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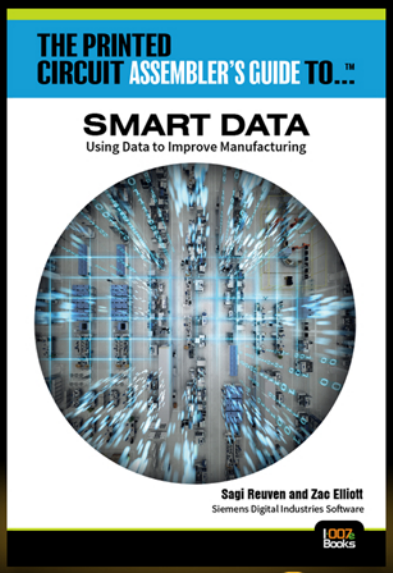

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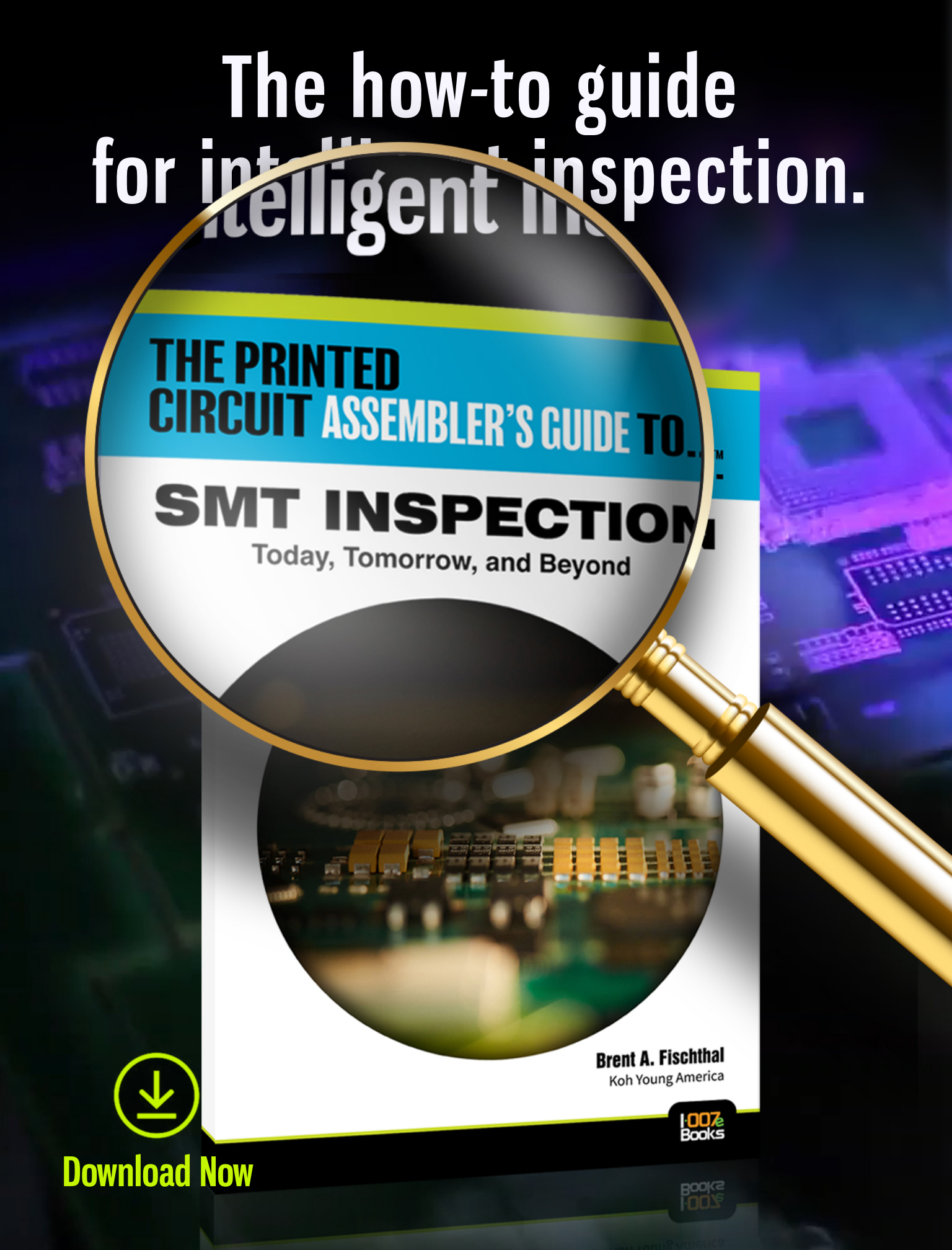

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SMT007 MAGAZINE

BOMs and the Supply Chain

This month we're considering the bill of materials (BOMs) and the unique challenges facing procurement and manufacturing under current conditions. As we explore BOMs and their future role, we discover that the need to control all the complexity is the impetus to a creative, new process.

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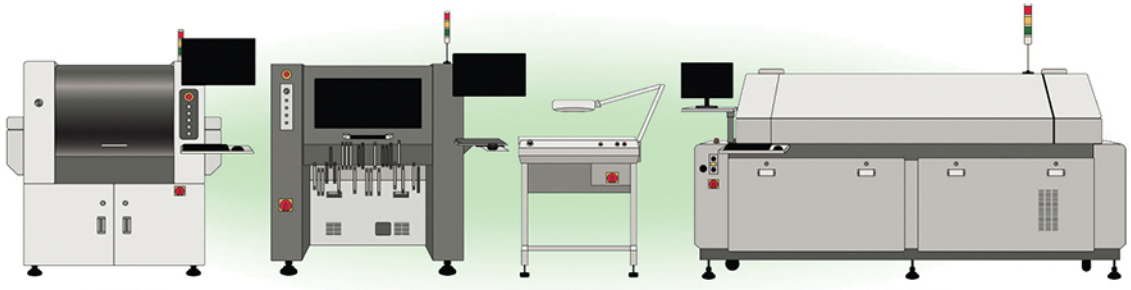

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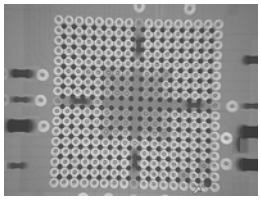

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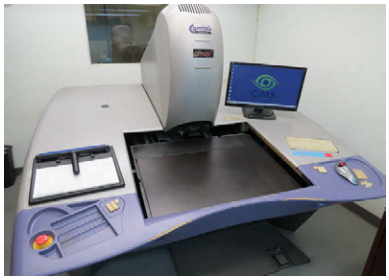

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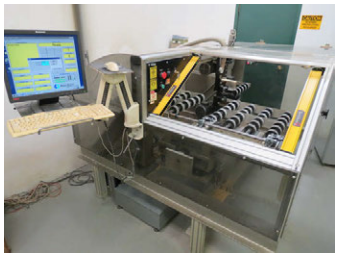

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BOM: The Path to Managing Parts

Nolan's Notes

by Nolan Johnson, I-CONNECT007

Throughout the process of developing this issue of *SMT007 Magazine,* I kept thinking of the opening lyrics to a song recently recorded by a well-recognized blues singer I'm proud to call my friend. The song is Anni Piper's "24 Guys Named Dave" and starts with:

"I'm fine, fun and fickle; so many needs which must be met..."

It's a humorous song about dating multiple men at the same time, and how she develops an ingenious system for balancing all her beaus, each of whom have their own unique value to her. Of course, this issue of the magazine isn't about dating, nor is it about the blues. In fact, this month we're considering bill of materials (BOMs) and the unique challenges facing procurement and manufacturing under current conditions. I kept thinking about Piper's song because there are some similarities.

In the magazine this month, we start with some higher-level discussion about BOMs in the 21st centu-

ry manufacturing world. We look at questions like "Who owns the BOM?" and "What makes up a BOM?" The reality is that BOMs are often oversimplified down to the component parts list when, in fact, a full-fledged BOM includes information on how to put the pieces together in a finished product as well. Think back to the last time you assembled flat-pack furniture, for example. The instruction sheet contained: a parts list and quantities; perhaps some necessary tools; safety information; and assembly steps. All these can be considered components of the BOM. The documentation is just as critical as the actual components. I'm reminded of the sales pitch I hear at the stadium from the program hawkers: "They're just a bunch of guys with numbers unless you have a program." Indeed, it's just a pile of parts in plastic baggies unless you have a set of build instructions.

As we set out on this topic, we suspected that BOMs and parts procurement was an urgent issue. When we talked to you in the industry, you not only confirmed but amplified our suspicions. The semiconductor shortages are well-documented, even in the mainstream news, and as is the norm when demand far outstrips supply, we're seeing lead times and pricing on the increase. OEMs and EMS providers are scrambling to find substitute parts for BOMs that have been stable and predictable heretofore. But it runs deeper than that.

It would seem, to the casual observer, to be relatively easy to swap to different components within a product line—upgrade to a higher-performance processor from the same family, for example. They're drop-in compatible, one would think—right? Except they're not. The pinouts can be completely different between the different configurations. Those semiconductor companies sure don't make it easy to adapt to alternate parts, as I-Connect007 columnist Duane Benson points out during my interview with him in this issue. Fickle indeed. Finding alternate parts must seem like an impossible situation—unless one finds new tools or methods.

Which brings us to this issue's expedition into software tools to assist in BOM management. Though some parts distributors have been making their stock and lead time information available through software APIs for as long as 10 years, now virtually all the major distribution houses have gotten on board in some way or another. Turns out that these APIs are just in time to help innovate some new solutions to BOM management. In this issue, we talk to two different vendors that work in the BOM management ("BOM scrubbers," euphemistically) about the problems they see and their solutions to the problem. Ultimately, the goal is to provide software tools that balance component inventories on hand, pricing and lead times from suppliers, and technical specifications about performance and compatibility to ensure substitutions still make for working boards.

Of course, this issue also showcases some EMS companies who are not only evolving and innovating in the BOM space but are also building solid businesses in a post-pandemic industry.

Now, back to Piper's music. The song's strategy is to manage all the complexity by keeping all the boyfriends' names the same: she only dates men named Dave. The need to control all the complexity is the impetus to a creative new process. Now, naming all your components "Dave" is not exactly a strategy that will work with BOM management. It's clear, however, that, in this current market climate, finding efficient ways to simplify, clarify, and reconfigure as needed your BOM management processes can be critical to your continuous improvement programs. **SMT007**

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

The Bill Comes Due: BOMs and the Digital Twin

Feature Interview by the I-Connect007 Editorial Team

The I-Connect007 Editorial Team recently discussed bill of materials (BOM) with Michael Ford of Aegis Software. The conversation explored the current state of BOM creation, maintenance, and transfer, as well as the role BOMs play in product development and product life cycle. Naturally, attention also turned to the importance of the BOM within the digital twin.

Barry Matties: To start, would you give us your definition of a BOM?

Michael Ford: You must be very careful about what you mean when you mention the word "BOM." There is the design BOM, where you will have the list of part numbers against the design intent, as determined by the designer, and maybe an associated AVL (Approved Vendor List) recommendation. Then you have the production BOM, derived from ERP, that reflects material part numbers selected by the purchasing team within the local manufacturer, which can often be different from those specified by design, with alternative and substituted parts, due to local availability, cost vs. performance issues, etc. The ERP BOM format usually features reference designators added almost like a comment to each part number record, the format of which can be quite variable and difficult to understand from a digital parsing perspective. On top of these challenges, you may also have variants of products where, for example, a product could have a single circuit board that is used in 100 different derivative models.

Do you really want to have to manage 100 different BOMs independently? At Aegis, we have comprehensive BOM management support that copes with these and other BOM-related issues very well. We have the concept of dynamic BOM, in which you have a single instance of a BOM, with defined choices for selected parts which are dependent on each specific product variant. This makes the management of the BOM where there are variants much more manageable, as there is simply one master BOM to maintain. So, the BOM is not just a simple list of part numbers and reference designators.

The essence of the practical problem is understanding what BOM data is ready to finally use. Data is coming from design, and is changed by the ERP material purchasing/selection process, which often continues right to the point the

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product goes into production. A central "live" BOM management strategy, as part of your engineering system, is essential. Decisions about whether a stocked or locally procured part could be used for a specific component reference with a product is based on complex data, and any alteration may need to go back for confirmation against the design intent, the AVL, or even back as a question to the designer.

The use of alternative materials is founded on necessary local procurement sourcing policy and material availability, but it introduces potential problems. There are times, for example, you think you're ordering the same component from an alternate manufacturer or supplier, but you end up with a reel of parts which are at a 90-degree rotation offset in their carrier compared to those you normally use and have set up in the SMT machine databases. You may not notice this when receiving the materials, and so mixed orientations often make it through to the machines. In the best case, the machine will notice, and stop with an error saying that it can't pick up these parts. What happened? The vendor changed and nobody realized there was anything different, and there was productivity loss. In the worst case, especially should the part be rotated by 180 degrees in the supply-form, the machine may not notice, resulting in serious quality issues. In the digital twin world, the exact shapes of the materials themselves are included. Therefore, automation is possible, from the receiving of materials through to the actual machine itself, where any exceptions would be highlighted, and automatic adjustment in machine databases made to reflect whatever differences there were, as each of the material carriers is uniquely labeled, and identified back to source.

Michael Ford

This is doable right now within MES. The further you go digitizing these areas in the form of digital twin, the less manual work, especially checking, that must be done on the ground in manufacturing. Automating everything means that no mistakes will be made.

Matties: With the digital twin at the end of your design process, isn't it just a press of a button and the BOM is created?

Ford: Yeah, that's it. Now you're done and everything beyond that should be automated in the digital factory.

Matties: The BOM is created, the intent is there, including all the revs. One quote we came across in our BOM research is a CEO of a company who said, "You built rev A, but it was the wrong rev A." If there is a variation between model numbers in the digital twin, each item that is being built could theoretically have its own box.

Ford: Yes. I used to work in a company that makes high-end products in the consumer market. Their products have superb quality and performance, however, every day there were several BOM changes across products in production across the factory. You just never knew in advance what had to happen as a result. The manufacturing engineers and operators were heroes in coping with such a dynamic situation, making those products work the first time. It was leading edge product technology, supported by humans.

A BOM is not just an instance in time. It must have some form of historical structure, such that you understand that in this instance of manufacturing, we're using this reference des-

ignator with that part number, knowing that it may change later. What happens when manufacturing from end to end takes a week, and the BOM changes halfway through? Where do you start to apply that BOM change from?

The timing of how you synchronize these changes is very important. Is it date, accumulation, work order, or lot based, or simply from the point when you run out of parts? You must control it somehow. Against that control mechanism, you then have the alternative BOM entries, so that you have one master BOM "source of truth," which applies to every variation and revision of your products, and you have included then, historically, every individual change that was made from the time that product was created. That one source of data—part of the digital twin—has everything you need to create, or recreate, any product at any instance or revision, in any variant.

Nolan Johnson: Or it can determine how a specific serialized product was built. You get a field failure; you can look back through the database and see exactly which components were used and how it was put together.

Ford: Exactly. It also helps ERP because sometimes the ERP is otherwise not 100% aware of exactly which part was used from the bill of materials in each individual product, and so how does it know how to accurately decrement materials from stock? BOM and traceability data work closely together in terms of material consumption.

Johnson: This is depending, though, upon critical information coming from the distributor of the component. That is critical information for the EMS company, for the actual manufacturer of the part. But that's not information that generates revenue for the company making the components. Why should they change?

Ford: The industry as a whole must be convinced that digitalization is a benefit for each individual player. Right now, a component maker may have many different barcodes, and many different sets of ID tags and locations on their packaging across all their customers. It's a bit of a nightmare for them to mark packages in the right way according to each customer's need. The use of a digital solution, based on standards, reduces the work, as it is one for all.

Similarly, for the material specification itself, which today is issued, effectively, on paper—bearing in mind that a simple PDF file represents only a digital twin of a piece of paper, not the data that it contains. The design of the material itself, even the simplest chip that is just like a square little box with leads, will have been designed digitally.

The use of a digital solution, based on standards, reduces the work, as it is one for all.

Digital transfer of data about materials has not been done until today, because there has never been a standard format in which to do so. Every customer would want the data in their own way. If there were to be a standard throughout the industry, the manufacturer would know that they could automatically format the design data into the standard format, with a trivial additional piece of software in their design application, which makes available a digital twin alongside the physical products. There is no significant cost to do so, yet quite a savings in terms of costs, considering the creation of all the data sheets in different languages, etc., that were needed. There is really a value for the component manufacturers. Now, the challenge is how do we convince people that it is true and change the industry paradigm?

Johnson: You mentioned there is standards work underway at the IPC.

Ford: Yes. The IPC-2552 MDB (model-based design) standard is due for release by the end of this year, or so. It's made in conjunction with team members in China. They have defined so much component material information in standard form, including a 3D representation, much more than you would get from the data sheet. Material data will potentially be delivered in a standard digital form fairly soon.

There are so many benefits from the application perspective of this standard, we hope that industry associations and players will adopt this. There is only the need to include a small piece of software within each solution in which components are designed to create the IPC-2552 format, in a similar way as IPC-2581 does for PCB design. So is that really a barrier? It needs these kinds of innovations to be understood to understand what is created by the standard in terms of opportunity, and then apply it.

Matties: For the people still using Excel and email—and apparently that's prevalent—how do they make that transition? What's the investment into a BOM tool and what are the benefits of using a tool dedicated for BOMs?

Ford: Using email and Excel sounds relatively simple, but it's not, and such practices are not secure either. Many original BOM reports still come out of ERP in the form that used to be sent to a printer. There are a lot of formatting changes that are needed, representing a lot of ways in which mistakes can be made, as the data needs to be manually manipulated. Having a solution with the intelligence to automatically translate these different formats and be able to then check consistency between the design intent, the original BOM that went to ERP, the BOM that came back from ERP, as well as the modified AVL, eliminates a huge amount of risk. Do all these things match up? Are there any reference designators in the design BOM that suddenly are not populated in the final production BOM?

Yes, you can process all of this manually, but even with Excel, you're liable to make mistakes and it would take many hours to do it properly with a lot of checking, whereas with a professional BOM merging tool within the production engineering system, you almost don't need to think about it anymore. The software will simply tell you if there is an unresolvable mismatch for any reason. Engineers can focus on adding real value. I would say that automating this whole process is vitally important, because if you make a mistake here, the product would basically be scrap.

Matties: There are a lot of subsets to the BOM, as you mentioned. How does a company manage all the subsets?

Ford: Today, with difficulty, I would say. The main thing is to make sure that the final BOM

matches the original intent to build the product and is accurately represented and synchronized in ERP and MES. It is then good to record the transition from the original BOM of design through to the final BOM that's used for manufacturing—the digital thread of BOM management, if you like. If you have that under control, then you're fine.

Johnson: Which begs the question: Between the OEM or a design team, who owns the BOM?

Ford: Initially, the designer does, because they are the person who is choosing the device that meets the design need. Design is not primarily for manufacturing; design is for making the product to be what it needs to be. The designer, however, may not understand that he's using a component which is tightly spec'd, in short supply, and extremely expensive. The procurement team from manufacturing comes along and suggests, "Why don't you just use this alternative, which is far less expensive, and does the same job?" But does it really do the same job in this specific application?

We normally see that there should be a product manager who is managing this situation. The product manager should be able to make recommendations or accept advice, based on the designer's intent, and other business-driven factors. The next question is whether this function of the product manager needs to be a human, or could it be digitalized or automated? Maybe a hybrid of the two. Once you start to capture the design intent digitally, and you can utilize your MBD-based library of knowledge for the information of all materials that fulfill that same function, it could become possible. This function can also be used in the design process, showing the designer usable alternatives. This comes down to automation and interoperability throughout the design and manufacturing flow. So, who ultimately owns the bill of materials? It's the product manager.

Johnson: And not procurement?

Ford: No, not if ownership represents responsibility, because procurement should not make a BOM change decision independently. They must follow a set of rules, recommendations, guidelines, and confirmations, derived from the original design intent. They can change the material supplier. They can even change a part number if that is the way to change a supplier, but the specification and function of that component must be approved. Procurements are merely changing the representation of the BOM. Procurement cannot be the owner because they don't have the responsibility to ensure that the product will work. That still needs to be verified by our either human or artificial intelligence-based product manager.

