of a practical business tool for the organization. The phrase "by the book" should not be applied to Lean Sigma. Use methods and approaches that fit your organization.

One example is the use of design of experiments (DOE) for your Lean Sigma projects. Implementing a DOE requires engineering



Figure 1: Lean Sigma toolkit.

effort, material cost, and equipment time to carry out a DOE correctly. It is an investment that an organization makes in carrying out this type of exercise. The Lean Sigma champion should provide proper guidance to determine when a DOE is applicable for a Lean Sigma project. Not all Lean Sigma projects should require DOE deliverables.

Keep It Agile

Your company must adopt the mentality of agile project management. This concept is a great tool not only for software development but also for manufacturing and will be explored in more detail in future columns. For the purposes of this column, the mentality of agile project management requires a tactical approach of monitoring progress frequently and defining a timeline to complete planned work activities in segments. The Lean Sigma champion must adopt that mentality to accel-

erate progress while monitoring performance closely.

Make Everyone Accountable

The old adage of holding everyone accountable needs to be reintroduced not as a punitive management method but as a method of self-accountability. The culture transformation using Lean Sigma will instill genuine pride in the team so that employees feel proud of what they do and of the company for which they work. This transformation allows for accountability to be seen as a personal accomplishment assessment. SMT007



Alfred Macha is the president of AMT Partners. He can be reached at Alfred@amt-partners.com. To read past columns or contact Macha, [click here](#).

ein Electronics Industry News and Market Highlights



N.A. Smartphone Market Plunges to Five-year Low ▶

Smartphone shipments in North America plummeted 18% year on year in Q1 2019 to a five-year low of 36.4 million units, down from a record high of 44.4 million in Q1 2018. This is the steepest fall ever recorded due to a lackluster performance by Apple and the absence of ZTE.

Shipments of Connected Wearables Will Reach 239 Million in 2023 ▶

Shipments of connected wearables reached 116.8 million worldwide in 2018, according to Berg Insight. Growing at a compound annual growth rate of 15.4%, total shipments of smartwatches, smart glasses, fitness and activity trackers, smart clothing, mobile telecare, and medical devices, as well as other wearable devices, are forecasted to reach 238.5 million units in 2023.

Worldwide Telecom Services Market Prepares for 5G Impact ▶

Worldwide spending on telecom services and pay TV services totaled \$1.62 trillion in 2018, an increase of 0.8% year over year, according to the International Data Corporation (IDC) Worldwide Telecom Services Database.

Polyimide Films Market to Witness CAGR of 10.6% During 2019-2025 ▶

The global polyimide films market is expected to witness a CAGR of 10.6% to reach \$3,425 million by 2025.

Chinese Panel Makers Starting to Dominate Large LCD TV Panel Market ▶

With Chinese panel makers accelerating the mass production of large thin-film transistor

(TFT) liquid crystal display (LCD) TV panels faster than expected, they accounted for 33.9% of the 60-inch and larger LCD TV panel shipments in the first quarter of 2019.

Global Commercial Telematics System Revenues Will Nearly Double by 2024 ▶

Global commercial telematics system revenues will nearly double by 2024 to over \$29 billion with subscriptions to exceed 86 million in the same timeframe, according to ABI Research.

UAV Market to See CAGR of Over 10% During 2019-2024 ▶

Growing applications of UAVs for various commercial purposes—like remote sensing; photo and videography; oil, gas, and mineral exploration; disaster relief; recreational uses; and other purposes—are driving the growth of the market.

Frost & Sullivan Reveals Top Internet of Things Platforms Poised for Growth ▶

With over 60 billion connected devices expected globally by 2024, IoT is a complex ecosystem that integrates information technology (IT) with operations technology (OT) to generate data that can be analyzed to increase revenues and improve business productivity.

Global Mobile Robot Market to Reach to \$9.90 Billion by 2023 ▶

The market is likely to showcase a high growth rate owing to the increased need for organizational efficiency and accuracy, rising labor cost and unavailability of skilled labor, and progress in both software, including cognitive technologies, and hardware, particularly sensors, actuators, and batteries.