Matties: When you have a company that's not a digital twin company, what's the best way for them to streamline their BOM process? Is it to go digital?

Ford: Yes, absolutely. The IPC-2581 standard is the best and easiest to use in my opinion, and has been around for a long time, so is mature. IPC-2581 is open, the only real industry standard. It includes both the design BOM and the manufacturing BOM as well as the design itself. The limitation, of course, is with the implementation across different solutions. For

example, in the Aegis Digital Manufacturing Engineering tools, we import a wide variety of differing BOM formats. We understand these formats perfectly. The problem is more how and to what extent the data has been populated. Different solutions will decide to populate different things based on the different processes that they go through as part of their design-through-manufacturing operation. Here is where "best practices" are very important to follow.

My recommendation is to look at the IPC-2581 standard, to understand how it works, then look at the solutions that support it throughout the flow and understand what they really provide. Then, in that flow, establish your own design-through-manufacturing best practice.

My recommendation is to look at the IPC-2581 standard, to understand how it works, then look at the solutions that support it throughout the flow and understand what they really provide.

Happy Holden: Looking at the BOM, I realize that it's essentially the singular focus of the EMS provider because they are all about the component. They must buy and stock the component. They only worry about the component footprint for solderability on the board. Then they test the component. But on the BOM is the printed circuit board, and when you go to a fabricator, they don't care anything about the component. The world of fabrication is all about the schematic and what it represents, but the world of assembly is all about the component and what it represents. Then it all comes together with the board designer who doesn't necessarily know a lot about assembly or fabrication, but nonetheless is trying to create the product.

We're talking about three very complicated, different worlds. You need these digital twins or these data standards to have the discipline to collect everything together. We don't realize how complex that communication path is, which is maybe why we keep coming back to a standard. There needs to be some way to simplify all this complexity.

Ford: Exactly. The use of standards in which data formats and language are specifically defined creates the opportunity for interoperability across different solutions.

But does the designer know how the interdependencies are connected across these operations? No. The digital twin must ultimately combine the manufacturing information for fabrication, together with assembly, together with the design intent, and use those three sources of information together. The nice thing about the digital realm is that you do it once, and it is automated. With people, everybody has a different perspective and it's very difficult to build up a consistent knowledge base. Where these things are done in the digital world, we have a chance for rules and a basic understanding of how these things work together. But it does require cooperation, which starts with interoperability.

I should add here that security of design information is also of key importance. It is good practice to restrict information to third parties to be on a "need to know" basis, and for it to be deleted after use. It is very dangerous to expose all the design and manufacturing information together. To this end, the data sharing should be managed and secured, such that only key information needed by each party is selected from the holistic digital twin and used as required. The secure transmission of IPC-2581 data, as well as the appropriate selection of data is a key area of enablement being developed currently.

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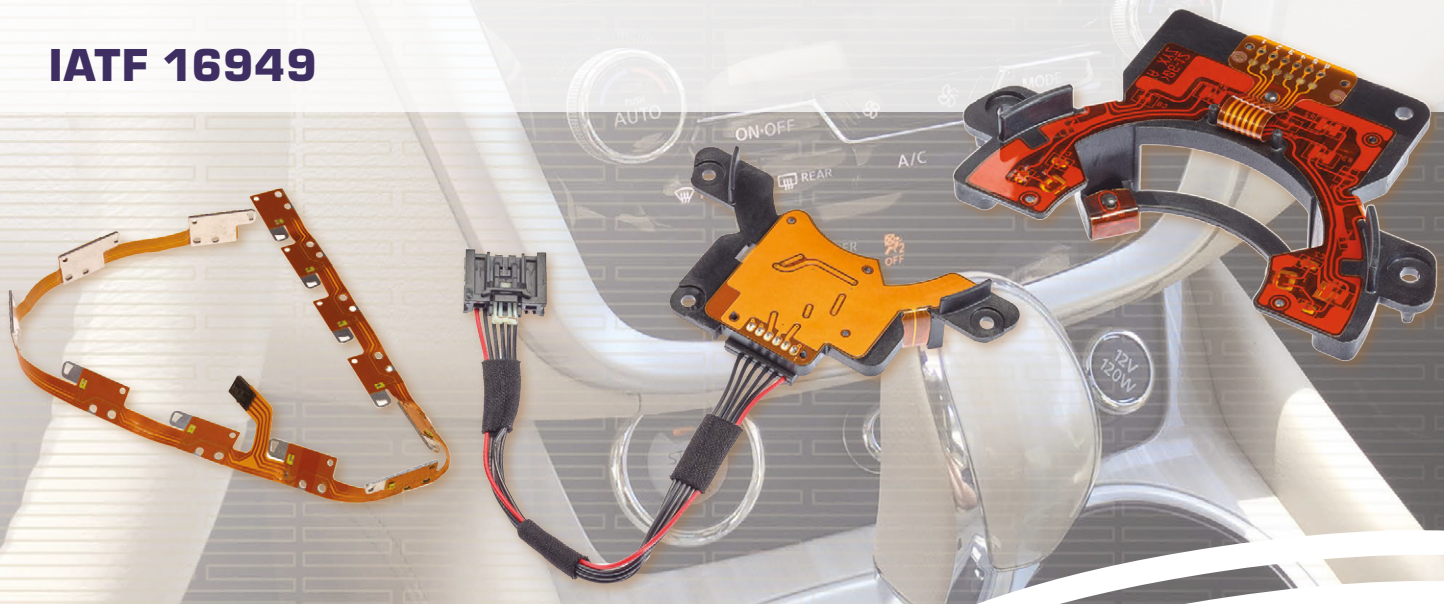

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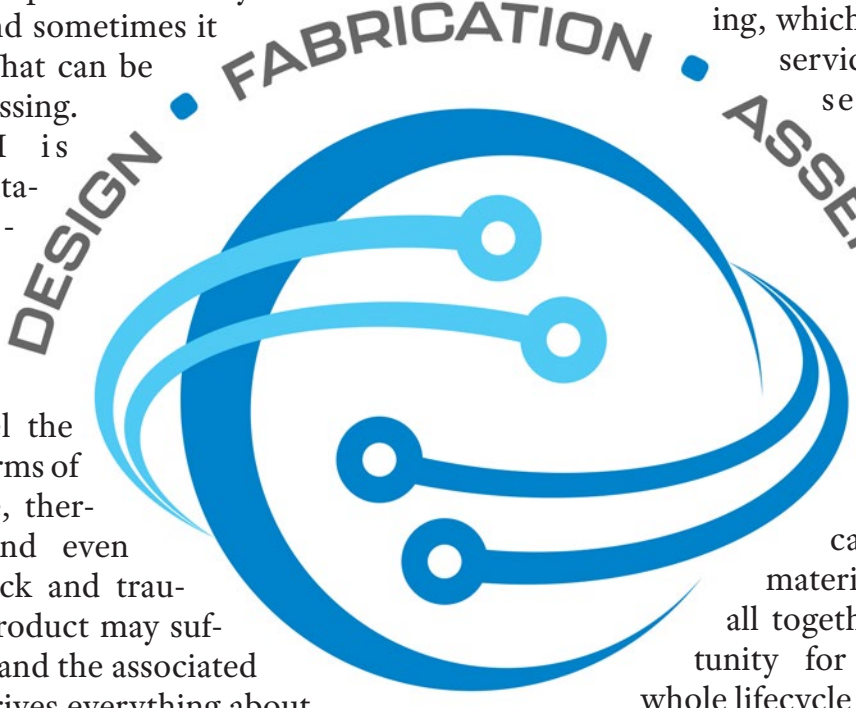
Matties: There are a lot of dependencies on a BOM that you may not think of: plant maintenance and production planning would be dependent on the BOMs. What's your thought about how other functions within an organization utilize a BOM separate from purchasing and manufacturing?

Ford: One of the biggest problems between the world of electronics and the world of mechanical engineering is the unspoken rule that things should not touch. You can do your circuit board design in the best way you can, but it must fit in this complex assembly, no matter what choice of materials that production may decide to use, and sometimes it just doesn't. That can be really embarrassing.



The BOM is the representative of the elements that go into that 3D space. Then you start to model the assembly in terms of physical space, thermal space, and even traits like shock and trauma that any product may suffer. The BOM and the associated information drives everything about that product, from design through manufacturing and on into the market.

Holden: I was thinking that, in many ways, the PCB designer is only there for a very short time at the very beginning, but the product may have a long life. In that long life, there will still be a product manager and somebody in marketing because they may have to make component changes.

They may have variants that they find sell better which are just minor adjustments in the schematic or bill of material. Eventually there will be obsolescence. But it also includes repair and rework and disposal or whether that is going to be recycled.

But the one that is probably toughest to explain is why these three different worlds—design, fabrication, and assembly—are so complicated and require so much study. They need some vector that connects them together, a standard to deal with increasing complexities, because nobody is going to know all three disciplines to the detail necessary, unless they depend on the database that is part of the BOM.

Ford: Seeing how this data can be utilized out into the market is especially interesting, which does include repair, servicing, in-service assessment using telemetry data, for example, in airplane engines, and things like that, seeing how the product performance matches up with the specific applicable manufacturing, materials and design data, all together providing opportunity for improvement. The whole lifecycle ends up being a huge circular diagram, with design, manufacturing, and market to end-of-life cycles, repeatedly—like a wheel that keeps on turning, getting better each time. It might turn every three to six months for consumer products, or every 25 years for key elements of an airplane or similar. The product becomes better each time because we're learning, relating design intent to actual product use-cases. The real tragedy is that almost all this information and opportunity is lost right now.

Some information is retained within each "silo," that understands perfectly what they're

doing, but are unable to communicate it beyond their sphere of influence, and without long-term retention of that knowledge. No one will be a designer for life or manufacturing engineer for life. These people move around, their skills and experience go with them, and the knowledge is lost. We see simple examples every day: "Guys, we've been doing electronics manufacturing for 30 years now. Do you really think this is the first time you've ever seen this problem?" Many are stuck in this rut, where we are re-learning the same things over and over, rather than opening up through digitalization.

The promise of the benefits of working in the digital realm, with interoperability, is not just to make things a little easier and better, it helps us get to the next level. We're hitting a ceiling now, based on the longevity of the human mind. Digitalization is the ability to learn based on our experience, progressively. Instead, many are at a stage where we're losing as much as we're gaining, just treading water. We need to break that cycle and use this opportunity in the digital realm to remember things and pass them on.

Matties: Any final thoughts today, Michael?

Ford: I think we've covered everything pretty well. Thanks. It's been a great opportunity to talk about this. It's great conversation. **SMT007**

Michael Ford is the senior director of emerging industry strategy for Aegis Software, and an I-Connect007 columnist. To read past columns or contact Ford, click here.

Packaging-free Design Quadruples Microbatteries' Energy Density

With wireless-enabled electronics becoming smaller and more ubiquitous, their designers must constantly find ways for batteries to store more power in less space. And because these devices are also increasingly mobile—in the form of wearables, robots and more—those batteries must be lighter while still being able to withstand the bumps and bruises of everyday life. Worse still, energy density gets exponentially harder to improve upon as a battery gets smaller, partially because larger portions of a battery's footprint must be devoted to protective packaging.

With that challenge in mind, new research from the School of Engineering and Applied Science has shown a new way to build and package microbatteries that maximizes energy density even at the smallest sizes.

The researchers' key developments were a new kind of current collector and cathode that increase the fraction of materials that store energy while simultaneously serving as a protective shell. This reduces the need for nonconductive packaging that normally protects a battery's sensitive internal chemicals.

"We essentially made current collectors that perform double duty," says James Pikul, assistant professor in the Department of Mechanical Engineering and Applied Mechanics and a leader of the study. "They act as both an electron conductor and as the packaging that prevents water and oxygen from getting into the battery."

(Source: Penn Engineering)

A Multi-Tenant PLM Software Solution

Feature Interview by Nolan Johnson
I-CONNECT007

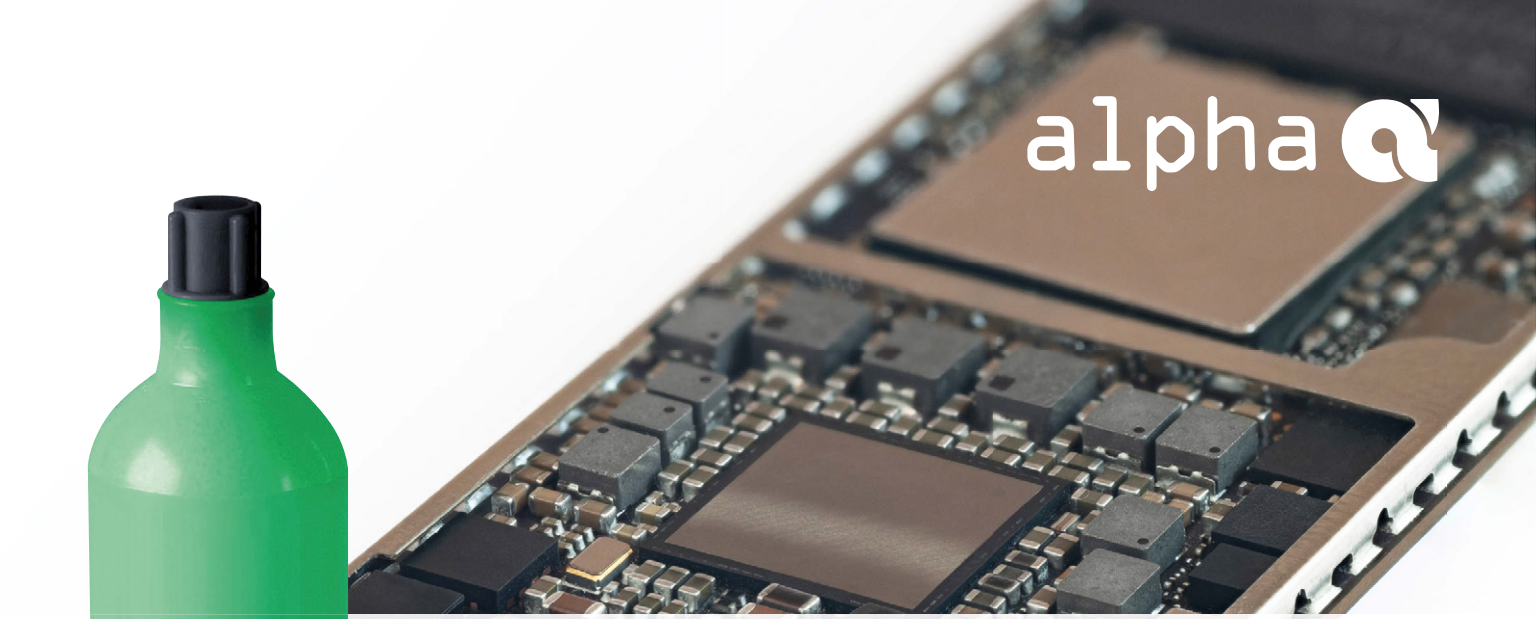
To better understand how bill of materials and business operations software can interact, we reached out to George Lewis, vice president of corporate strategy for Arena, a PTC Business.

Arena introduced the world's first multi-tenant PLM software in 2000 as a service solution. Since that time, Arena has helped thousands of companies globally to introduce products to market faster. Arena's software is cloud-based, and manages the entire product record, including the bill of materials (BOM), while connecting key products to improve quality management, regulatory compliance, training, requirements management, and more. Arena's software is intended to keep internal product teams and external supply chain partners aligned so that they launch new products on time and under budget.

Nolan Johnson: Digital twin is a concept appearing in nearly every meaningful discussion of factory automation, and bill of materials (BOMs) are a central component to digital twins for design, manufacture, engineering, and tracking products in the field. How does Arena see your products advancing the digital twin as a smart factory schema?

George Lewis: The concepts of factory automation and digital twin begin with strong control of the BOM and associated product development processes. In this regard, product lifecycle management (PLM) solutions like Arena create the framework for this communication. A cloud-based solution provides unique advantages in those scenarios where supply chains are heavily leveraged, which is commonplace in many industries today through market forces like digital transformation. Arena is well-positioned to create connections from internal teams like engineering, quality, and operations to external supply chain partners' manufacturing floors.

Johnson: In PCB manufacturing, most facilities are pre-existing; there aren't that many green-



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field site builds outside of Asia. What is your advice for an existing facility looking to become more digital, more "smart," in manufacturing?

Lewis: Whether you are a new or existing manufacturer, the need to work smarter and avoid cost overruns, scrap, and delays is critical to your survival. The great thing about cloud solutions is that they don't require the technical support or overhead to quickly adopt. Companies no longer have to install software or set up virtual private networks (VPNs) to protect their intellectual property (IP). Cloud solutions are designed with security and ease of use so that every member of the supply chain can access and collaborate with their partners.

With this in mind, we see many manufacturers striving to enable more collaborative means of communication with their customers and cross-functional teams. Processes like design for manufacturability (DFM) should include the original design teams and their printed circuit board assembly (PCBA) suppliers to eliminate quality issues and manufacturing delays. Legacy practices of emailing or providing access to large, static data packages create revision confusion. Cloud software enables dynamic communication practices to provide the latest, real-time product information and digital thread or persistent record of the product design as it moves from new product development (NPD) to product launch. Working smarter just means that you create processes that are more inclusive of the customer, so product development and commercialization processes can be executed rapidly to yield higher-quality products on time and under budget.

Johnson: To that end, what are some of the most common difficulties manufacturers face in integrating a PLM or a quality management system (QMS) into their existing systems?

Lewis: Manual, siloed, or paper-based legacy practices and processes can inhibit growth for any manufacturer looking to engage their customers and supply chain partners with a PLM or QMS software system. For instance, the need to create continual reports just to track, monitor, and approve BOMs or other design changes is typically not required because cloud-based software-as-a-service (SaaS) systems do this automatically. Furthermore, legacy practices that include serial review processes are no longer needed when you use software. You can create parallel review and approval processes for teams, where applicable, to speed the time to approve new designs or changes.

George Lewis

Older on-premises PLM or QMS software solutions are also more difficult to implement, use across geographically dispersed supply chains, and maintain. These older client/server solutions were not architected for the cloud and create additional deployment challenges, communication latency, and barriers to adoption.

Today's manufacturers should seek to leverage PLM and QMS software to collaborate on the entire mechanical, electrical, and software product design record to ensure the com-

plete product works as designed as you move from early design to volume manufacturing. Cloud PLM and QMS software systems have evolved to address many product development and quality management processes more effectively. And they are designed to easily pass information between design systems (e.g., EDA, MCAD) and enterprise systems used to manufacture products and support customers (e.g., ERP, CRM) so that accurate information passes seamlessly throughout the entire product lifecycle.

Johnson: Improving software systems needs to provide an ROI for the investment. Arguably, smart factory and digital twin work can be expected to have longish ROI periods. But what should a business owner expect?

Lewis: That is a great question. Historically, buying and implementing on-premises software solutions required a heavy capital investment and longer ROI horizon before companies could justify the expense. Cloud-based software solutions eliminate the need to purchase software, so you pay as you go with SaaS pricing models. And, as stated earlier, the implementation no longer requires software installation on every client. You simply access the software via any web browser. So, ROI for cloud software tends to be months, not years.

The perception that smart factories and digital twin solutions create longer ROI periods is understandable, but not as applicable in SaaS solutions. Whether you deploy your own internal cloud solution or collaborate with your partner's solution—the investment in training and implementation is greatly reduced when compared to older on-premises software solutions (or even client/server solutions that are hosted in the cloud).

We think it's important to evaluate both soft costs (e.g., benefits and business process improvements) and hard costs (e.g., cost of software, systems, support) when evaluating benefits and ROI. Depending on the manufacturer's existing systems and processes, we typically see these average benefits that lead to shorter ROI periods:

Improved productivity
- Increased part reuse across products by 59%
- Reduced time spent searching for information by 65%
- Eliminated data entry errors with revision-controlled changes by 20%
- Cut design review cycle time by 20%

Engineering change and NPD efficiency
- Reduced engineering change approval cycle time by up to 90%
- Reduced NPD cycle time by 45%
- Reduced new product introduction (NPI) cycle time by up to 60%
- Accelerated time to market by 30%

Quality assurance and compliance
- Increased quality process efficiency by 40%
- Accelerated compliance and document approval cycles by 90%
- Responded to audits 50% faster
- Reduced return merchandise authorizations (RMA) by 50%

Accelerated design and manufacturing
- Reduced shipping delays by 50%
- Cut manufacturing errors by 75%
- Increased product release process efficiency by 30%
- Increased global manufacturing capacity by 200%

Faster ROI comes with today's cloud-based PLM and QMS solutions that address product development, quality management, and specifically, BOM control. These types of cloud systems enable business owners to create a closed loop between the digital and physical worlds with a digital thread, and better support how products will work in the field as product information is passed from engineering to manufacturing and customer support

systems. Leveraging the digital twin or virtual representation of a product throughout its lifecycle makes it easier to predict product performance and thus shorten the time to ROI.

Johnson: A common problem in traditional workflows is that small incremental changes to a design to improve manufacturing yields often never make it back to the OEM design team's version of the design.

Lewis: Absolutely. The irony is that both original equipment manufacturers (OEMs) and contract manufacturers (CMs) strive for better DFM feedback. The trouble is that existing communication systems are ill-suited to capture and share this type of feedback in the context of the design or product record. For instance, emails are great to communicate, but they are disconnected from the product record itself and can easily be ignored, lost, or forgotten. The email may not get to the right person, or the right person may not be available to act—so the email sits in their inbox.

The challenge is to provide effective, real-time collaboration in context to every aspect of the product design so that it doesn't get missed by those responsible for executing on the design or manufacturing of the product.

Cloud PLM and QMS systems create a product-centric approach to manage the full assembly (or BOM) with every aspect of the design, drawings, models, and documentation linked to each component of the BOM. Then as teams review the designs, they can collaborate formally with engineering change requests (ECRs) or engineering change orders (ECOs), or informally (with social chats linked directly to the affected part or assembly) so that everyone sees what feedback or issues arise throughout the product development and introduction process.

Johnson: You have a white paper[1] on streamlining a product NPI on your website. Where should a manufacturer start?

Lewis: Yes. There needs to be a synergy and alignment with the manufacturer's NPD and NPI processes. Making sure that the engineering design teams can continue to work with their best-in-class design systems is key. The same is true for downstream enterprise resource planning (ERP) and customer relationship management (CRM) systems.

Making sure that the engineering design teams can continue to work with their best-in-class design systems is key.

We help companies bridge the gap from design to manufacturing to bring the complete product design together so all teams beyond engineering can make sure that design can be manufactured effectively and in the targeted time frame.

So, because NPI processes encompass many engineering and manufacturing teams, you must start by creating a single source of truth for the product record. This allows all design, operations, and supply chain teams to collaborate on the latest information any time and anywhere. Both cloud-based PLM and QMS systems provide the centrally-controlled product record in one system to keep everyone on the same page and streamline both NPD and NPI processes to ensure all stakeholders can ultimately produce the right products at the right time.

Johnson: Who's the ultimate owner of the NPI? And how much detail should that owner be alerted to?

Lewis: In many ways, the CEO is responsible for the go-to-market approach of NPI launch-

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es. In my experience, the most successful product companies typically have a leader who has an intense focus on delivering high-quality, innovative products on time and under budget. Often, it's the head of operations who is responsible for making sure the product can be built and delivered to customers. They must make sure that all internal and external teams working from design through manufacturing are collaborating on the latest design to meet the company's product launch goals.

Regardless of who has the ultimate responsibility for NPI success, it's critical to have a transparent process. If any aspect of the product design is a problem, then the right stakeholders can be alerted to the problem. Often, lower-level teams can recommend a solution or fix without involving management or senior leaders. However, if the problem is complex and requires management approval to determine the best course of action, then using a PLM or QMS system allows anyone to quickly notify the right person of the problem so it can be resolved as quickly as possible. The full product record and history of team collaboration is stored in the digital thread, ensuring decision-makers have the right information to make an informed decision.

Johnson: We recently published an issue of the magazine on the designer-to-EMS communication channel. Not surprisingly, both sides of that conversation feel that communication is inefficient and error prone. Based on the work you're doing now, look out five years and tell me what will change between now and then.

Lewis: Yes, we hear that, too, when we work with companies that are struggling to improve their processes. PLM and QMS systems have been evolving rapidly and the cloud has helped many companies leapfrog their competition. Whether you are a consumer electronics manufacturer, medical device manufacturer, or industrial product manufacturer, you still have to get great products to market faster than your competitors to stay alive in this global economy.

We see smart technologies like the Internet of Things (IoT), artificial intelligence (AI), and augmented reality (AR) having a huge impact on both our customers and how we help them design and deliver products that meet their consumers' needs.

At PTC, we see the entire experience of bringing the digital to physical reality as the key to future success. So, the ability to have a persistent digital thread is the glue that will allow tomorrow's manufacturers to succeed. We are working with cross-functional teams across PTC's SaaS business unit now to build the solutions that will help companies thrive in the years ahead. And, while you asked about a five-year horizon, we are already starting to leverage new technologies to enable a better digital thread and digital twin.

Let me leave you with this thought: We see tomorrow's teams and processes integrating more closely as engineering teams design in CAD solutions, extended teams govern and distribute those designs in PLM/QMS systems, and operations teams then introduce smarter products while gathering greater insights with IoT smart product capabilities. And it's exciting to see how leveraging the digital twin is going to help companies to better support and service their products with AR-based technologies by allowing remote teams to either repair products from afar, or field service technicians will use AR to visualize and address issues with smart glasses that highlight what they need to look for and resolve in real time.

Johnson: Thank you for taking the time to talk with us. **SMT007**

Reference

1. "Breaking Down the Barriers to Product Innovation," and "Streamline New Production Introduction (NPI)," arenasolutions.com.

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Whizz is Da BOM


Muhammad Irfan

Feature Interview by the I-Connect007 Editorial Team

In this interview, Whizz President Muhammad Irfan shares his 20-plus years of experience by breaking down the bill of materials process in today's challenging environment. Irfan describes what that means for his team and suppliers, and how we move forward in a post-pandemic climate.

Barry Matties: We've been looking at several areas where there's room for improvement, including the bill of materials (BOM) process. When you look at the BOM process, starting with quoting and going through the process, what challenges are there, and what improvements do you hope to see?

Muhammad Irfan: Right now, there are multiple solutions that are not cohesive as one solution. Typically, you're getting a BOM and tying it electronically into all the distributors' networks to check stock and inventory. But once they're present in the system, in reality, that is one pain point. Because, in parallel, there are other transactions that could be going on where the system is showing stock, but within 30 minutes, maybe two large POs came in and the stock is not even there anymore.

In the BOM process, one challenge is checking it and tying it to the real inventory stock with the distributors. Second, it is getting a snapshot and report to the customer, but by the time the customer places a PO, it could have totally changed on the distributor side. We tell our customers, "If you act quickly, it's more likely going to be very close to what we are showing you here as available, and here is that pricing." Customers must understand that they need to make quick decisions on one purchase authorization. If they take days or sometimes weeks, you redo all that work. On top of having the tool to electronically tie into the distributor check of the system, it's about calling and making sure it's there.

Then there is end-of-life components. We have a subscription to a parts database service. It is an expensive subscription, but we maintain it because it gives us a lot of visibility

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into parts, their specs, and help with replacement issues. If there's an end of life, what other parts are identical, and which one could be a direct replacement? We still do our engineering check on it, but the parts database service is only one tool; there are other small tools that build out our distributions, and utilities that tie into the network. We compile all that data to come up with a realistic picture of that BOM. Then we see if there was a way to update the availability automatically.

We compile all that data to come up with a realistic picture of that BOM.

Matties: We hear that much of the data coming in on the BOMs is mistyped, or there isn't complete data, leaving your team to figure it out; or you spend a lot of time going back to the customer for clarification. How accurate do you think most BOMs are? Do they all require some sort of communication back to the customer before you can complete the process?

Irfan: On the ones we design, when the BOM is under our control, our BOMs are pretty organized, but with the BOMs we receive from customers, we always have questions due to missing information or incorrect part numbers. Almost always.

Matties: Right. And are these questions valid? Should they have been answered when they sent you the material?

Irfan: They should have been sent, but the problem is that the early BOM is put together by engineering. Engineering doesn't have a manufacturing mindset, so to them, it was a complete BOM. But from a manufacturing perspective, that's a very different BOM. The operations and product release groups would understand that these are not complete manufacturing BOMS. Tier ones are very disciplined in that, but most other companies are not very well disciplined and have gaps in them.

Matties: I guess they probably don't realize that inaccurate data is only causing delays in their project, right?

Irfan: Yes, but it's the engineers' mindset you're trying to train, and generally they see the BOM, and they think it was pretty good documentation that they handed over. Then, when you point those things out they say, "But why can't you figure that out?" You still have to go back and say, "This is what I think it should have been, but I need you to sign off on that." It causes delays.

Matties: When you're in the quoting process, you spend time to decipher this information, and then if you don't necessarily get rewarded the job, that's a costly exercise.

Irfan: It is, but fortunately in our situation we're not doing a lot of RFQs where we're not getting the project. We are selectively engaging with customers, so most times when we're doing a quote it's very early in the relationship and we say, "We're capable of doing this project of yours, so let us show you how we would approach it." It's a known investment we make into that. For example, with a recent customer, we did maybe about a week and a half's worth of work into the project from an engineering point of view and some work on other types, and we presented a very detailed scope.

We know that we're seeding a customer for that, but generally, our hit ratio is very high. When we're quoting, we're quoting in a known situation where we know we'll get the project. But as we grow and we increase our sales and marketing flow, we will start having more

of those where we quote without knowing if we're getting the project, so we will need to automate or bring more efficiency to our quoting process to minimize the time it's costing us because we don't know if there will be a return.

Nolan Johnson: Given the fact that Whizz does business in the prototype space, I would expect that lead times and snapshots can be extremely volatile right now. How do you adapt to that? For example, you've got your bill of materials resolved and now the bottom drops out somewhere and lead times jump suddenly to, let's say, 24 weeks. How do you adjust to that?

Irfan: In our business, that's a disaster. When somebody is engaging us and they're really ready to build the board, they say, "Here's a BOM, go buy the parts." But it doesn't happen that way. For most of the boards we are building, we design those. In the design phase, the first order of priority is to establish very high-level components to finalize our architecture and then we say, "We know for sure these eight components are on the board. Put those on order." What's our plan for the build? We ask the customer for the first 10, 20, 40, 50 board kits. We will put those on order weekly, even daily, so that during the maybe three or four months of the design phase, we're constantly adding (as the BOM is finalized) all the new parts within a day to our procurement team, and they're putting those on order. By the time we finalize the design, we have a final BOM.

By the time our engineering completes the design, We have at least 95% of the parts already in stock, and very few items left to take care of. During board fabrication release, we take care of the last couple of components. That's normally how it flows here at Whizz. If a customer is doing their own design, we're going to manufacture for them, and when the customer is experienced, they engage us early in their design phase, and they're handing over their BOMs to us. We're good at managing an evolving BOM; the new BOMs keep coming, and we have a great process internally to manage the changes expeditiously. By that time, the goal is the same: when they're done with their design we should be ready to manufacture the boards. But if somebody comes in at the last minute and says, "Here's a BOM, can you build the board?"... Tough luck these days, that's very hard; even though, we still manage to do it as much as we can.

Johnson: The takeaway for anybody working on the design is that once you've specified parts early in the design cycle, you should then start the ordering process and getting some quantities in.

Irfan: Yes, definitely.

Johnson: Are we seeing lead times continue to run out longer and longer, or has it started to pull in? Last year, lead times were really quite crazy. Are we still seeing that?

Irfan: Yes, they're still quite crazy. Nothing has improved. Some things got worse, and generally, we haven't seen any improvement.

Johnson: Which components have gotten worse?

Irfan: Sometimes these components are in regular supply and suddenly they have lead times because of the actual raw material shortage in the market. There was a phase where tantalum capacitors had a lead time because the raw material to build those capacitors was in short supply. There was another situation when the fab raw materials for laminators became in short supply. FR-4 became in short supply. We constantly are on the lookout for these. As soon as we see an emerging trend, we work with our suppliers to see if we can pay and take physical possession of components right away, rather than following the traditional just-in-time model. Lot of CMs cannot do that due

to cash flow issues, but fortunately, we are financially very strong, and can pipeline longer than normal inventory. Our ability to purchase parts right away protected many of our customers from extensive product delays. One of the things we're very good at is we go back to our customers very quickly to highlight what's happening. "To protect you, this is what you need to authorize us for. We've given you the solution; you just need to authorize us." They really appreciate it, because we're not coming back after the fact saying, "Sorry, the distributor screwed up, and I can't have the parts."

For most customers we work with, in current market conditions, we carry a six- to nine-month pipeline inventory, and visibility for next 18 months for long life cycle products. We're constantly watching over that, figuring out any changes that could jeopardize it, bringing it to their attention, and getting their approval. But they appreciate that we're able to do that and proactively give them input ahead of time, so it doesn't become an issue. So far, we have not missed any delivery because of lead time issues, because we plan for it way ahead of time, and are financially able to buy the parts ahead of time; of course with customers approval.

Johnson: How about pricing? Is that as volatile as the availability?

Irfan: It is very volatile. For the 20-cent parts, sometimes you're paying $2. In prototype quantities, when you're building for 10 boards, customers just say, "Get whatever you can." In current market, we have been getting them from distribution or known trusted brokers; wherever we can get the parts to timely build our protos. In some cases, where we suspect part quality could be an issue, we use a quick lab test to check the legitimacy of the part and then use it. And some we have longstanding relationships where we know these are known suppliers and they're not going to be counterfeit components.

Matties: I would think counterfeiting is on the rise as well.

Irfan: Big time, yes.

Johnson: It sounds like your parts and procurement team must be doing checks against all of the active BOMs on nearly a daily basis.

Irfan: Yes, we are. We understand how important and critical it is, so we're doing it.

Matties: Have you reallocated staff into that area because of the demands?

Irfan: We have.

Johnson: Does your parts availability database tool help you in the management of this part of the supply chain?

Irfan: It provides some visibility because parts availability is very volatile right now, but It's more related to end-of-life specs, tying it to alternative part numbers, and general part life history.

Johnson: That's interesting, because end of life and extremely long lead times are kind of different causes but end up with similar responses, right? We need an alternative part.

Irfan: Well, not exactly. With end of life, you just can't get the part anymore; it's over. But with long lead times, if you're planning ahead of time, we've mitigated that risk. We place those parts on order, or we paid more somewhere just to get them.

Matties: Very good. Is there anything that we've missed that you'd like to cover?

Irfan: I think that's it. We appreciate the opportunity. Nice to catch up with you.

Matties: Thanks for your time. SMT007

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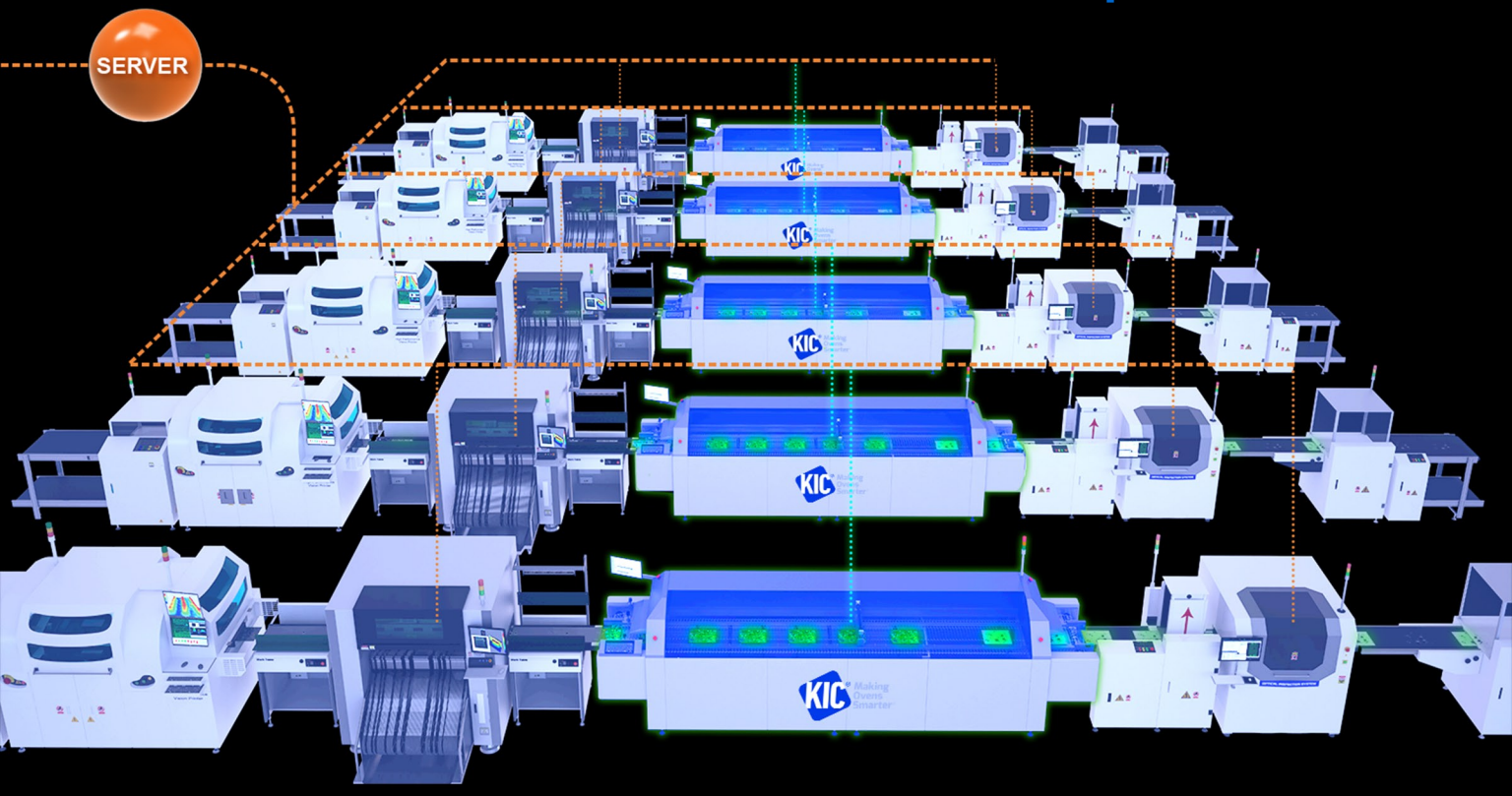

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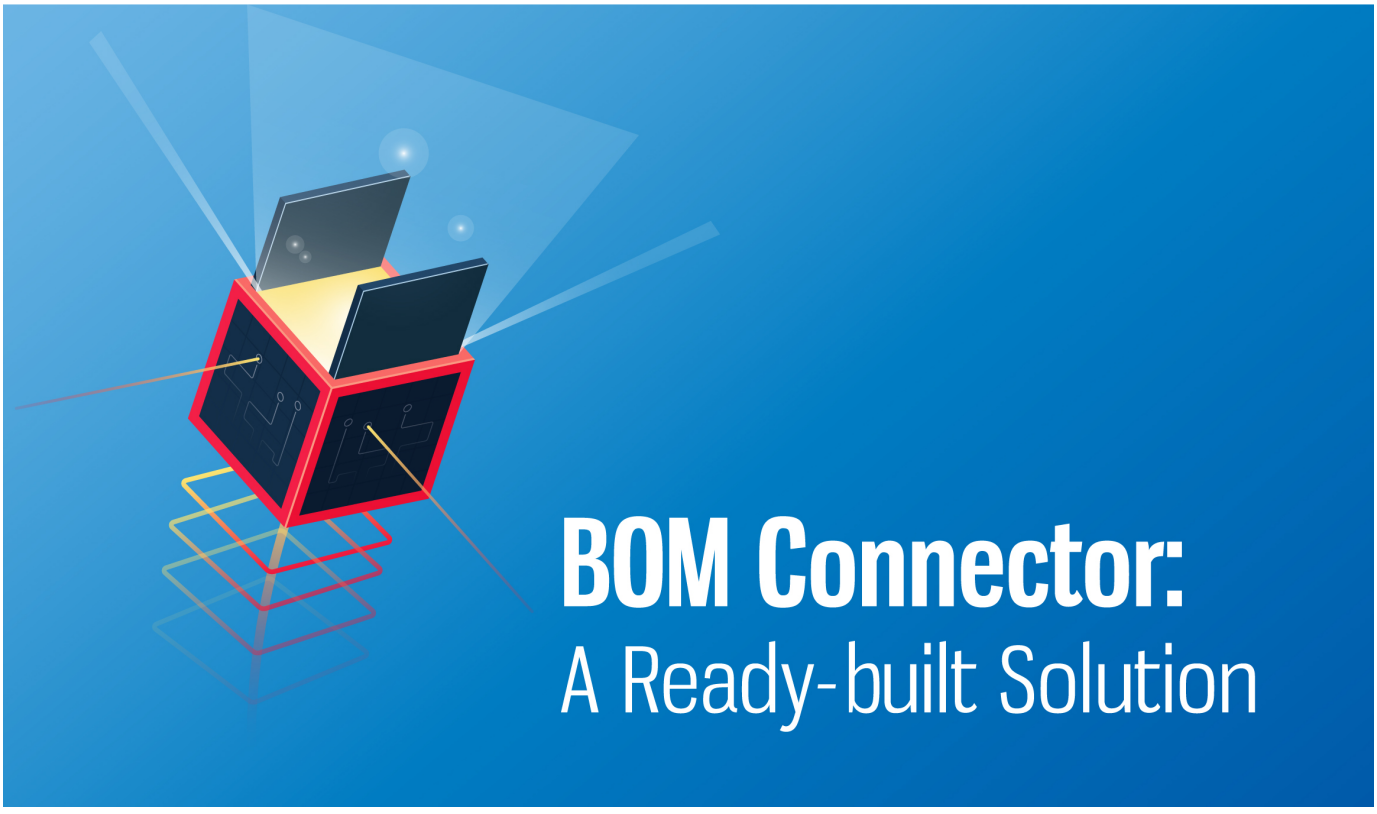

BOM Connector: A Ready-built Solution

Feature Interview by the I-Connect007 Editorial Team

Kevin Decker-Weiss of CircuitByte and Mark Laing of Siemens explain how a tool called BOM Connector can improve quoting and manufacturing flow. Mark and Kevin are openly enthusiastic about this topic; this conversation launched immediately into a technical discussion.