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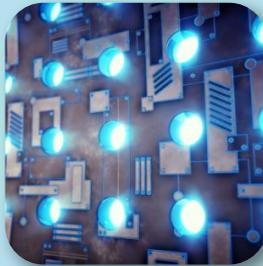
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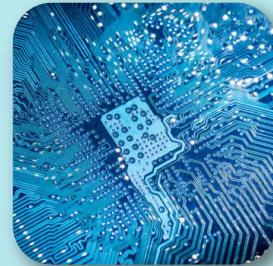
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Benchmarking Defect Levels in Your Products

SMT Solver

by Ray Prasad, RAY PRASAD CONSULTANCY GROUP

In this column, I will discuss why zero defect may be a desirable goal but not realistic. I will share some industry data to prove my point, and you can use that data to benchmark defect levels in your products. I will also address the choices we make about selecting components that have a big impact on the level of defects you should expect.

I do want to make one thing clear. It may be unrealistic to have zero defect in products right after reflow, but we do need zero defect in products that we ship to the customer. That is the very basic reason for inspection, test, and repair even though they are non-value-added process steps, but they are necessary steps. After all, you don't want your customers to discover those defects at their site or in the field.

In next month's column, I will talk about bad and good defects. Yes, there are bad and not-as-bad defects even though all defects are

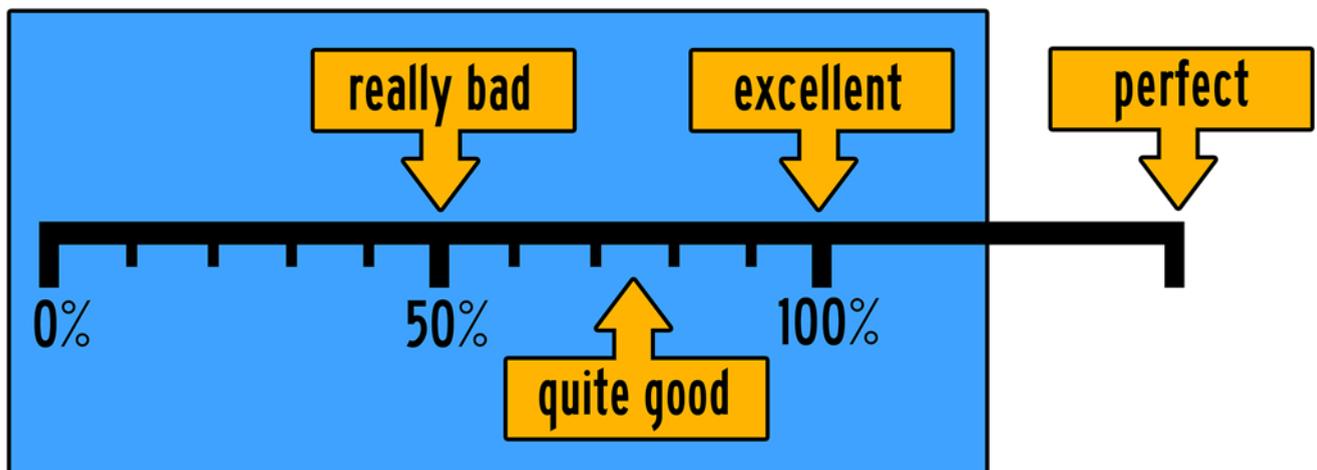
unacceptable. Heads up: Almost all companies have bad defects in their products. They can escape despite the rigorous test and inspection regimes you may have.

Why Do We Not Have Zero Defect?

Most companies attempt to achieve higher yield in SMT products through trial and error at considerable expense and frustration. Even though we have been manufacturing SMT products in high volume for more than three decades, less than 10% of companies have first-pass yield of more than 90%. That means 90% of companies have much lower first-pass yield.

I am using 1985 as the baseline for high-volume motherboard production. Some of you may remember the first serious PCs with Intel 286—a very fast 6-MHz processor. It cost me USD \$5,000 with a 20% Intel employee discount. I do acknowledge that I went overboard

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with two floppy disks and lots of memory (256 KB, not MB), but I did save lots of money since I did not pay another \$1,600 for 30 MB of hard drive. Why did I need a hard drive when I had a high-density, 1-MB floppy drive? It was more than adequate for writing the first edition of my textbook *Surface Mount Technology: Principles and Practice*.

On a serious note, the motherboard design and process steps have not changed since then. However, the complexity of newer motherboards has only increased with lower pitch packages that must be processed with some of the same old packages, including through-holes. Use of lead-free materials and no-clean fluxes have compounded the problem.

Use of lead-free materials and no-clean fluxes have compounded the problem.