Nolan Johnson: When companies tell you that they are building their own BOM spreadsheet, what do you say to them?

Kevin Decker-Weiss: We say building is exactly what you shouldn't be doing, yet we see a lot of companies trying to build their own pricing engines with Excel, Access, or SQL. After putting a lot of money into it and not getting it done, then they start looking for ready-built solutions.

Johnson: You've set up exactly the problem. One of the things about bill of materials issues and parts, procurement, supply chain information, and getting the components together for builds, is that it's a tool that we need, especially now. Rolling your own tool is a complex process. Is that why you developed BOM Connector?

Decker-Weiss: We've been a Mentor partner for a long time selling Valor; before that we sold the predecessor called CAMCAD Professional. We asked the customers: Where does it hurt and how can we help you? What processes do you most want to improve? Especially from EMS companies, 99 out of 100 would say to improve BOMs either in general or quoting.

So, this is where we put our focus. We first developed it for a big customer. When we saw how happy they were with it, we realized we had to "productize" this. BOMs come in all shapes, sizes, and quality levels. They are really a pain to scrub and maintain. Then, the BOM is manufacturing-ready, and your customer calls and says, "Two things have changed." You know it's never two things, but more like four or five things.

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By the time you've identified what has changed and manually made the changes, you realize it is just wasted time spent on a mission-critical step. One mistake in a thousand-line BOM ruins your entire production. There is no room for error in the BOM, which is exactly not the process you want to be doing manually. Then, we started hearing from customers, "This is a great scrubbing tool. The reason I need to scrub my BOMs is I need to quote them. I would really like to stay in this tool and not have to go into Excel or some other tool. Could you add some component sourcing features to it?" That's how it grew into a BOM/component price quoting tool.


Kevin Decker-Weiss

Johnson: You're providing BOM scrubbing and component quoting, as well as aggregating what the BOM will cost you to purchase. How does a user interact with this tool to scrub the BOM?

Decker-Weiss: It starts with just having a very flexible, smart BOM reader. Developing a BOM reader is a lot more perspiration than inspiration. You need experience and to have seen a lot of BOMs. You need to understand it needs to be specific for the electronics market. That's another issue we saw in tools on the market. They might say, "A BOM for a PCB is just like a BOM for a bicycle," but anybody who works in electronics knows that's not the case.

From a very high level it is, but from an operational level, you have very important data for electronics. Reference designators are important. On a bicycle, who cares if it's screw six or screw seven, but on a PCB, C7 or C6 makes all the difference in the world from a production standpoint. There are a lot of very electronics-specific things in a BOM that you need to be able to recognize, identify, and clean up as easily and as quickly as possible. That's really where it all starts—being able to get all these different types of BOMs cleanly into the system with no loss of data.

Barry Matties: Kevin, you're saying good in/good out?

Decker-Weiss: Yes.

Matties: It's really a product of the discipline of the user inputting the information. The tool streamlines the process, but it's still a human interface that regulates the quality of the content.

Decker-Weiss: If I do something once, I shouldn't have to do it again. The system should be smart enough to know though you did all this work, something in the BOM structure has changed. Take a look and make sure that your settings still apply. It needs to be smart, but it needs to reduce those repeat efforts. That's the first thing.

Matties: Would you consider it to be an AI function if the BOM is anticipating?

Decker-Weiss: I would.

Matties: That really evolves within your product, I would think.

Decker-Weiss: Correct. There is a debate amongst developers as to what classifies as real AI, but that is such an esoteric discussion sometimes. The truth is, it's a learning system. Like any good product, it gets smarter the more you use it.

Matties: How does it assist the BOM reader? Is it possible to reach a point where somebody who may not have all that experience can be as efficient?

Decker-Weiss: It assists by recognizing typical field names: "Based on my experience, this looks a lot like a manufacturer part number, or the other way around, this does not look like a manufacturer part number. It doesn't have any of the rules. These are typical manufacturer names. They are not infinite. There are a certain number of parts manufacturers on the market." It should do checking, like you've got some inconsistencies, your manufacturer part number doesn't actually match the description, things like that.

Mark Laing

It doesn't make sense to take a faulty or incomplete BOM and start pricing it because you're just going to start pricing in your mistake. If there are inconsistencies there and the quantities don't match, the board doesn't match the BOM, waiting and pushing that under the rug by saying, "Well, let's just go to procurement anyway," is just kicking the can down the line and even worse, making sure that if there's a problem, it will eventually get revealed. The question is just how much energy, pain, and money will it going to cost you when you discover that problem? So, let's discover them earlier.

Matties: Sooner is better, right?

Mark Laing: I think this is indicative of the BOM scrubbing capability; if you go back five or 10 years, BOM files were fairly straightforward. They were typically single line. People were using alternate parts and what we've seen is that's expanded a lot to the point where a customer I spoke to yesterday said, "My tool doesn't read an Excel file and most of the BOMs I get are an Excel file format. I have to manually remove all the AVL data because it can't handle the AVL data." The cleanup that we're talking about is to be able to extract that.

We could be talking of five or six alternate parts and one isn't quite right. So, you want to pull in as much of that as you can and then be able to correct and adjust the stuff that isn't, and not just throw everything out and say, "Let me just get a little bit enough to get the job done." That doesn't work when you're looking at the different quoting aspects, especially in today's supply chain challenges, where if you can't get certain parts, you want to try and get another part, but you want to get a part that fits physically and electrically. That's an incredibly important thing and I think we've seen that in the last 18 months how important it is to extract as much as we can because that gives you options downstream.

Johnson: The supply chain right now requires a great deal of flexibility thanks to changing lead times, etc. Finding suitable, functional copy exact qualifiable alternates is something that the procurement people are doing constantly. How does BOM Connector assist with that?

Decker-Weiss: When we first started out, we were a BOM scrubbing tool, which did a little bit of quoting. Now we're a quoting tool that has BOM scrubbing as a necessity in order to get to your quality. Most customers buy BOM Connector today because of supply chain hassles, so that really has become the focus of the tool. It does that in several ways. First, we are database-driven, so it all starts with a foundation. You have a database as opposed to a calculator, which essentially, Excel is just a fancy calculator. We're exchanging a calculator file-based tool with a central database tool, so that's how we start.

Then we take advantage of something which is still relatively new in the supply chain, which is that distributors and manufacturers allow third parties to develop direct interfaces to

their systems. What they have now are true API toolkits, which let you develop directly to their ERP systems. We're not touching their website. We don't care about the website. The only thing we use their website for is to verify the data that we're getting over the API connection.

We don't care about the website. The only thing we use their website for is to verify the data that we're getting over the API connection.

With these, I like to compare it to the way we booked a ticket to London 10 years ago: we either called or went on the websites for United, American or US Air. Now, with one click online, we see all the airlines offering flights for these prices and these conditions. Here, I can take my bill of materials, hit one mouse click, and I get results from all these different suppliers.

BOM Connector as a smart tool takes that information, organizes it, and suggests that based on your rules, you should buy this part from supplier A , this part from supplier B, and this part from supplier C, but if you're willing to go a little more over the edge, or if you're willing to wait a few more days, you can get a 3% cheaper price. We take that heavy lifting off the customer. We present the data right there. And now, of course, you're back to what you had said at the beginning: My 13-year-old nephew doesn't know what to do with this data, but an experienced procurement person knows exactly that's the data I'm looking for.

Matties: When you're looking at what's available, is that a real-time stock check?

Decker-Weiss: Yes, absolutely, which means your stock levels are appropriate to your geographical region. If I'm in Southern California and the stock is in Arizona, that's a big difference than if the stock is in Malaysia. I see the stock local and relevant to me and I get my pricing, not just some market pricing. So, if I have conditions with any supplier, that's the information I see.

Matties: In terms of booking the order, is it done right then and there? If they see it's in stock, they can make the purchase through your system?

Decker-Weiss: Not yet.

Matties: Is that where you're headed?

Decker-Weiss: We're working on that. It needs to be rolled out carefully, because you are placing these legally binding orders and you don't want to have anything wrong. But we absolutely will have it by the end of the year.

Laing: I think there's another area we haven't touched on. If I get a bill of materials for my customer and I read all the data in, I suddenly realize that 100 of those parts are available in stock in my ERP system. I don't need to get pricing information because the parts are already in inventory. It's just that the part is called something different. It's an alternate that they didn't import. When you're subject to the supply chain challenges that we've all just talked about, it's valuable to know the part is sitting right there in the warehouse. So, I think that's another big area here that is really utilizing your ERP system to its maximum.

Matties: Is that connection already in your system?

Decker-Weiss: It is. Of course, it always sounds easy until you try to do it. Like Mark just said, it's not that easy. We check the daily market

price against the number they've got in their ERP, and we mix and match. We say, "Use it from stock, but quote, based on the market price of X," which is 30% higher, let's say. It gives them that input. So, that is the reason we didn't name it BOM Pricer or BOM Calculator, but BOM Connector.

Matties: What is the training curve? How quickly do people expect to be fully capable of running this tool independently?

Decker-Weiss: Generally speaking, it's a three- to six-month total learning curve. We do two full-day training classes for the team and a one-day workshop a few weeks afterward to refresh.

Matties: Now, when it comes to a function within an organization, what roles would people have? Or is there a new role that's emerging?

Decker-Weiss: It really depends on the size of the company. Often, the first people who use our tool are inside sales. Oftentimes there is a quoting department, but depending on the size, purchasing may also do quoting.

There usually are BOM engineers in charge of maintaining, revisioning, checking, and pushing the finished BOM into the ERP or MES system. Now we have one other role, component engineering, which is using the system more frequently because end of life, obsolescence, involves RoHS, REACH, SCIP environmental standards and requirements. Often, many of the parts in the BOM either cannot or should not be purchased. So, a component engineer grabs the BOM first, evaluates for obsolescence, then gives the BOM over to sales/quoter/purchaser.

Johnson: That's a function that BOM Connector is starting to do?

Decker-Weiss: It is, but we don't want to get into the data maintenance. We don't have the size to start competing with a silicon expert, an IHS Markit, or even an Octopart yet. We have nice real-time connections into these tools. We have partnerships that we built up with them. We can offer a special BOM Connector, a subscription, and they never see the portal. They don't have to take the BOM, upload it into the portal, download the information, copy the information. They just hit a button, check silicon expert, it pulls the silicon expert data into the BOM, and now they can start looking and evaluating. Do I have obsolescence? Do I have parts that are too close to end of life?

Johnson: This information that you're talking about certainly makes sense for the design team to have access to during design when they're making key decisions that will then percolate all the way to the manufacturer. Is BOM Connector information available in the CAD tool? Do you see that as a direction to go with the tool?

Decker-Weiss: Whether we'll ever integrate it directly into the design tool or something is a little open, but certainly from within the de-

sign tool you can start BOM Connector and we encourage very much that designers start doing it as well. Our slogan is it's never too early to start thinking about the right part. Unfortunately, a lot of EMS companies have minimal connections to the design team. They get a design and it's finished. You are right; oftentimes, people start using the tool too late.

Johnson: For the design team and procurement point-of-view, your tool starts to fill in a gap in the digital twin. There's also a back annotation feature you find yourself in the middle of as well. A design team just procured this one particular part from this particular distributor, it's actually an alternative to the primary spec part, and it's going into these individual specific assemblies. Your tool can provide information for that provenance. Is that something you see BOM Connector doing?

Decker-Weiss: Absolutely. Just as a price and availability gatherer that's looking far too narrow because it's the processes that are important and being part of the process. And that's why our connection with Siemens is so important because it really fits perfectly into, as you said, the digital twin concept, just the overall process, a step. We've been talking up until now just about material costs, but production costs are about a quarter of the final product cost as well.

Laing: In general, the material cost is about three-quarters of the overall price, but it's not just the parts; they don't magically turn into a product. You must assemble those parts on a PCB and put PCBs together. Other mechanical pieces that are part of that process ultimately drive the product cost. This is an area that I think is definitely very open at the moment.

Johnson: With all the various CAD tools on the market, how heterogeneous is the input domain, if you will, with respect to bringing data into BOM Connector?

Decker-Weiss: We decided to focus primarily on the EMS market, as opposed to the OEM market. The OEM market would have the advantage of being far less heterogeneous; you have just a few major systems. SAP is probably being used by 80% of OEMs. In the EMS market, you have a lot of ERP systems, so we have to have a lot of ERP connections. You have so many different types of BOMs and formats. You have so many different types of CAD formats. Yes, most are using ODB++, but you still have about a dozen different CAD systems producing different types of things. It's a very heterogeneous market. On the supplier side, you have lots of suppliers; on the manufacturer side, you have constant fusion of manufacturers and everything else.

One of our unique selling points is that we do not, or do very little, specify to a user that this is what you must do, this is the format you have to use, this is the way to your data needs to look. The flexibility is key there. When you get into production costing, it's even more because you have so many different machines and lines and everything else.

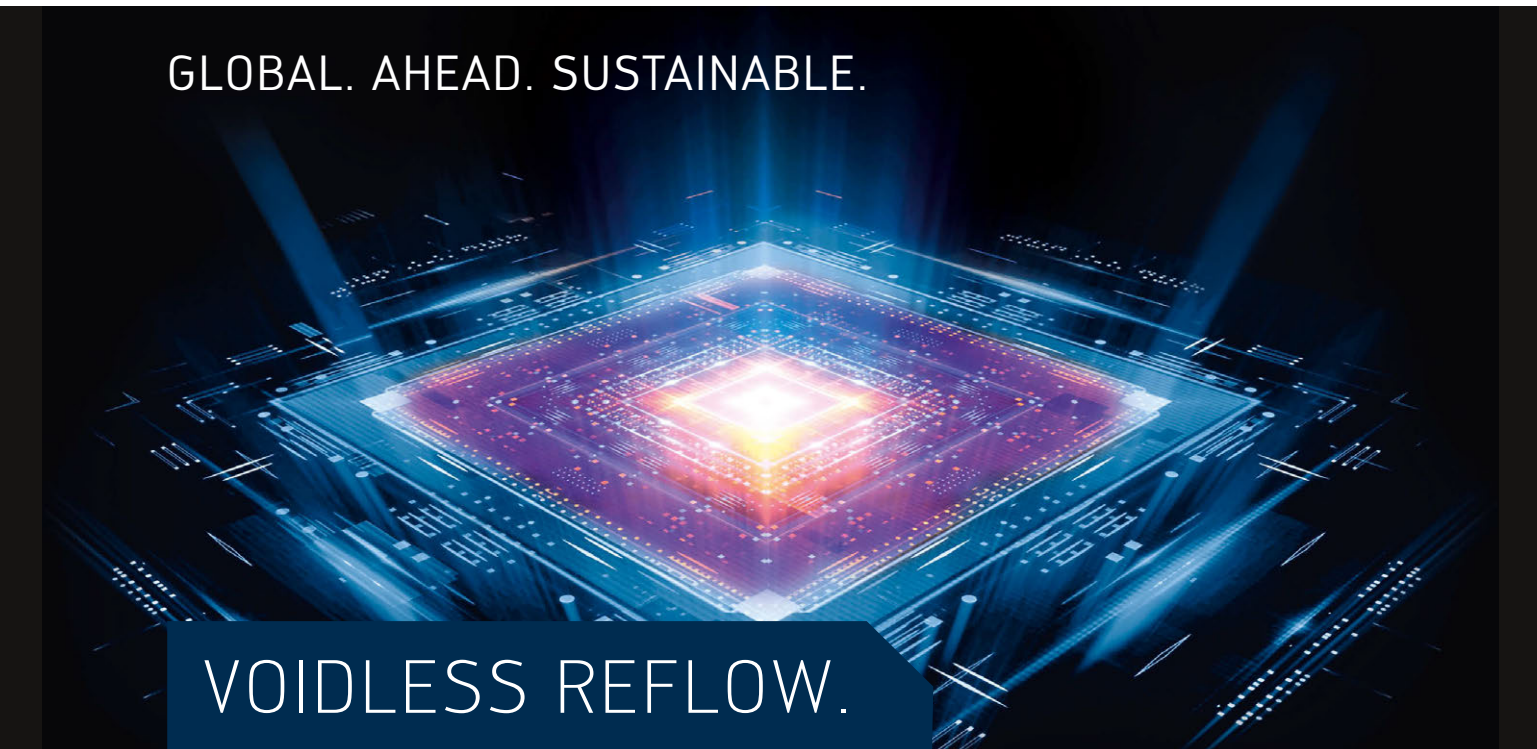
Johnson: Are you supporting IPC-2581?

Decker-Weiss: Yes.

Laing: In general, we're supporting quite a few historical formats. We want intelligent data because intelligent data we can read and interpret. We have the tools to handle even Gerber files and convert them into a level of intelligence, but there's extra work involved. We can do it, we've got the tools to do it, but we very much push our customers to see if there is a better way, or can they find the intelligent data because it's a button push with intelligent data. We know how to deal with it. We know how to read it. We know how to extract information, and that's what we pass over into BOM Connector, to create the process quotes.

The thing with the process quotes is we're not just taking this number and multiplying it

kurtz ersa



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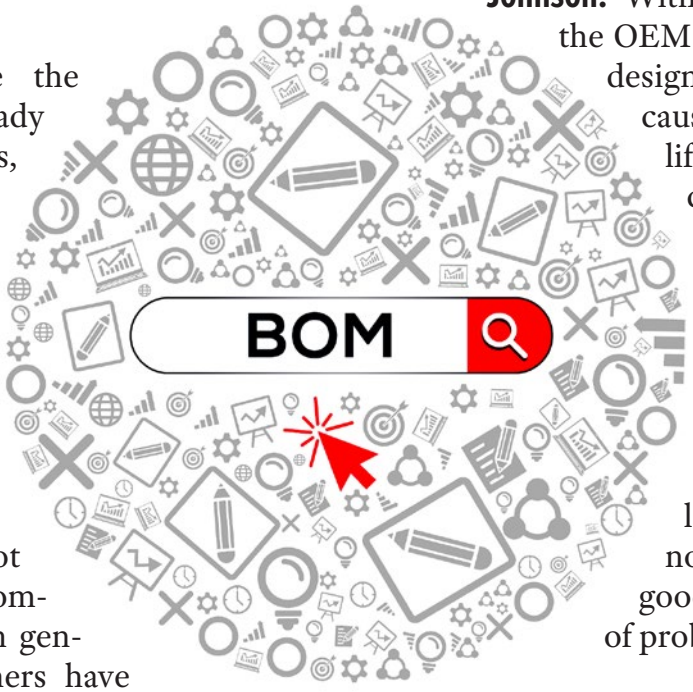
by 12. It's far more complex. I think Kevin and I learned a lot in the last few years, talking to people about how complex these strings are in order to give them the numbers that they want. If this was easy, then they would just continue to use Excel, but it very quickly runs out of steam, otherwise you really need an extensive programmer to deal with them because the statements are just so significant and there's a lot of elements to this as well. So, it's just a matter of putting that all together and being able to package that for the user. I think we've got a good balance in what we've come up with collectively.

Johnson: You've done the heavy lifting work already for the EMS customers, what with all the different flavors and formats in the MES systems. It seems that developing closer tool access for the OEMs is going to be fairly easy.



Laing: It's different. Fundamentally, we have a lot of OEM and EMS customers that manufacture. In general, our OEM customers have fewer variables, one or two machine types. They have one ERP system; they have one type of BOM. It becomes much simpler, but their focus is different. That availability part, obsolescence, becomes more key, and that's where the opportunity is with BOM Connector; our tools are able to help manage the supply chain.

From an EMS perspective and who's building a product, then it's about when I can get these parts. From an OEM perspective, it's about how long I will get these parts. If it's three months, six months, 12 months, how is that going to affect it? And it's not just from an electrical perspective. Typically, if you talk to people who are requiring parts, they will think about it electrically. I need a 1K, 1%, four to what resistor? Is it a 1206 or an 0805? There's a physical aspect to this as well. That has a huge impact on manufacturing. A key piece is making sure that the AVL is not just optimized electrically but optimized physically. There is an opportunity to help the OEMs get ahead of the challenges that we're facing. I mean, these are not new things, but I think the last 18 months has really shown how very dependent we are on all aspects of the supply chain.

Johnson: With all that information, the OEM design team can avoid designing in a forced rev because they used an end-of-life product; that is critical.

Laing: Absolutely. I think that's certainly going to continue. In some ways, you can say it's going to become more of a problem moving forward, not less. Software is very good at solving these types of problems.

Johnson: What are your customers telling you about their burning needs and struggles? What's their hot button?

Laing: I think it's that people don't necessarily know the problems they're having. Kevin and I had a session where someone contacted us after a previous session that we held and said, "Finally, someone understands that I'm not the only one." That was quite an enlightening conversation when they see a light go on and that you can help them with their solutions.

Matties: Do they understand their problems or are those problems hidden?

Laing: I hate to think how many times I've heard over the years, "This is the way we always do it. We've done it for 20 years." When thinking about adopting technology and software it's not just about adopting the tool but reviewing how you use the tool. It's the combination of changing the way that you work, as well as adopting new technology. That's when you get the synergy.

Matties: In many minds, that creates disruption. Who wants to learn a new piece of software today? We have enough going on in our lives without having to sit down and figure out how to run a piece of software, then really make a tool that delivers a meaningful ROI, not just on the bottom line, but in simplifying my workflow. That's a tough hurdle to overcome.

Laing: It can be. But when you understand the inefficiencies, and when that can be automated, you're making those people much more effective and you're able to take advantage of their capabilities. Now, people are relying on their capability to get the job done.

Matties: Well, it's the misery I know versus the misery I don't.

Laing: Technology and tools will continue to evolve. If we look back, how many times has Microsoft Office been changed over the last 10–15 years? We've all gone through those changes and tools, but as operating systems and hardware changes, these tools evolve too. And some of them fall by the wayside. Our technology and our value proposition today is not what it was five years ago or five years before that, because the tools have to evolve. The environment evolves.

Matties: The other challenge is whether I'm making the right decision. You can get into analysis paralysis. There are so many choices. Is this going to be the Beta-VHS war, so to speak, and am I getting on the right boat?

Laing: Very much so. For example, about eight years ago, I gave my phone to my kids. It was a Blackberry. The first thing they did was pick it up and try to swipe the screen, but it has a trackball. Tools change and people's views on how they interact with technology change over time. We must be aware of that. Integrating into that environment can be a springboard for your solutions moving forward. If you're antagonistic to that, it becomes very challenging. Things have to evolve over time as well and it's finding that balance. The product is fantastic only if you adopt and deploy it.

Things have to evolve over time as well and it's finding that balance. The product is fantastic only if you adopt and deploy it.

Matties: Your product is being used in several areas, so it's not just the learning curve of one area. Multiple teams on multiple levels for multiple uses must commit to this. How does the company measure the ROI? What is the information you share with people on that?

Decker-Weiss: Yes, I agree with you. There's always a little skepticism at first, as most customers aren't going to do that for a 10% improvement in their process. You really need to show a major improvement in the process. We rely heavily on customer demonstrations and when we do them, we say, "Give me one of your BOMs. The best is to give me something that maybe hurt a little bit, so let's do it on your BOMs so you feel closer to what we're doing."

Typically, you get the "wow" effect when somebody says, "Before, that took me an hour. You just did it in five to 10 minutes." Now you have their attention, and especially the boss's.

They see that it's not just an incremental benefit, but a real benefit. Now, they're more willing to invest time, money, and resources into implementing this program. The ROI is taking what was a half-day to get done into just a couple hours or even a few minutes.

Matties: I think there are also some soft benefits from utilizing a tool, such as increasing the number of sales that you actually close.

Decker-Weiss: Exactly. We start with the hard benefit and then we move on to exactly that, the mistakes in the quotes, which costs you so much or as you said, how often you tell a company owner, "How often did you hear a call something along the lines of, 'Hey, that was a great quote, but unfortunately it took too long. We already gave the order to somebody else.'"

Matties: And it may also help a company determine if it's the right work for their factory.

Decker-Weiss: Exactly.

Matties: This is kind of a sales conversation where you're talking about workflow shift; the methodology and the way people function is what you're selling. The tool is the tool, but you have to convince them to change their workflow.

Decker-Weiss: I hear more frequently from C-level that we cannot just continue the way we've been doing now. We have to make a change here.

Matties: Where do you rank in the priority of decisions and process change for companies?

Decker-Weiss: ERP is the hungry lion that seems to get almost all the resources sucked into it, so we're somewhere behind the ERP system. That is pretty high up. For an EMS company, there's almost nothing more important than getting quotes out quickly, because that really affects their bottom line. We also go in with products and we say, "We can make your SMD programming 30% to 40% faster. They say, "That's nice, but you don't get near the same kind of excitement from C-level." Then you say, "We can get your quotes out quicker, which means it's going to mean more business to you." In that sense, we rank pretty high.

Matties: Your tagline might be, "We help you close sales."

Decker-Weiss: Exactly. Pretty much every demo has somebody from the sales team in it. They really want to know that this is going to improve.

Johnson: Streamlining the sales process can increase your system uptime on the shop floor by a significant amount.

Matties: As well as your bottom line, especially if you're taking into consideration the link into the ERP and current stock availability balanced with current pricing. That equation alone can bring additional profit to a job. This has been a great conversation. Do you have any final thoughts?

Decker-Weiss: Anything that raises awareness and helps companies realize, "Hey, there are better ways to do this." As Mark said, people ask, "Who's your biggest competitor?" and I say, "The biggest competitor is the statement: 'That's the way we've always done it.'" There's no argument to that; that pretty much cuts off all further discussion. There really is no room for that statement anymore.

Johnson: Gentlemen, thank you! SMT007

Kevin Decker-Weiss is sales director of CircuitByte.

Mark Laing is business development manager at Siemens Digital Industries Software.

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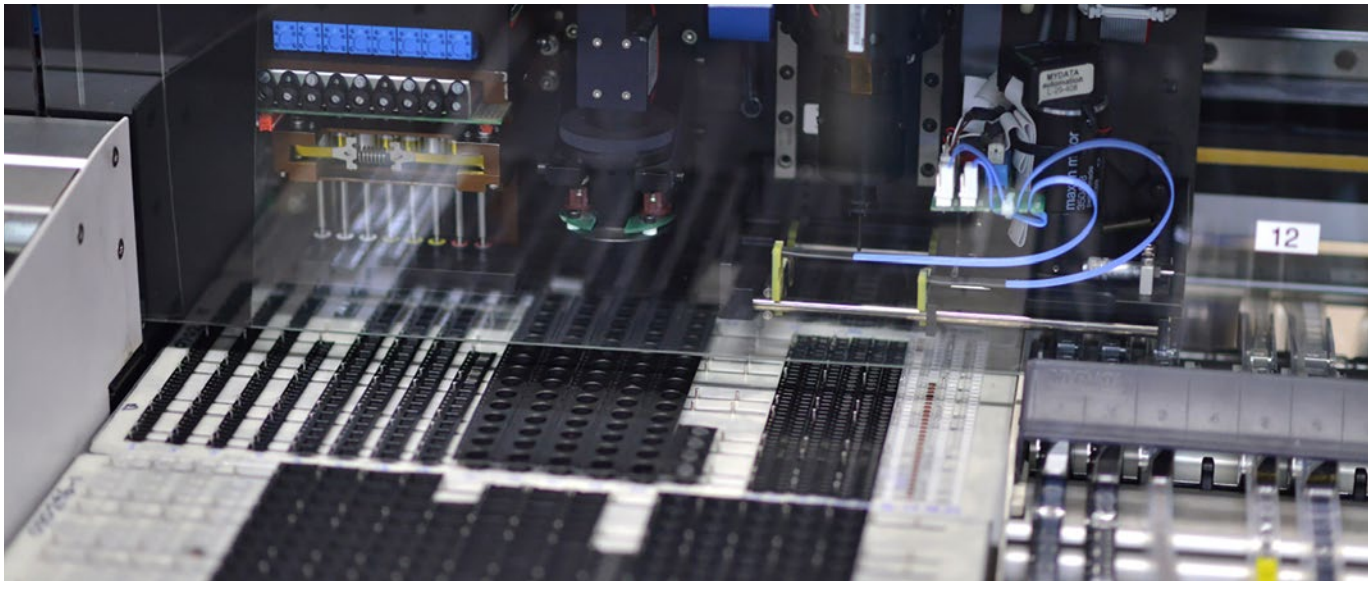

BOMs and the Supply Chain
From an Assembler's Point of View

Feature Interview by Nolan Johnson
I-CONNECT007

Duane Benson of Screaming Circuits speaks with Nolan Johnson about issues assemblers encounter with BOMs and part shortages; Duane gives advice on how to avoid some common pitfalls.

Nolan Johnson: Duane, in early 2020, we were covering some short-term supply chain issues and parts procurement challenges in the magazines. Just as that seemed to wrap up, we had the disruptions of the COVID pandemic, and the supply chain issues associated with that. Now, even with semiconductor companies putting out more product, the demand is even higher. Companies are putting tens of billions of dollars into building out new production, and word is we're looking at parts availability challenges at least two years out.

Additionally, there's all the "regular stuff" like having key components on your production boards go end-of-life so that you need to look at replacements to keep moving things forward. How does a design team cope? How does a design team work well with their assembler to have that communication, and that give and take through the process?

Duane Benson: Communication really is the key. The challenge is very similar to what we saw in 2018, although I think this may even be more extreme. In 2018, things would change on a moment-by-moment basis. If we learned anything from that, it's the ability to adapt to change.

Let's just start with putting together a prototype. As you build it out, you're spec'ing components, filling out your bill of material, and then you build the prototype. You send in your bill of material and your design files for a quote, and you find out that of the 75 parts on your bill of material, 25 of them don't exist, and another 10 or 15 of them are on a 24-month lead time.

Fortunately, a good portion of the unavailable components have alternates. You just have to act and communicate quickly. First, before you send the bill of material in, you double-check. Don't assume that something that was

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in stock a month ago, or even a couple of weeks ago, is still in stock. For passive components, you should find alternates ahead of time. Someone will send us a bill of material, the component is out of stock, they send us an alternate, we double-check on that, get an approval to purchase it, go back to the vendor and it's out of stock. This happened in 2018, and we see the cycle again this year. It can happen two or three times in a row—if we have to go back and forth repeatedly, each cycle has us requoting it, getting approval, ordering it, and a potential for that part to go out of stock. Whoever you're working with as an assembler, get some alternatives ready so that you can stop that cycle.

Duane Benson

Also, be on top of your communication. If an engineer sends us a design on Thursday, we send it back on Friday and tell them, "These parts are out of stock. Can you give us some alternates?" Then they send us some alternates. By Friday afternoon, we can quote, determine they're in stock and order right then. But when they don't get back to us with approval until Monday, those parts could be out of stock already. So, be willing and able to communicate at a moment's notice.

Johnson: There's this dynamic that feels like you're dealing with agricultural futures pricing—pork bellies or something.

Benson: Some brokers are buying out popular inventory; things that would have cost 30 cents, now they're saying, "You can buy a hundred of them for five bucks each." They're playing that game. And then they're bidding them: "Oh, you'll pay five bucks? That other assembly house or that other manufacturer, they'll give me $6.50 for them. How desperate are you?" Speculation, I think, has become an unwelcome part of the economy, whether we like it or not. Demand-based pricing has its place, but when it's minute by minute and it becomes exploitation, that's not good capitalism.

Johnson: It sounds like having alternates is a good business practice for the design team even as they're preparing to go into prototype? Or should they wait until they're prepping for manufacture?

Benson: It goes from prototype into manufacturing. When you're going into volume manufacturing, say you need 150,000 of a particular resistor, and the manufacturer can buy all those reels for the first three months. But for the next three months, that part is gone, and it's a 24-month lead time. In this case, have a couple of alternatives and unfortunately be willing to commit for longer-term inventory.

The car manufacturers are getting hammered right now, partly due to the great number of electronics components in the cars, but also due to just-in-time (JIT) inventory. That was really the savior of manufacturing back in the '80s and '90s with everybody converting to just-in-time. It cut costs down and minimized waste. JIT may not be the best strategy for the next year or so. Just don't go crazy and buy up everything like the car manufacturers did in 2018.

The other thing is to go for the smaller component sizes. If a fab company is trying to spin back up and they have a choice of making a bunch of 0402 or 0201 components on a wafer vs. 0603s or 0805s, which require considerably more material for the same spec component, what are they going to do? The finished components cost about the same. They're going to go for the smaller sizes because you get significantly more per unit of raw material. So, designers who have not yet bridged that gap to the smaller components need to do so because that's where the supply is going to be—smaller

and smaller. And it doesn't matter whether it's passives or chips.

Say you're a chip manufacturer and you've got your wafer level chip scale packages, which is just the silicon with some bumps on it, tiny little thing, or you can have a big old SOIC that requires a lead frame, plastic, glues, all these other materials. Which one is it going to make sense to build when you're opening your capacity back up again? If you don't need that big old package, go for the smaller parts.

Johnson: Great advice. Now, who oversees this? You're promoting the idea that alternatives are necessary in the bill of materials to ensure resiliency and steady production; I get this. But who puts this resilient BOM together?

Benson: In the prototype world, it's often up to the design engineers themselves. In the volume manufacturing world, especially with the larger organizations, it is more likely to be supply chain folks. And those supply chain folks are supposed to be talking with our supply chain folks to make sure there are alternates and that they do buy ahead. What often happens is suddenly these people who were used to placing a couple of orders here and there, a couple of emails back and forth, they might have one or two BOM issues to deal with, suddenly now they've got hundreds of BOM issues to deal with. They've got suppliers that are calling them up constantly saying, "This, this, and this is out of stock." Now, their workloads have gone through the roof.

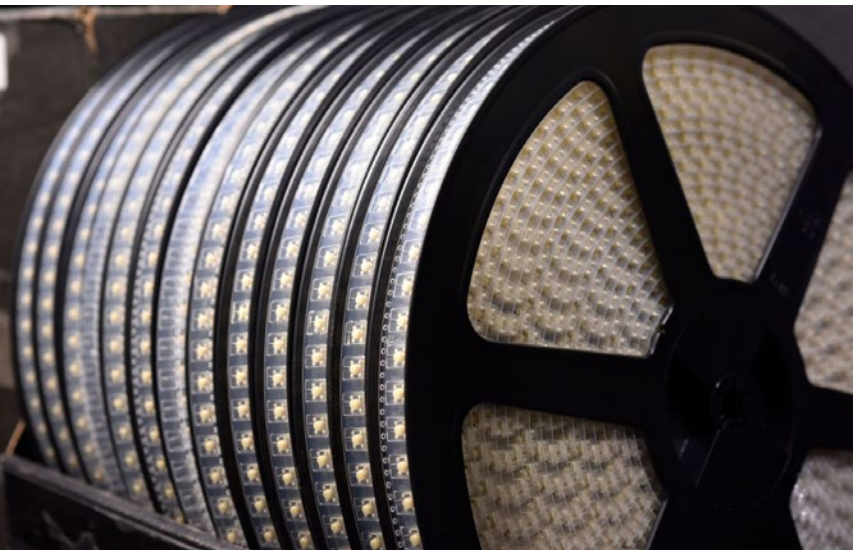
It just compounds the problem because it requires a lot of time and effort, and the people who do that work are just being hammered with additional workload. We see it ourselves here. We've had to staff up in our purchasing department with our buyers and everything because their workload has just gone absolutely crazy.

Johnson: This sounds unsustainable; back to the whole idea that this feels like it's a commodities market. This is a situation screaming for a live update tool.

Benson: Some people have tried. And I'm not going to name any names, but if you look at the live update tools or the things that are close to live update tools, they're not built for this either. Nobody's inventory is even up to date. You go to the online tool, and it says they've got 50,000 of these. Awesome. I need 20,000, so let me place an order. "Oh, no, sorry. We sold all those yesterday." Or they sold all those an hour ago or 10 minutes ago. A real-time tool that went from the manufacturer to the distributor, to us, to the engineer, to the purchasing folks at the OEM company would be really nice, but yesterday's definition of "real time" is not good enough right now.

Johnson: And of course, with that kind of workload in procurement, some of that will get pushed back onto the engineers. The bill of materials, from a designer perspective, is onerous. In their eyes, filling out an Excel spreadsheet with 16-character part number strings for all 250 components—this is not what an engineer wants to do. It looks like it's going to get even worse because there isn't enough bandwidth on the teams to keep all the bills of material up to date as quickly as the market is changing. That puts a lot of burden on the assembler.

Benson: Here's where this becomes cyclical. When supply is generous and manufacturers must be more creative, the original component manufacturers must be more creative to get people to buy their parts, so they fractionalize their product lines: "We've got a 5%, we've got a 10% and a 20%. How about a 2.5%? How about a 2% or 2.7%? How about a 2.85%? They fractionalize it because they've got to do something to stand out and to talk directly to people who need something exact. The microcontroller—the silicon people—do the same thing. I know one particular chip that you can buy with 256 bytes, 512 bytes, 16K, 32K, 64K,



Reels of parts.

128K, all these different variations, and then that gets people dependent upon those different variations. That's part of what we're going through right now that makes substitution so difficult. That's when you start to see the manufacturers consolidate.