I will have some defect data later on in this column, but the bottom line is that 90% of companies are doing too much rework. Rework adds to the cost of the product and reduces the reliability of solder joints due to an increase in intermetallic thickness each time the solder joint is reflowed. The reasons for this high defect rate include the following:

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

What Is the Defect Level in the Electronics Industry Today?

Let me start by citing a paper by Stig Oresjo^[1]. This is an old paper, but with the widespread use of fine- and ultra-fine-pitch QFP; high-pin-count BGAs; 0402, 0201, and 01005 resistors and capacitors; and lead-free materials and no-clean flux, yield problems are not getting any better. I must also note that the conclusions in this paper are very similar to my own findings at various client sites during my consulting assignments.

Stig Oresjo conducted an extensive study at 15 major U.S. and European Tier 1 OEM and EMS companies. He used over 325,000 boards with over 550 board configurations amounting to over one billion total solder joints. It is safe to say this study used a large sample size and these manufacturers were Tier 1 assemblers who could afford AXI inspection systems costing over \$500,000.

Only AXI machines and not functional or in-circuit-test (ICT) equipment were used in the study to determine defects. Taking into account the limitations of AXI machines, if anything, the defects counted may have been higher if ICT and functional tests were also used. Be as it may, the defect levels in the study varied between 650 to 10,000 PPM, and the average for all the boards was 1,100 PPM.

You do have to follow the correct procedure for calculating PPM levels. For example, if you have 100 components on your board and all components together have 1,000 leads, the total opportunities for defects are 1,100 (i.e., all components are bad, and all solder joints are bad). Hopefully, you are not that bad and unlucky (no one is) and you only have 11 defects in that product. Your PPM level will be 10,000 (11 divided by 1,100 multiplied by one million).

The beauty of calculating the PPM is that it does not matter how simple or complex your board is. However, while first-pass yield is a valid method for quality measurement, it does not distinguish between a very simple board with 1,000 opportunities for defects and a complex board with 10,000 opportunities for



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defects. A much lower first-pass yield in a complex board may be a better indicator of quality than a higher first-pass yield in a simpler board. We should use both methods to benchmark our quality level.

Component Types, Pitch, and Defect Levels

It is important to know the relationship between the type of components and the defects levels in them. For example, one of the interesting findings in the study was close relationships between types of components and defects. For example, even though we have almost 70 years of experience in wave soldering through-hole components, they had a very high defect level (4,000 PPM). Compare that to 1,400 PPM for gull-wing devices and only 600 PPM for BGAs. The average of all these components was 1,100 PPM.

The biggest impact on defects is the pitch of a component.

The biggest impact on defects is the pitch of a component. Pitch is defined as the distance between the centers to the center of adjacent pins, not the distance between adjacent pins. Pitch of a component determines the selection of solder ball powder size, the type of paste, and the kinds of printers and pick-and-place machines you need to process them. For example, the study found that PPM levels varied for different pitches of a gull-wing device. The findings are in Table 1.

Pitch	PPM
16 mils (0.4 mm)	13,088
20 mils (0.5 mm)	18,78
25 mils	950
50 mils	650

Table 1: QFP defect levels vs. pitch.

It goes without saying: Be careful when using pitches below 20 mils or 0.5 mm.

Targeting Defect Levels in Your Products

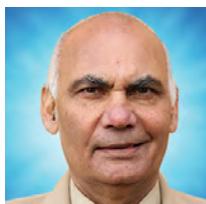
I have seen a very low level of defects, such as 6 PPM in one Intel product and 4.5 PPM at one EMS company in Malaysia. However, even at these companies, not every product had such a low defect rate. While less than 50 PPM is very rare, it is not uncommon or impossible to have less than 100 PPM. However, as highlighted in my [May 2019 column](#), you need to not only have in-house written DFM and process documents but also (and more importantly) follow them.

Also, as mentioned earlier in this column, some components, such as through-hole for wave soldering and gull-wing components with pitches below 0.5 mm, will make it harder to achieve lower PPM levels. Use such components only when you don't have other options.

Achieving the low PPM defect level is important but not sufficient for high yield and reliability. You need to have the right kind of defect, which will be the subject of my next column in July. Stay tuned; it's only one month away. **SMT007**

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1. Oresjo, S. "Year 1999 Defect Level and Fault Spectrum Study," SMTAI Proceedings, 2000.