In 2018, there were a couple of passive manufacturers who said they were doing away with all their big sizes. I don't know if they ever did, but that will happen. Components will consolidate. You've got fewer to choose from and fewer variations, fewer part numbers, and the fab lines are turning out a smaller number of components. That starts to mitigate the situation a little bit. I suspect that's going to happen again. It seems like the end of the world, but I remember when that happened in 2018 and our component suppliers were saying, "I've never seen it like this in my 20 years of business," "This is worse than it's ever been," and, "This could be a four-year problem." It's awful when you're in the middle of it.

But engineers adjust. These engineers who are having such a terrible time spec'ing this stuff are smart. They engineer things. They'll engineer a process. The engineer that gets burned by one particular component manufacturer isn't going to use them anymore. My suspicion is that by early 2022, we'll be in a lot more sustainable situation.

Johnson: Maybe just in time isn't the most effective strategy for this part of your process?

Benson: We have a globally intertwined economy. Personally, I don't think that's a bad thing. I think the more interdependent we all are on each other, the better off we all are in the long run. But it can lead to problems. Interdependent should not equal "sole source" from one manufacturer or from one region.

This interdependence transcends industries too. I don't know how many people know that electronics manufacturing and passenger air travel are tightly linked. Before the pandemic hit, much of the fast response component orders piggybacked on commercial passenger flights. You might think a flight from Hong Kong to the western U.S. would be jam-packed full of people. Quite often they're not, because they need the extra weight capacity for fuel and cargo. Well, when passenger flights are 80% down, all those orders must go someplace else. They go into shipping containers. Guess what? There aren't enough shipping containers. Guess what? They can't build more shipping containers because steel is in short supply. Why? Because the steel manufacturers were hit hard by COVID. Guess what? There isn't enough port capacity to load and unload these things to free up the shipping containers. That's the price you sometimes pay for a globally interconnected economy.

Johnson: A situation like this usually triggers some sort of innovation.

Benson: There are a couple things that I would really love to see from the silicon vendors, especially the microcontroller folks I mentioned. As most engineers know, you get one part and there are two, four, six, eight, a dozen parts in that product line. If you need the 16K version, a 32K will work perfectly fine, except that the configurations are different; you can't just swap

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them in on a manufacturing line. If I need the 128K part, I set the configurations for that, but then none of the smaller versions work. However, if I need the 32K bit part, and I set the configuration bits for 32K, the 64K, the 128K, anything more capable should drop right in without any software changes—but they don't. You know how much heartache that would solve? Yet every single one of those microcontrollers can't mix and match on the line because they all must have those configuration bits set separately. Fix that problem. I beg you.

Johnson: A big part of being able to design for manufacturability is extracting logic and reason out of the manufacturer's chip catalog.

Benson: Even when we're in a normal supply chain situation, I've run across that. Sometimes I design the little electronic handouts that we give out at trade shows, and I run into that exact situation. I need the 16K; they were fine for prototypes, but now when I want to build 600 of them, they're out of stock. Well, what about the 32K? Can't mix and match.

Johnson: That's an interesting point. Design for manufacturability discussions often stop by concluding the designer didn't get it right. When the designer may be working with component supply issues that they just can't work out.

Benson: The other issue is with passives. I like to say there are engineered passives and there are passives that are just picked. I need some bypass capacitors. Okay, 0.01 microfarad 16 volt, whatever. Just give me some. Well, going to the assembly house, we don't know when something is picked or engineered. That's why we can't just say 0.01 microfarad 16 volt, there you go. We can't say that because we don't know if that's an engineered or a picked component. And if the industry could come up with a way of specifying that such that we know, that solves another headache, because the engineer is saying, "It's a bypass capacitor, it doesn't matter. Just pick one." Yet the engineer in the next cube over is saying, "Because of the particular frequency spectrum, the operations of my board, you had better pick the exact bypass capacitor that I specified, or this thing isn't going to work."

Johnson: And yet, that same designer, that same engineer, on a different project, could see that bypass capacitor as critical. It's application specific. If a design team goes just a little bit further along to specify which ones are engineered in and which ones are easily swappable, that eases the assembler's complexity. That makes it more manageable list, doesn't it?

Parts in feeders.

Benson: It really does.

Johnson: As an assembler, do you have an ideal for the bill of material specification you are sent? Is there a set of column headings that are just your department's dream for what a bill of materials will contain so that you can do your job as effectively as possible?

Benson: Format used to be a big issue, but it's not so much anymore. The com-

ponent vendors have better automated tools, but if we've got manufacturer and manufacturer's part number, it's much, much easier for us just to work that way. We can program our machines with just that much information. The alternates, you want them on the same line as the primary, except off to the right. That's something that would be helpful, but that's not really standard. Sometimes people put them one above each other in the spreadsheet, and then we must sort through and pick the information out. But putting them to the right, that's a standard we would like to see. And make sure you put in every single character in that part number.

The prefixes and suffixes mean something. Sometimes it just means the difference between a reel and a tube, but sometimes it's the ISR or the ESR, temperature range, you never know. So put every single character there. LEDs are infamous for having one character in a suffix indicating something unique, like a reversed polarity—the polarity markings on the diode point to the cathode; a different suffix, the markings on the diode point to the anode. It's the same part, but they went through the marking machine backward or something. Red to green LEDs are famous for that, but I've seen it on green to green or red to red LEDs, especially in the 0402s. I think the manufacturers of the LEDs sometimes put the parts in the reel backward or something for the polarity mark printing. Every single character is significant.

Johnson: They just turned a bug into a feature?

Benson: Exactly. And sometimes the only difference is a single character in that part number.

Johnson: Is there something that the CAD tool vendors can do?

Parts loaded into pick-and-place carts.

Benson: Yes. Move forward. Continue to move forward on the intelligent CAD data. I think that's where we could benefit from better bill of materials management. Some of the CAD tools do a really nice job of bill of materials management, some not so much. There are different standards in the intelligent CAD data, but most of our customer engineers are still using spreadsheets. And to me, that means there's improvement to be had in CAD tool bill of materials management. Work on that and work on making sure your footprints are right, have ways of validating that, making sure your data has rotation, and more in it. Manufacturing is really complicated. The clearer the picture that we get from the data provided, the easier it is for everybody involved and the less error-prone the system will be.

Johnson: Some good food for thought, and insight, Duane.

Benson: I think so too. I appreciate the opportunity to talk with you. **SMT007**

Duane Benson is director of marketing for Milkwaukee Electronics, Screaming Circuits and San Diego PCB Design. He is also an I-Connect007 columnist. To read past columns or contact Benson, click here.

Reducing the Cost of Solder Alloys Used in Wave and Selective Soldering Assembly Applications

Article by Mitch Holtzer
MACDERMID ALPHA ELECTRONICS SOLUTIONS

The continued devaluation of the U.S. dollar and the industrial supply-demand balance between silver has increased the price of silver used in solder alloys. MacDermid Alpha Electronics Solutions has developed a number of low- and no-silver solder alloys to offset this continued trend in the increase in global silver cost. These alloys are appropriate for most applications, but not all. This article will describe the reliability, soldering performance potential of low- and no-solder alloys on different assemblies, and quantify the cost savings associated with using lower silver-bearing alloys.

As Figure 1 shows, the price of silver has doubled over the past year. MacDermid Alpha Electronics Solutions has a strict policy to never speculate on the future prices of tin, silver, or copper used to make lead-free alloys, but the current trend of the U.S. government to stimulate the economy by using deficit spending has caused economists to predict increased inflation and a reduction in the value of the U.S. dollar.

Silver traded on the London Metals Exchange (LME) and the New York Commodities Exchange (COMEX) is denominated in U.S. dollars. Any reduction in the value of the U.S. dollar generally increases the cost of metals trading on these exchanges.

However, using lower silver-bearing lead-free alloys should continue to be a lower cost alternative for circuit board assemblers who require a lead-free process. Silver constitutes 44% of the cost of metals used to create the most common lead-free alloy, SAC 305, as of

Figure 1: Looking at the price of silver. (Courtesy of Kitco.com)


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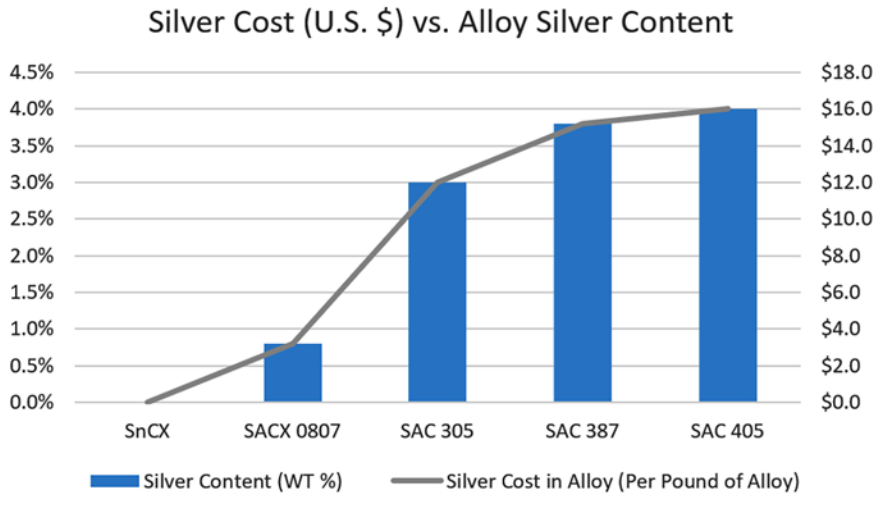

Figure 2: Silver contribution to alloy cost (silver at $28/troy ounce).

June. That cost can be eliminated by using a silver-free SnCX Plus alloy (an advanced SnCu0.7 alloy) or reduced by 26% using a SACX Plus 0807 alloy (Figure 2).

Silver in lead-free solder has proven to enhance thermal cycling performance in demanding applications such as under-the-hood automotive assemblies (-40°C to 140°C THC), but typical consumer assemblies used in white goods, hand-held, remote control, and in-home audio-visual devices do not require the same thermal cycling resistance (0°C to 100°C). Low/no-silver soldering alloys are perfectly acceptable in these applications. In fact, data shows that reduced silver content increases the drop shock resistance of these devices [1].

Additional value from the low/no-silver alloys includes lower dross generation, particularly in wave soldering processing (scrap required to be recycled), and longer process life through reduced copper dissolution from OSP-finished substrates.

This article will detail previous findings in wave soldering barrel fill, copper dissolution rates, dross generation, and as shown in Figure 2, the lower cost of metals in a way to inform users of bar solder to exploit the cost savings opportunity of using SACX Plus 0807 (0.8% Ag) or SnCX Plus (no intentional added Ag) in their wave or selective soldering process.

Barrel Fill

Primary attach barrel fill results, using SACX0807 alloy to assemble PTH connectors onto a 20-layer, 120-mil thick test vehicle were comparable to those test vehicles assembled using SAC305 with yield levels of 99.7% on standard designed connectors (Figure 3).

Copper Dissolution

When molten lead-free solder is in contact with copper plating, it results in copper dissolution. This is particularly an issue with lead-free alloys due to the high tin content and lead-

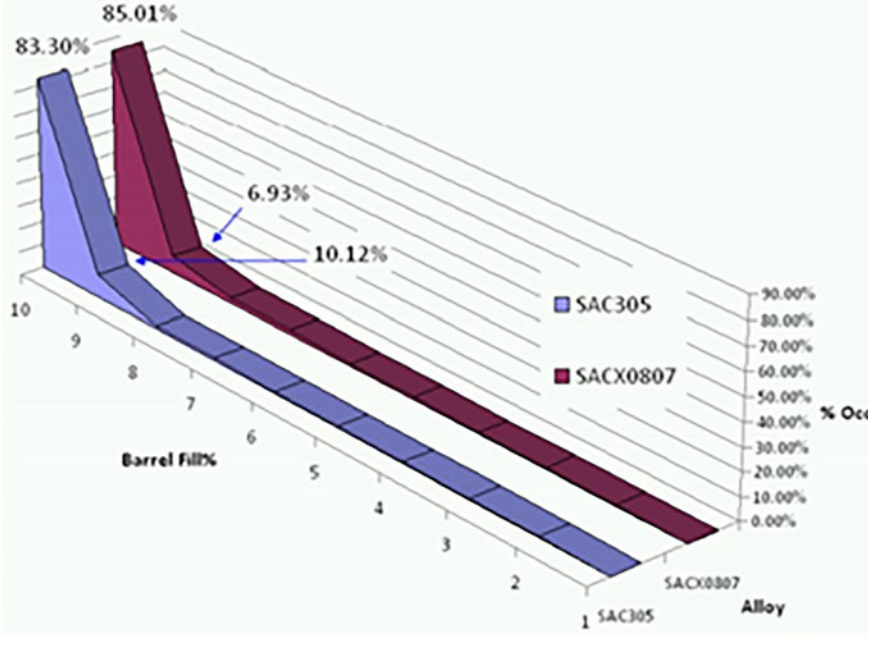

Figure 3: Barrel fill vs. alloy. (Courtesy of Craig Hamilton, P.Eng., PMP, Black Belt, Process Engineering Consultant, Celestica)

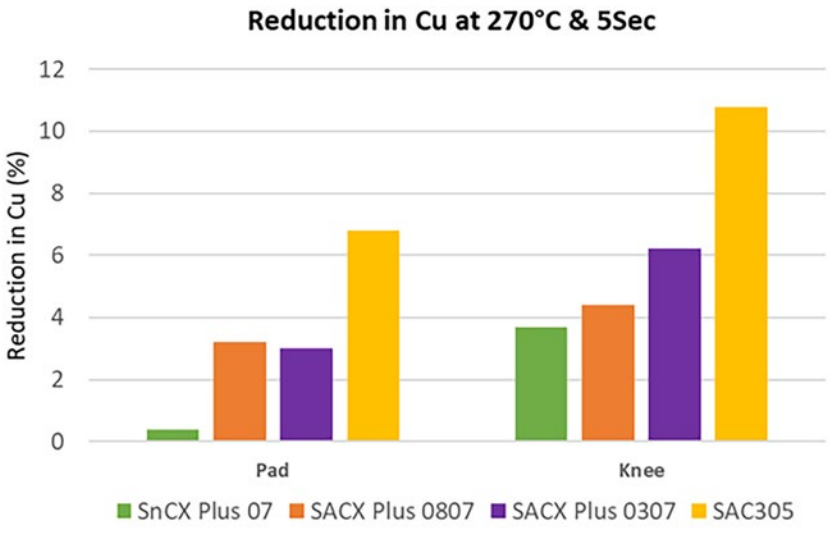

Figure 4: Copper dissolution vs. lead free alloys.

free soldering temperatures. The fastest rate of dissolution occurs at the knee of a plated through-hole joint.

To evaluate the copper dissolution, average measurements from multiple pins on multiple boards assembled under the nominal condition of 270°C, five seconds have been used (Figure 4). Measurements from the pad and knee are shown here. It is evident from the figure that SACX Plus and SnCX Plus alloys result in reduced levels of copper dissolution vs. SAC 305. There is a clear trend showing that higher silver results in faster copper dissolution, especially at the knee of the PTH joint (Figure 5).

Dross Formation

Several studies conducted by Alpha have confirmed that the rate of dross generation is reduced as the content of silver is reduced from wave soldering bar solder. Although SAC dross can be recycled, there is a cost of recycling to the circuit assembler. Dross for recycling requires processing of metal oxides to the base metal, so the selling price is approximately 50% of the LME price of the metals when the dross is sold for recycling.

Again, metals prices fluctuate, but as dross is removed from a wave soldering pot, it must be replaced with new bar solder. The cost of the new solder is at least two times the selling price of the dross, so obviously reducing dross generation reduces the total cost of ownership of the solder used in a PTH process (Figure 6).

The processing variables used were pot temperatures of 240, 255, 270, 285 and 300°C, and contact times of three, five, and seven seconds. Thermocouples were placed in predetermined locations to ascertain the temperature on the test vehicles.

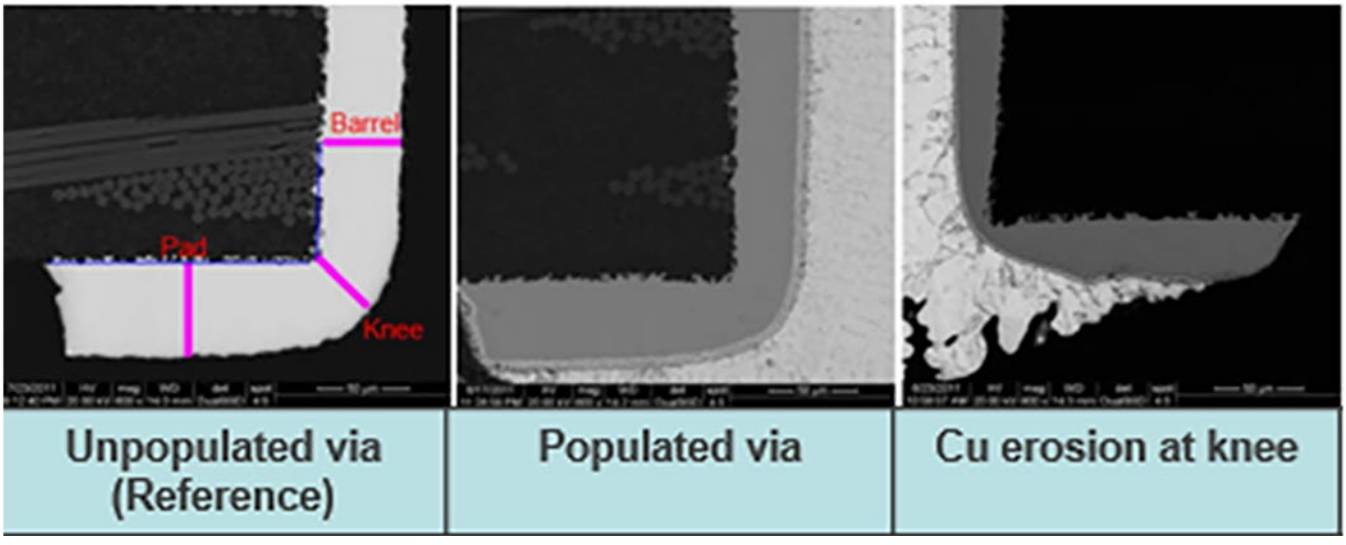

Figure 5: Copper dissolution at the knee of plated through-hole joints.

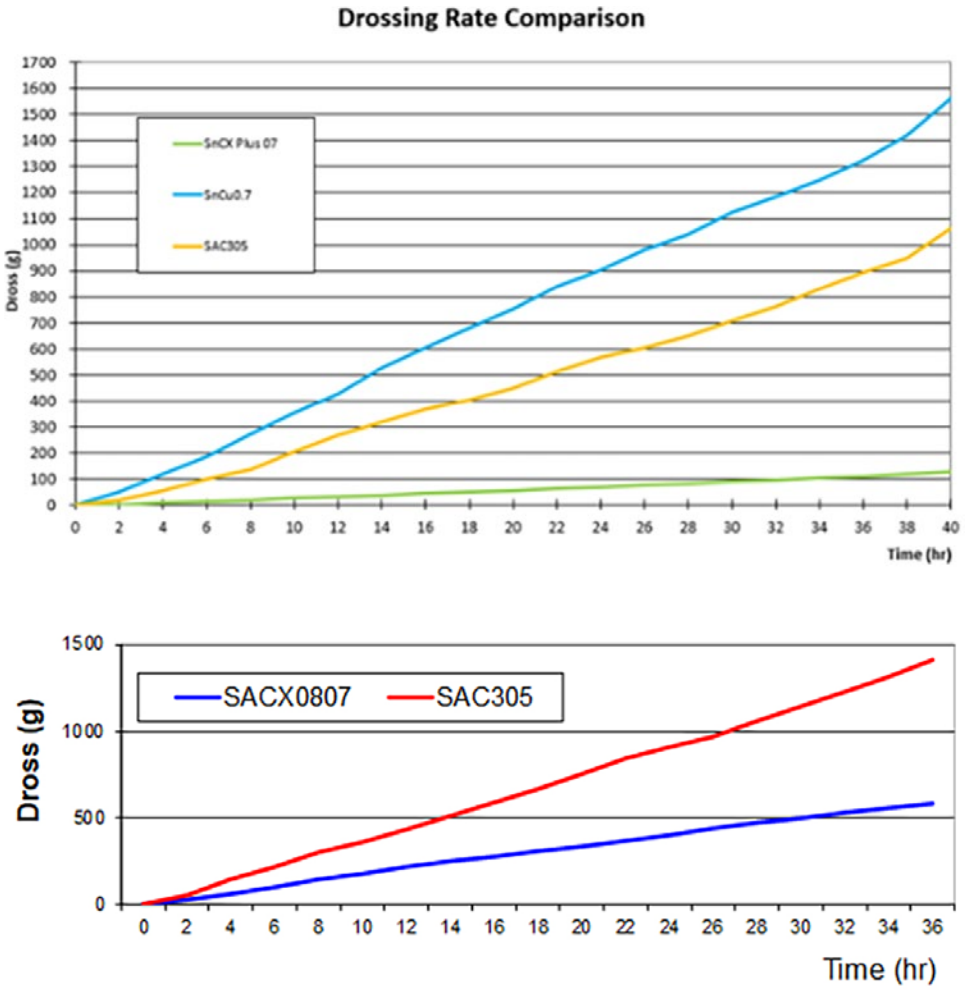

Figure 6: Dross generation as a function of (top) time, and (bottom) alloy.