Ray Prasad is the president of Ray Prasad Consultancy Group and author of the textbook *Surface Mount Technology: Principles and Practice*. Prasad is also an inductee to the IPC Hall of Fame—the highest honor

in the electronics industry—and has decades of experience in all areas of SMT, including his leadership roles implementing SMT at Boeing and Intel; helping OEM and EMS clients across the globe set up strong, internal, self-sustaining SMT infrastructure; and teaching on-site, in-depth SMT classes. He can be reached at smtsolver@rayprasasd.com and has an upcoming SMT class July 22-24, 2019. More details at www.rayprasasd.com. To read past columns or contact Prasad, [click here](#).

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The electronics industry is at our best when we help people around the world live a life that's a little less challenging. Whether we make growing our food supply more efficient, delivering power more reliable, traveling the globe more safe or pushing the boundaries of human endeavor more promising—our products shape society. For members, being a part of IPC makes manufacturing consistently high quality, highly reliable electronics less challenging ... and more promising, too.

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*Source: TechValidate survey of 609 users of IPC. Published: Jan. 5, 2018 TVID: C96-ADC-FD2



#StartWithTheStandards



Editor's Picks from SMT007.com

1 Powerful Prototypes: Moisture Sensitivity—What's the Risk, and What Can You Do About It? ▶

Duane Benson describes how a recent trip to New Orleans, Louisiana, relates to humidity and discusses when he first learned that plastic could absorb moisture. Read on to find out the risk and what you can do.



Duane Benson

3 Quest for Reliability: These Darn Kids/Back in My Day ▶

Youth, both in terms of humans and technologies, go together since they rely on each other to a large degree. The latter has more than likely shaped or even invented by the former. Regarding reliability and what we have seen here in the failure analysis lab, youth in the industry have played a large role.



Eric Camden

2 Standard of Excellence: Four Tips on Listening to Your PCB Suppliers ▶

Once you have done your due diligence, have developed a strong working partnership with your PCB suppliers, and now feel confident that those suppliers are the right ones, the next step is to recognize that your PCB suppliers are indeed the true experts and that you can trust them enough to listen to them. Here are four tips on listening to and learning from your suppliers to ensure that you have the best PCB value that money can buy.

4 IPC Asia President Phil Carmichael on China Trends ▶

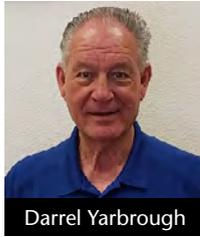
At the productronica China 2019 show in Shanghai, Barry Matties joined Phil Carmichael, president of IPC Asia, to discuss the continued growth of IPC in Asia, including the increasing emphasis on training. IPC China has grown from hosting two technical conferences five years ago to 32 in the past year.



Phil Carmichael

5 Catching up With Darrel Yarbrough of YES ▶

Yarbrough Electronic Sales (YES) is one of the fastest growing contract manufacturers in the Southwest. As people get to know them better, they are becoming the go-to company in their area. In this interview, long-time industry veteran Darrel Yarbrough, owner of YES, provides a background about the company, its capabilities, and his outlook for the industry.



Darrel Yarbrough

6 SMT Perspectives and Prospects: The Role of Bismuth (Bi) in Electronics, Part 6 ▶

In this installment of this column series on the role of bismuth (Bi) in electronic products, Dr. Jennie Hwang looks at the effects of Bi on the properties and performance of solder interconnections in electronic products when Bi is not contained in the solder alloy for the SMT assembly process (Bi-absent solder alloy composition of solder paste).



Dr. Jennie Hwang

7 SMT Solver: Assemblers Can Help Customers Reduce Cost, Improve Reliability ▶

It is commonly assumed that the level of defects is primarily dependent on how the assemblers control their manufacturing processes. This sort of mistaken belief will cause you to never find the root cause of the problem. Hence, the problem will persist forever. Find out why.

8 The Manifest: Managing Your Double-sided Assemblies ▶

Using a double-sided board in your finished application allows you to produce more complex circuits while saving space, offering an array of benefits for high-tech applications and electronics. But challenges to double-sided board implementation are plenty, including placement questions, solder processing challenges, and heat dissipation.

9 Eileen Hibbler and Jason Emes on Improving the West Penn SMTA Chapter ▶

At the recent West Penn SMTA Expo, Eileen Hibbler, a chapter support specialist at SMTA, and Jason Emes, the current president of the West Penn SMTA Chapter, discuss ways to improve meeting attendance and develop a new slate of chapter officers.



Eileen Hibbler

10 Electronics Industry Endorses US-Mexico-Canada Pact ▶

Top executives from electronics companies across the United States have endorsed the proposed U.S.-Mexico-Canada Trade Agreement (USMCA) and call on the Trump Administration and Congress to support policies that will drive advanced manufacturing.



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Career Opportunities



Technical Account Manager Chicago/Minneapolis

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

Qualifications:

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

We offer:

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

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Analyst Programmer, Hong Kong

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

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

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

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

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

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Career Opportunities



APCT, Printed Circuit Board Solutions: Opportunities Await

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

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

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

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

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Technical Service Engineer (PCB Process Engineer) Plano, Texas

PRIMARY FUNCTION:

To provide expert technical advice on production and engineering issues in the application of solder mask and other Taiyo products.

ESSENTIAL DUTIES:

- Troubleshoot customer problems
- Conduct technical audits
- Advise and consult on product evaluations
- Conduct technical presentations
- Frequent travel to customer facilities (travel required, up to 50% of the time)
- Write trip/audit reports
- Coordinate travel arrangements to realize significant transportation savings
- Respond to and write email messages
- Write monthly reports
- Prepare agendas for customers, detailing goals and objectives
- Must comply with all OSHA and company workplace safety requirements at all times

OTHER DUTIES:

- Other duties as assigned from time to time

REQUIRED EDUCATION/EXPERIENCE:

- College degree preferred with solid knowledge of chemistry
- 10 years of technical work experience in the printed circuit board (PCB) industry
- Computer knowledge
- Good interpersonal relationship skills

WORKING CONDITIONS:

- Occasional weekend or overtime work

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Career Opportunities



Field Service Engineer: Multiple U.S. Locations

Reporting to a regional service manager, these customer-focused engineers will uphold the Koh Young culture while delivering professional technical services for our award-winning portfolio of inspection solutions. The role will enthusiastically visit our growing list of customers for installations, training, and evaluations, as well as technical support and maintenance.

We are looking for candidates with a technical degree or equivalent plus three or more years in a production environment with relevant experience. Given our growing customer base, the position will require extensive travel, including some internationally, as well as a collaborative attitude that drives success.

Koh Young is the leading 3D measurement-based inspection equipment and solutions provider. We perform quality control and process optimization across a growing set of industries including PCBA, machining, final assembly, process manufacturing, and semiconductors. In addition to our corporate office in Seoul, our international sales and support offices help us maintain a close relationship with our customers and provide access to a vast network of inspection experts.

Join the industry's leading provider of true 3D inspection solutions. Forward your resume to Michelle.Hayes@KohYoung.com.

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Vision and Machine Learning R&D Engineer Atlanta, GA or San Diego, CA

At Koh Young, we are focused on developing the future and continue to bolster our newly established R&D center near San Diego, California, with top talent focused on vision engineering and machine learning for electronics and medical applications. Currently, we are collaborating with top medical universities and hospitals across the U.S., Korea, and Japan to develop innovative neurosurgical robotic systems. With core technologies developed in-house, we expect to deliver neurosurgical breakthroughs.

The role will develop practical, scalable 3D machine learning solutions to solve complex challenges that detect, recognize, classify, and track medical imagery. Additional focus on the design, implementation, and deployment of full-stack computer vision and machine learning solutions.

The ideal candidates will hold a master's (doctorate preferred) in computer science or electrical engineering with at least three years of relevant experience. We desire a strong understanding of machine learning and computer vision algorithm application within embedded systems, plus significant vision expertise in multi-view geometry, 3D vision, SFM/SAM, and activity recognition.

Koh Young is the leading 3D measurement-based inspection solutions provider. We perform quality control and process optimization across a growing set of industries including electronics, final assembly, semiconductors, and most recently, medical imagery.

Join the 3D inspection leader as we expand. Forward your resume to Michelle.Hayes@KohYoung.com.