This data was confirmed by a large consumer electronics manufacturer who converted their wave soldering alloy from SAC 305 to SACX Plus 0807 and SnCX Plus 07. They reported a 50% reduction in dross generation.

Conclusions

Primary attach barrel fill results, using SACX Plus 0807 alloy to assemble PTH connectors onto a 20-layer, 120-mil thick test vehicle, were comparable to those test vehicles assembled using SAC305, with yield levels of 99.7% on standard designed connectors. This soldering performance enables SACX Plus 0807 to make good barrel fill according to Class 3 hole-fill requirements with board thickness at 120 mil or more under suitable soldering process parameters. SnCX Plus's Class 2-hole fill requirements should be attainable for PCBs up to 2.4 mm thick, with five to seven seconds contact time.

Low/no silver alloys significantly reduce the copper dissolution into wave and selective soldering baths, reducing the frequency of solder bath maintenance or replacement.

Reducing the rate of dross creation also lowers the volume of solder purchased, reducing the cost of ownership.

Most importantly, reducing the percent of silver in the alloy used, significantly reduces the cost of solder purchases. **SMT007**

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Mitch Holtzer is technical knowledge leader, global R&D, MacDermid Alpha Electronics Solutions.

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Electronics Industry News and Market Highlights

Coalition Calls on Congress to Invest in Domestic Semiconductor Manufacturing, Research, Design ▸

The Semiconductor Industry Association (SIA)—along with a broad coalition of 19 other tech, auto, medical, defense, and other business and labor groups—in a letter urged Congress to enact funding for the semiconductor manufacturing, research, and design initiatives authorized in the "Creating Helpful Incentives for the Production of Semiconductors" (CHIPS) for America Act.

Survey: Companies Lagging the Industry in Digital Transformation ▸

Almost half of the respondents, around 46.6%, believed that their own companies fell behind the industry average when it comes to utilizing digital tools as part of business processes, according to a survey conducted by AIBP and Oracle from March to April.

Inseego Unveils the Ultimate 5G Industrial Gateway ▸

Inseego Corp., a leader in 5G device-to-cloud solutions, introduced its Wavemaker PRO 2000e industrial gateway. Combining high-performance 5G with the most advanced 4G LTE capabilities, this solution delivers best-in-class throughput and reliability for industrial IoT and enterprise networks.

InSight Mission Unveils Interior of Mars ▸

The interior of Mars has for the first time been revealed using the seismometers carried on NASA's InSight mission to Mars. In a series of articles published in Science, researchers use the seismic measurements from the SEIS instruments aboard the InSight lander to derive the interior structure of the planet as well as giving clues to its early evolution.

LPKF Laser Technology Ushers in New Era in the Medical Implant Industry ▸

More than 60,000 cochlear implants are sold annually, but at least 60,000 babies are born with hearing loss in India and China alone. TODOC, a South Korean startup, was founded to address this global shortage of cochlear implants by developing manufacturable cochlear electrode arrays using an ultrashort-pulse laser system, the LPKF Proto-Laser R.

Lenovo Research: Three Steps Businesses Can Take to Innovate Beyond Boundaries ▸

Lenovo Group launches Beyond Boundaries, a new report on the state of business innovation today. The study examines how businesses are innovating their way into the post-COVID future, not just to satisfy pent-up demand and unlock growth, but also to improve their social and environmental performance.

Synthesis AI Unveils Enhanced Synthetic Data Capabilities ▸

Synthesis AI, a pioneer in synthetic data technologies, announced enhanced capabilities to simulate driver behavior in the car cabin environment to ensure automobile and autonomous vehicle (AV) manufacturers have access to high-quality, perfectly labeled training data to build driver safety systems.


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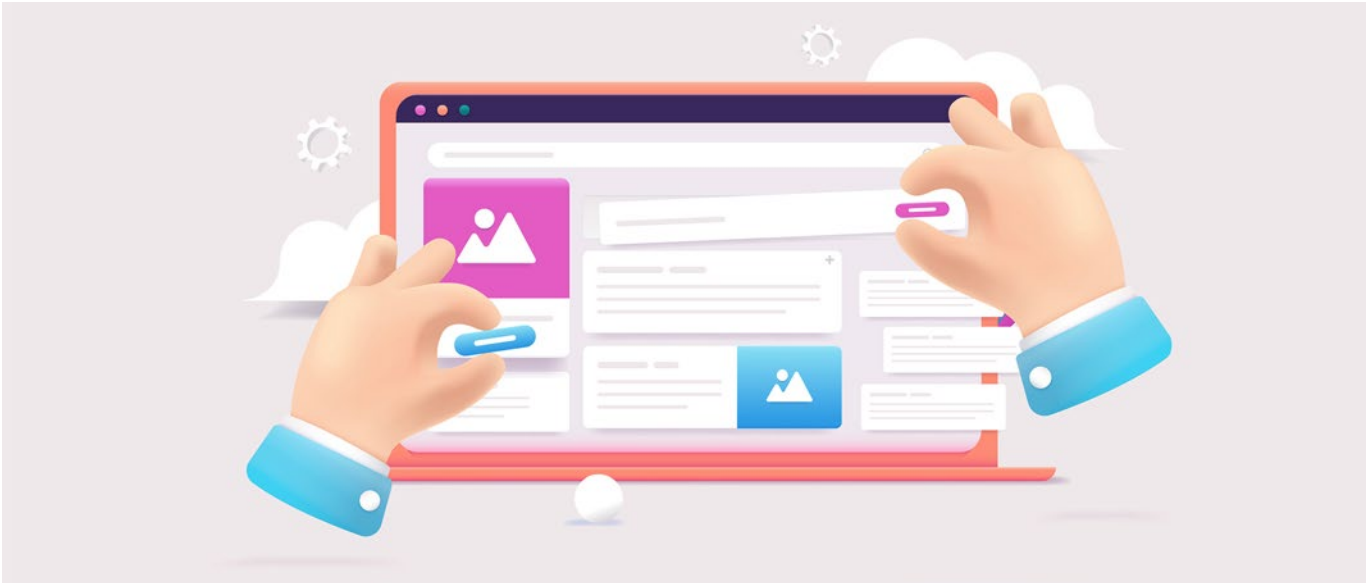

Luminovo Cuts BOM Waste, Improves OEM/EMS Communication

Feature Interview by the I-Connect007 Editorial Team

Luminovo founder Sebastian Schaal says his company is using its experience as an AI provider to help implement LumiQuote, a new EMS RFQ software tool. Sebastian explains how LumiQuote helps cut down the waste in the BOM process and friction between OEM and EMS providers, and gives designers the EMS data they need earlier in the design process so they can make more informed decisions.

Barry Matties: Sebastian, tell us about your company. What is your mission?

Sebastian Schaal: The mission at Luminovo is to rethink how printed circuit boards and electronic products are brought to life, from being an idea to reaching the market-readiness stage. Our approach to this is building software that makes these processes faster, cheaper, and more effective. More specifically, we are concentrating on the processes between PCB designers and EMS providers, shifting the skewed knowledge distribution and preventing the costly decisions that are made at the various stages based on missing information.

Taking a step back, the biggest issue we see with the current product design processes is an asymmetry of knowledge in the value chain. Looking at typically occurring downstream design implications, the PCB designers only have about 20% of the knowledge when it comes to the actual manufacturing, while they are responsible for 70% of the costs. Most of the knowledge is usually held by the EMS providers, where it is stuck in disconnected legacy tools and manual workflows. This brings us to our solution to build a tool that supports EMS providers in digitizing their workflows today, so that we can encapsulate and distribute that knowledge along the value chain and ultimately make it accessible for designers at the point when they make these potentially costly downstream decisions.

Based on this thinking, we have developed our first product over the past year and recently launched it for selected customers. Our RFQ

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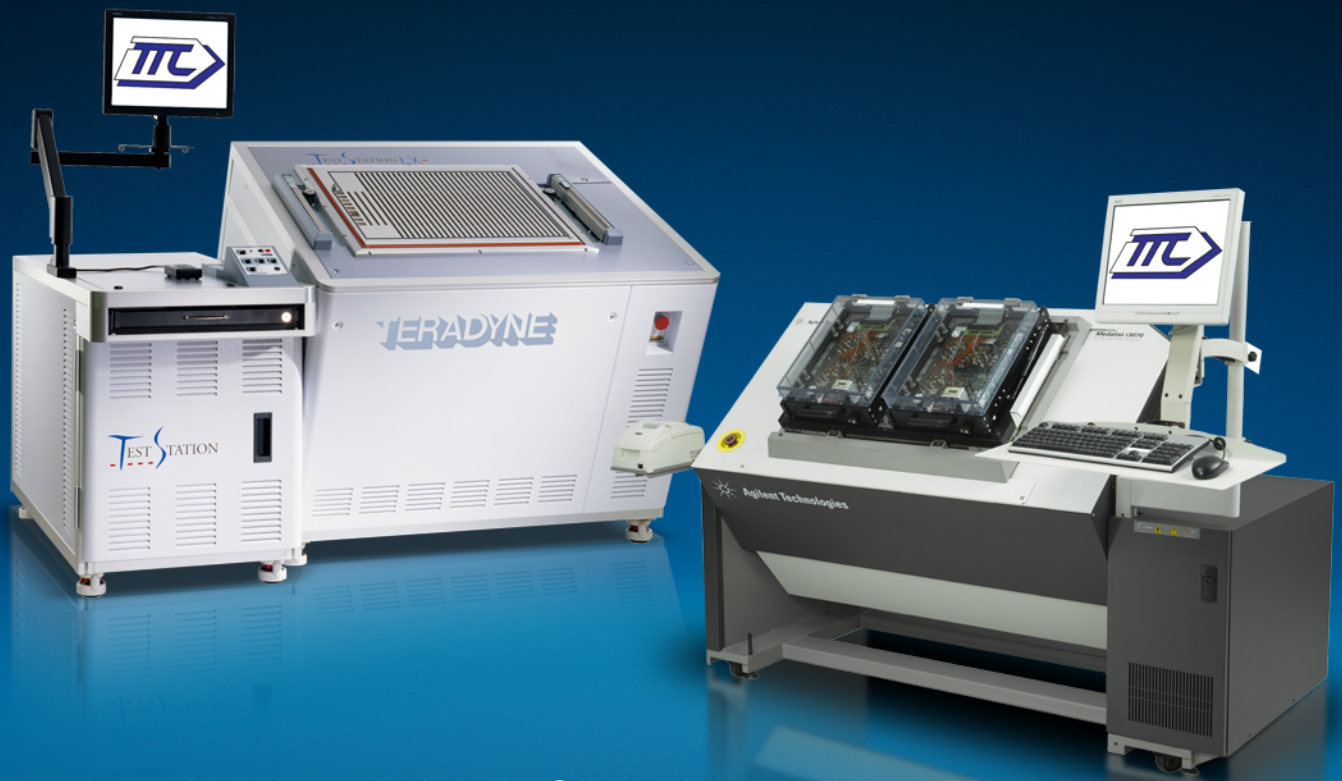

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software, LumiQuote, digitizes and automates the quoting processes for EMS companies. It reduces the friction at the intersection between OEMs and EMS providers that currently exists because of lengthy traditional workflows, and paves the way to smart data usage and decision-making in the future.

As humans, we can learn new skills in a linear fashion when it comes to a broad range of tasks. But technology grows exponentially. Because work is highly divided in our current society and professional skills are highly specialized, we experience a specialist shortage in many niche areas these days. But if we want to stay on top of that exponential growth curve and use tech to its fullest potential, we need those very few experts in their respective niche areas to build software that's usable by the bigger mass.

As humans, we can learn new skills in a linear fashion when it comes to a broad range of tasks. But technology grows exponentially.

What we see happening to hardware production processes now is the same trend that we've been seeing in software development with the low-code/no-code development. Many expert software developers are building abstraction layers to enable different groups of people—for example, people who are experts in the business context of an application itself—to do more of the technical work, so they can keep up with a huge demand for new products. I think that is exactly what is going to spill over to the electronics industry as well and it is our vision to build this fundamental data and software layer called the Electronics Operating System.

Matties: Tell us how your tools work and who buys them.

Schaal: Our current tool is mainly for EMS companies, allowing them to deliver accurate quotations to their customers at unparalleled speed. But we want to go beyond only automating quoting workflows. Our thinking is, "There is so much knowledge in the EMS industry that sits in data silos, Excel sheets, and heads of experts. How can we condense this into software to make it widely accessible?" In other words, "How can we slowly build up a resident engineer for everyone so that we get the full knowledge, not just for the very big projects, but for every single project involved?"

Currently, we are mainly selling to high-mix, low-volume EMS companies, primarily in Europe. We started in the DACH, beginning with some smaller companies with a few million dollars in revenue, and are now up to the larger EMS companies in Europe.

We have our roadmap and know exactly what we have to build, so to prepare for a wider expansion, we are now fully focused on our product maturity. Besides varying in size and location, we also sell different "packages." Some of our customers are simply licensing the current state of our product, while others are development partners in a joint mission we're working toward. They're already buying into this joint vision now, but the features that they need are not yet there.

Matties: So, this is not a circuit design or layout tool, right? You still need the designer to design a circuit board.

Schaal: Correct. Luminovo started out as an AI service company, so we were naturally attracted to investigate the design automation space. However, if you look at reinforcement learning, a style of machine learning, as a promising new approach for this, it always comes down to how good your reward function is. How well can you say what a good

design looks like, and what are the constraints and parameters? That's why we said, "If we ever want to go into that space, we have to do the 'unsexy' work first: digitizing and connecting all the parts of the supply chain, where important information is hidden that is needed in the design process." But it's basically "in the drawer," and we are focusing on this other part first.

Matties: Do you think this might evolve into an AI tool that will autoroute complex PCBs?

Schaal: The question is, really, what's the best way of delivering insight to a designer? We're focused on moving from EMS to OEM customers and tapping into the designer space. But I think the first step for us is not going to be building autorouting and autoplacing features. There are other functions that are low-hanging fruits and that can help folks avoid respins without automating all their work, by delivering information to the point where they need it.

In general, I'm a believer. Placement and routing are constraint optimization problems, a fairly complex one, and mathematically this is something that a tool can at least support you with. Maybe we will reach that point where we will have a "compiler for hardware" that brings your problem schematics all the way to the physical layout without you having to do a lot of double-checking. But until we reach that point where we have this "compiler status," we have a long way toward a design tool.

I see two trends. One, from the front end, is moving toward an easier schematic set-up, easier library management, and compiling this all into a physical design which can still be opened in one's design tools to do double-checking. The other one, from the backend, where one may still be working in a similar workflow with the same design tools but would be given a lot more insight. This would mean knowing that the work you do is meaningful and that you'll avoid respins.

Sebastian Schaal

Happy Holden: That's how we got into our automatic board design system at HP, the Board Construction Advisor, which was an automation of our DFM manual. This allowed us to set the goals for the design and the boundary conditions, and with our three-dimensional field solver, it would provide feedback on material stackup and geometries. But when they tested the software on new electrical engineers, there was a problem—it was great at giving answers, but they didn't know the questions.

HP Labs went back and said, "What we need is software that asks the questions that has 20 years of experience, like Happy's group, because we can hire electrical engineers out of college, but it takes a long time to grow experienced people." That's where self-learning artificial intelligence came in. The eight PhDs who developed this were from Carnegie Mellon and had a background in AI. As it designed each one of these boards, it learned the rules and techniques.

Schaal: Happy, this is something revolutionary you did, and you jumped right in and started with the "automation process" itself. For us, in our two years as an AI solutions company

where we built AI products, we learned that if you want to have a product that's infused with AI and derives value from it, first you must digitize a process, own the interfaces to the right stakeholders, and start collecting meaningful data. That's exactly why our product here is a workflow improvement automation tool that collects the right pieces of information and stores them, so you can derive value from it in the future.

For now, it's an RFQ tool for EMS with the most magic happening in the BOM importer and the automatic sourcing. As an EMS you can select BOMs of any file type and pull them into our tool without pre-formatting. Within seconds, LumiQuote extracts all relevant information and creates a neatly structured overview in a digital version. The person handling the BOM at the EMS can then check the identified information and manually edit details if necessary—for example, if we didn't find the part number (MPN) from an unknown manufacturer. Moving to sourcing, certain scenarios can be set, like "I want to have a prototype with 10 pieces, I want it as fast as possible, and I want it from only my preferred suppliers," and our tool automatically gets the different prices from all the different suppliers through connected databases.

Apart from that, we have the individual suppliers integrated for our customers and they get their specific custom prices directly in the tool. Potential issues with selected parts from certain suppliers, like long lead times or cheaper prices for larger quantities than selected, are marked in the sourcing overview. This way, time from manual work is saved and the focus can be put on these "critical" parts. If we didn't find anything, it's marked with no sources. At this point of the process that I just explained, they could basically just go back to the dashboard, hit export, and get a quoted BOM. Normally it takes them two weeks, but now they have all the prices and data within minutes. You can do your downstream process and, in the end, deliver a quotation to your customer.

In the manufacturing feature, we allow users to do a bottom-up calculation and to later compare it with actuals after production. With the blocks on manufacturing costs and material costs, we only need a flexible calculation module for you to be able to do a full end-to-end digital quote. That's where it starts to get interesting, because then you can give the EMS company this tool and OEMs can do sales quotes on their platform. OEMs can start uploading their BOMs, and we can start using these modules and bring them closer into the OEM workflow. But, for us, the process of developing and prioritizing features was guided by how we can get to market as quickly as possible, get customers, and get actual data.

Holden: Sebastian, how does this handle the bare PC board?

Schaal: That is something that you currently have to do with a manual quote, but we are co-developing with a German manufacturer to work with parametric quotes. We will have a Gerber extractor that delivers some parameters like the minimal trace width, the number of layers, etc. In addition, the user will have to enter extra information like the color of the PCB. If the PCB manufacturer has the necessary infrastructure, we can use this data to get you an instant quote or it will still be a manual quote, but the supplier will still get the extracted parameters. If we can get an API connection with the supplier, this is our preferred choice.

Matties: I imagine there are other software solutions doing a similar task on the market?

Schaal: There are products out there. For us, the unique idea is the connection and transfer of knowledge into the OEM space later on. It's this larger vision that we have. In other products, most of the stuff is built on legacy tech, so building a similar infrastructure like ours to turn data into insights is very hard for them.

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It's something that was not available, and so we had to build this ourselves.

Matties: The speed that you're gaining is really through the connection into the distributors and so on—having that instant access.

Schaal: Yes and no. The BOM processing is also a very cumbersome task where our software currently creates the most "magic moments." This is also where we could really apply our skills of language processing and data structuring most effectively. Unfortunately, there is a lot of chaos in the market's documents, but you can hit our tool with some random BOM, and we'll still make it work.