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Career Opportunities



Multiple Positions Available

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

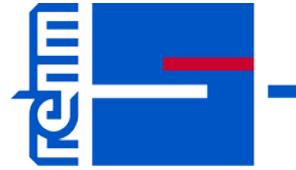
Indium Corporation offers a diverse range of career opportunities, including:

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

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

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THEMAL SYSTEMS

Service Engineer Reflow Soldering Systems (m/f)

To strengthen our service team at Rehm Thermal Systems LLC. in Roswell, Georgia, we are seeking candidates to fill the position of Service Engineer—Reflow Soldering Systems.

Your area of responsibility:

- Installation of Rehm reflow soldering systems at the customers' site
- Maintenance and repair work as well as technical service for our customers in the USA and Mexico
- Execution of machine training

Your profile:

- Completed education studies as an engineer in the field of electrical engineering/mechatronics or comparable education (m/f)
- Basic and specialist knowledge in the field of electronics and electrical engineering/mechatronics
- High willingness to travel and have flexible employment
- Service-oriented and like to work independently

We offer:

- Performance-oriented, attractive compensation
- Comprehensive training
- A safe workplace in one successful group of companies
- Self-responsibility and leeway

Please send application documents online to Natalie Werner at n.werner@rehm-group.com.

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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



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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U.S. CIRCUIT

Sales Representatives (Specific Territories)

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

- Florida
- Denver
- Washington
- Los Angeles

Experience:

- Candidates must have previous PCB sales experience.

Compensation:

- 7% commission

Contact Mike Fariba for more information.

mfariba@uscircuit.com

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Career Opportunities



We Are Recruiting!

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.

The successful candidate will benefit from a generous package and report directly to the U.S. general manager.

Applicants should apply with their CV to
melanie.latham@hkw.co.uk
(agencies welcome)

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Zentech Manufacturing: Hiring Multiple Positions

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

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

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

Please email resume below.

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Career Opportunities



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Premier Training & Certification

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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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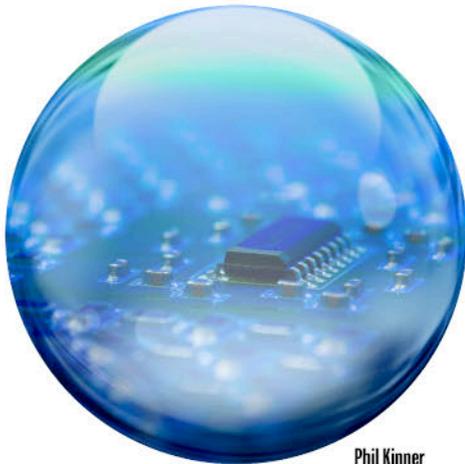
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Events Calendar

International Conference for Electronics Enabling Technologies ▶

June 4–6, 2019
Ontario, Canada

EIPC Summer Conference 2019 ▶

June 13–14, 2019
Leoben, Austria

IPC SummerCom ▶

June 15–20, 2019
Raleigh, North Carolina, USA

NEPCON Thailand 2019 ▶

June 19–22, 2019
Bangkok, Thailand

NEPCON South China 2019 ▶

August 28–30, 2019
Shenzhen, China

SMTA International 2019 ▶

September 22–26, 2019
Rosemont, Illinois, USA

productronica and electronica India 2019 ▶

September 25–27, 2019
Delhi NCR, India

52nd International Symposium on Microelectronics ▶

September 29–October 3, 2019
Boston, Massachusetts, USA

Additional Event Calendars



Coming Soon to *SMT007 Magazine*:

JULY: Failures and Reliability

Original equipment manufacturers are seeking improved reliability from electronics manufacturing. We explore current trends and developments in failure prevention, analysis, and reducing field failures.

AUGUST: Wet Processes

Wet processes are the core of printed circuit fabrication. What's new, and are there any new offerings down the road to make your wet process capabilities sharper? Faster? Greener? Easier to operate? Find out in this issue.

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

SALES MANAGER: **BARB HOCKADAY**
(916) 608-0660; barb@iconnect007.com

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

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

CONTRIBUTING EDITOR: **STEPHEN LAS MARIAS**
+63 906 479 5392; stephen@iconnect007.com

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

ASSOCIATE EDITOR: **KIERSTEN ROHDE**
kiersten@iconnect007.com

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

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TOBEY MARSICOVETERE

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EDITORIAL CONTACT

Nolan Johnson
nolan@iconnect007.com
+1 503 597-8037 GMT-7



mediakit.iconnect007.com

SALES CONTACT

Barb Hockaday
barb@iconnect007.com
+1 916 365-1727 GMT-7



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