Matties: Your universal translator has some secret sauce there to bring in any format and put it into a useful table that you can then manipulate from there.

Schaal: I hope it can become an even more "secret sauce" in the future. When I studied in the Valley, you are normally told to only talk about the vision and then maybe a little how you can get there. Right now, I'm back in Germany, and I'm back to saying, "Hey, let's communicate what we have today and where we want to go tomorrow." We try to not BS our way into it but be very up front. That's how we're thinking about it.

Matties: What's the risk for somebody? If they're coming in, and they already have another tool, they're not likely to change, especially with a startup. But if there's not a tool in place, that's probably a prime prospect for you.

Schaal: As Clayton Christensen said, ideally, you are "competing against non-consumption." Our entry customers are the ones who are currently using Excel which allow us to set foot in the industry, collect real feedback and develop our product further, so we can ultimately win over the companies who are currently using a different tool just in our beachhead market. This RFQ and EMS space is our start. We built this in less than a year, where others have taken four years to get to this point.

Matties: One of the things that we constantly hear is that, again, the incoming BOM data is incomplete. Whoever is creating the quote is spending a lot of time going back and asking qualifying questions, and you can't get away from that.

Schaal: The final stage in our EMS product is what we call the OEM collaboration. For example, you have a webspace where you could log in and start inviting your customers. You can send them a log-in key, and they can start collaborating with you on the BOM in/out tool. Then in the beginning, what this does is just like parts approval workflows. Users would say, "I have this alternative part; can you give me the approval for that?" It then continues to the consignment of parts, which always happens, but ultimately, it includes all the collaboration or the communication that should happen—collaboration is one of the biggest issues. The designers often must talk to the procurement folks, and the procurement folks talk to the EMS folks. But in our tool, you can have a peer-to-peer connection. This is a very val-

ued function specifically during the current times of part and supply shortages. The fact that information on parts is changing daily increases the need for communication and alignments among all players of the value chain. LumiQuote replaces some of these phone calls by automatically updating availability of parts through the APIs with suppliers and thereby allows for earlier alignments on alternatives with clients.

We ultimately want to come to a place where the OEM, especially the designer, can do some self-quotes. Some custom prototype shops have tried this already, but it's still always decoupled from the actual series production. We want to have a space where the customer can upload their BOMs themselves, have first conversations and, where our system already talks to the customer, replace the first involvement from the EMS. In case of a lack of clarity in the data, for example, we know this is something that the OEM must give input on. They could click through it themselves and do a self-quote to save everyone some time. I think that's the end goal for this EMS product, where we're bending toward the OEM side. Now, with this stage, we're curing the symptoms. How can we make sure the disease never breaks out?

Matties: As you're talking, you're keying on exactly what my thought is. This tool ultimately resides with the EMS. They can sit there and do their own quote with this tool, answer all the questions, and then upload it to their preferred vendor. Is that how you see this ultimately working?

Schaal: That's the nail-biter. We don't want to be a marketplace where we say, "We are acting as a virtual EMS where you're just uploading this stuff, and we're just treating them as manufacturing sites." This is something we deliberately decided against. But of course, there's an opportunity for us to help the designer or the OEM in making a good selection of whom they should talk to, who's their perfect partner. Even if this quote engine has been shifted over to the OEM so that they can already assess a bit beforehand who they should talk to, maybe there's a way that we can bridge this gap and make sure that people spend time on value-adding things and not trying to cut the pie in pieces instead of enlarging it.

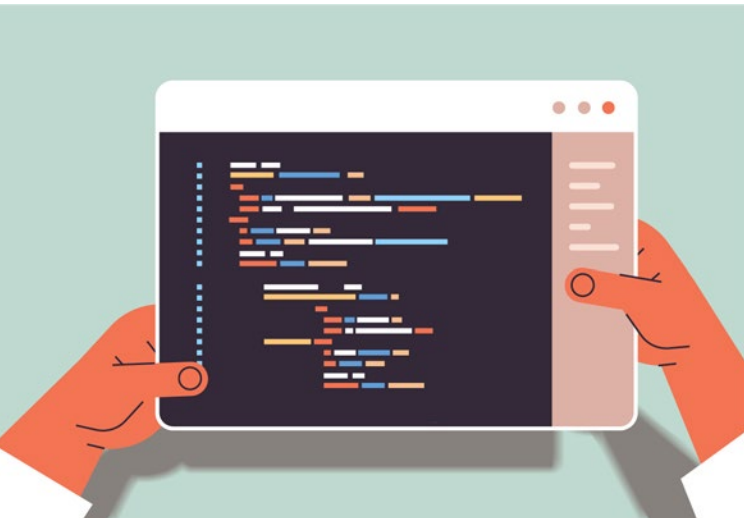
We don't want to be a marketplace where we say, "We are acting as a virtual EMS where you're just uploading this stuff, and we're just treating them as manufacturing sites."

Matties: But is this tool something where an EMS will say, "You're my customer," and give it to their OEM exclusively? So anytime you want to do business, you use this tool exclusively through that window, and not the others.

Schaal: The virtual residence engineer, where this tool comes with all the manufacturing idiosyncrasies, comes with a preferred part library. If you're using this, we are making sure that the process is smooth. This is something we're currently exploring.

Matties: That would streamline the whole BOM issue because it's not going to come to your EMS until all those questions are answered. The onus isn't back on the EMS to go back and have qualifying questions, it is now just with the OEM, and once it's complete it sends it back over, or when they're satisfied with what's there.

Schaal: Yes, exactly. The most exciting part is that there is a lot of opportunity in the industry, there's a lot of room for us to innovate, and,



through setting the priorities and hiring more engineers, to build even more awesome features.

Matties: When you looked at the BOM process or the quoting process, one thing that motivates a tool like this is you recognize that there was a lot of wasted resources there.

Schaal: When we started, we said, "Let's talk to everyone involved from idea to market-ready product about all the struggles, all the issues." We had some knowledge from our personal experience as electrical engineers, but we didn't know the market perfectly. In the beginning, we must have had at least 250 conversations, and with our checklist of good opportunities for us to tap into this value chain, we saw the most common pattern where everyone said, "Why is this still like this? How is this possible? Why do we still have to waste so much time? Why does it even take a dedicated job description for essentially just work preparation, which is cleaning BOMs?"

Matties: The other issue that we bumped into, and we hear about frequently, is that an OEM, an EMS, or a PCB fabricator will clean up all the data, prepare a quote, and then they don't get the job. They have invested 10 to 20 hours into cleaning data for an OEM, they're mad as hell, and they don't get it.

Schaal: If you're a startup, you're tapping into the established processes. You're not going to be the only software used. There's always going to be at least an ERP. How can you make sure that what you are doing is not colliding, but rather enriching the current tooling landscape? For us, that was exactly where we saw these different people, some that said, "We have a high enough hit rate, maybe 30%. So, it's okay if we put everything in the ERP system and have some unused data entries lying around." Others said, "No, it's not fast enough. We need an Excel sheet." So, we said, "We can be that speedboat that is agile that can work with this messiness and can also shield your ERP from all the quotes that you won't get." You use the ERP for what it was originally designed for, the resource planning, and not for the "I hope I get that quote" planning.

Matties: Where do you see your work in terms of market share, selling, and getting your story out? What stage are you in?

Schaal: Now we are getting out of our closed beta phase. We had this first phase of exclusively co-development partners, people who are already paying us but are not getting anything yet because it's not developed. We will still have those kinds of partners when looking at new features. But now, we can also start at the bottom of the market, because now our solutions are rich enough for them. Including development partners and first customers, we had about 15 customers on our platform in the closed beta.

Now, we are mature enough to open to more customers. In Q3, I expect for us to push a bit more in terms of sales. At the end of the year, we can then put more resources on our OEM value propositions.

Matties: This has been great. We really appreciate it, Sebastian.

Schaal: Thank you. It's my pleasure. SMT007

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

Making Progress on Uptime

Maggie Benson's Journey

by Ronald C. Lasky, INDIUM CORPORATION

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

Maggie was entering the main engineering building of Ivy University to see her mentor, Professor Patty Coleman. Patty had suggested that Maggie hire several Ivy U engineering students to work on the process improvement projects at Benson Electronics to improve productivity and reduce costs. Maggie and Patty planned to discuss the status of the projects at this meeting.

Maggie had to admit that she was a bit intimidated by her mentor. Maggie was never able to beat her in golf, and clearly Patty was Maggie's superior in technology knowledge. Maggie hoped someday she would find something she was better at than Professor Coleman.

Maggie knocked on Patty's door, and Patty opened it.

"Hi Maggie! Come on in," said Patty cheerfully.

"Hello Prof... Patty," replied Maggie.

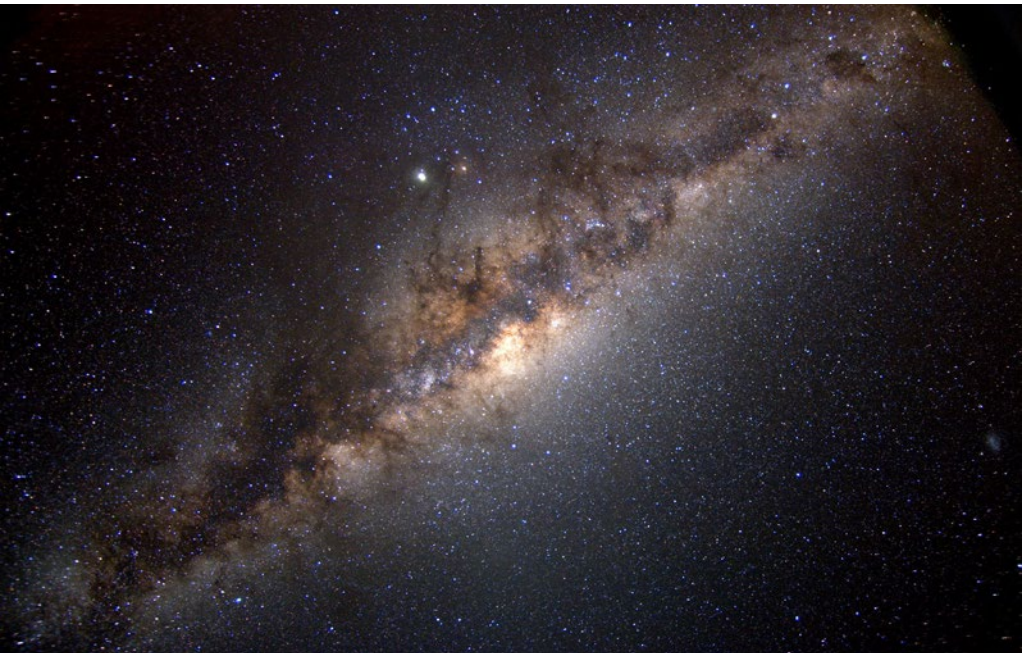
"Hey, it's working! You almost called me Patty," Patty joked.

They exchanged a few more pleasantries and then Maggie asked, "Did you see the partial eclipse a few days ago?"

"You know, I was thinking about it, but even though I was up early enough, I got side-tracked," Patty responded.

"It was really neat," Maggie said. "Also, I saw the Milky Way recently on Mount Ascutney. There was little light pollution and it looked striking. I think the Bortle scale here is better than three... maybe even two."

"What is the Bortle Class and how can you see the Milky Way?" Patty asked.



The Milky Way. It can look this good in some dark sky locations.

Simon spoke to GEN3 about qualifying his manufacturing process with **Objective Evidence.**

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Maggie Benson

"Yes, yes!" Maggie thought, "I know something that she doesn't know."

So, Maggie explained that the Bortle scale was a metric that described the darkness of the night sky and that the area in New England where Ivy U was located had quite good night skies for viewing. Maggie then explained that the Milky Way was visible on some clear nights.

"Maggie, that's really neat," Patty said. "Maybe sometime my husband Rob, I, and our twin boys can join you to see the Milky Way. I didn't really think it was possible to see it here."

Maggie was beaming.

Three days before...

Let's look in on Maggie, John, and Frank Emory's meeting with Chuck "The Tower" Tower.

"Maggie, John, and Frank, it was an enlightening experience to measure the uptime and develop an improvement plan," Chuck began.

Maggie and John could sense that it was hard for Chuck to use their first names.

"Fill us in," Maggie said.

"Well, the uptime is actually 19%, a little better than originally thought. But during the time we measured it, the team was working on the improvement plan, and I think they started paying attention to what they did that caused lost time," Chuck said. "A big surprise to all of us at the improvement plan meeting was that we didn't have the sense that if the lines are not running, BE is not making money. In a way, the lines being up pay our salary and secure our future. Tanya Brooks said it best, 'How can I be such a big dummy? This is so obvious.' When she said it, the whole group burst into laughter and one person said, 'Tanya, we are all big dummies.'"

"Chuck, tell us about the results of the improvement plan meeting," John said.

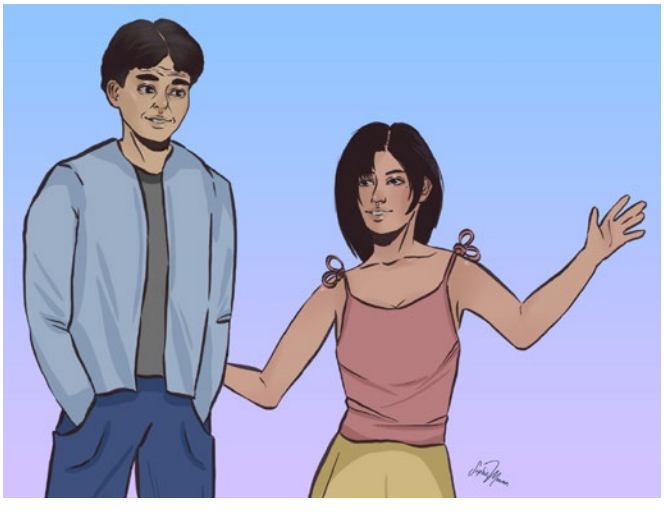
"Here was what the three of us discussed as a starting point," Chuck said.

1. Feeder racks, though available, were not used. They were in storage and there was never time to learn how to use them.
2. Even with the white boards, there was usually "shopping time" required to locate a needed component or a stencil.
3. There was not a sense of urgency to replenishing solder paste or components on feeders. Often when these actions were needed, the operators would use this time to take a break, hence stopping the line.
4. The lines were shut down for the 30-minute lunch hour, but the line was down much more than 30 minutes.

Chuck continued, "As a result of our meeting, we are now using the feeder racks; they are up and running. What a blessing as they save several hours on a new job. We fill the feeder racks with components for the next job. When it is time to start the next job, we just roll the feeder racks in. For each new job, we assign a 'feeder rack person' to assure that this happens."

"Chuck, that is terrific," Maggie told him. "Tell us about the white boards and 'shopping time.'"

"The white boards were one of our bright spots," Chuck said. "They list what is needed for the next job and who is responsible. Unfortunately, there has not been a sense of urgency, which almost always caused a lack of a few components, a stencil, etc., to start the job. This situation resulted in 'shopping time' to find the needed items. So, a sense of urgen-


"Chuck Tower and Tanya Brooks. Chuck is known for his height and boyish good looks."

cy has been added to the team. Also, our stock room has been reorganized as some components were mislabeled or in the wrong spot."

"Wow, sounds like a great success," John said. "What about paste and component replenishment?"

"Again, having a sense of urgency was the main issue," Chuck replied. Now, the line is only stopped when absolutely necessary. But I have to say, there was one big disappointment."

"And that was?" John and Maggie asked in union.

"Shutting down for lunch," he replied. "We couldn't work out a way to do it. The folks on each of the lines are friends and they want to eat lunch together.

Frank was silent during the meeting until now. He then commented, "If we gave everyone a $2/hour raise, then we could figure out a way to keep the lines running over lunch?"

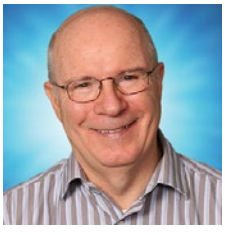
Epilogue: Even without running the lines over the lunch hour, uptime went up to over 30% with the changes Chuck and the BE team implemented. BE could now take on almost twice the business they could before the changes.

There was also a rumor that Chuck Tower and Tanya Brooks were now an "item" after spending so much time working together on the uptime project.

Stay tuned:

What is Frank Emory's plan to keep the lines running during lunch? Could BE really pay the workers $2 more per hour and make it work financially?

What is the story on Chuck and Tanya? **SMT007**



Ronald C. Lasky is an instructional professor of engineering for the Thayer School of Engineering at Dartmouth College, and senior technologist at Indium Corporation. Image of Maggie Benson by Sophie Morvan. To read past columns, or contact Lasky, click here.

Ultrasensitive Pressure Sensors Pave the Way for Robot 'Skin'

Robots could soon have 'skin' so sensitive it can detect a flower petal or a grain of rice.

Researchers from NTU Singapore have invented a pressure sensor that can be 'printed' onto flexible material such as paper or plastic film, and which are 100 times more sensitive than existing commercial sensors.

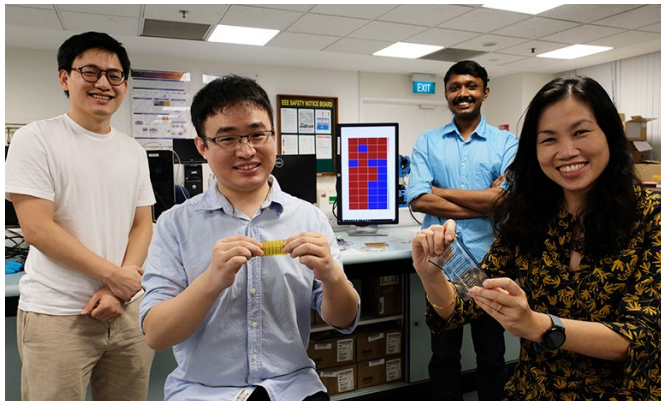
A working prototype of the sensor has been integrated into a robotic hand that is capable of gripping delicate objects, such as an egg.

These sensors can be printed onto large, flexible patches, which can then be used as a 'skin' on autonomous robots for real-time feedback and touch sensing. Robots covered in such a skin can react to stimuli the same way that humans do, making them safer and more responsive when deployed in crowds.

Led by Assistant Professor Leong Wei Lin from the School of Electrical and Electronic Engineering, the team, comprising research fellow Dr Chen Shuai and PhD students Surendran Abhijith and Wu Xihu, is developing these further applications for their breakthrough based on a grant from Singapore's National Robotics Programme.

These sensors are enabled by a breakthrough in a type of transistors called organic electrochemical transistors (OECTs). While traditional OECTs contain liquid electrolytes, the NTU team's sensors use solid polymer electrolytes instead, which can conduct ions and electrons just as effectively as liquid-based OECTs while overcoming their limitations.

(Source: Nanyang University)



Supplier Highlights

The Mannifest: A How-to Guide—Avoiding Pitfalls When Purchasing SMT Equipment ▸

When weighing your equipment options, you first must decide what you want more: a lower up-front cost or ensured reliability. Choosing used equipment will save your company money, but unexpected problems with the purchased machine may occur. With new equipment, the initial investment will be more, but you can set high expectations for the longevity and quality of the machine.

Mek Appoints Austin Jones to Sales Engineer ▸

Mek (Marantz Electronics), a leading provider of Automatic Optical Inspection solutions and Solder Paste Inspection systems, has appointed Austin Jones as their new sales engineer for the North American geographic region.

Mycronic Receives New Order for Two SLX Systems ▸

Mycronic AB has received an order for two SLX systems from a new customer in Asia. The order value is in the range of USD $7-10 million. Delivery of both systems is planned for the second quarter of 2022.

Rehm's First Trade Fair Appearances in Germany ▸

Here we go again! Although trade fairs have already taken place in China and Russia in recent months, the first trade fairs in Germany that Rehm Thermal Systems will be taking part in are now coming up: Bondexpo in Stuttgart and productronica in Munich. The Rehm team is looking forward to in-person visits once again.

Flexible Circuits Uses Essemtec FOX2 for High-Rel Flex-Centric Electronic Interconnect Assemblies ▸

Flexible Circuits, Inc. (FCI), a leading supplier of the highest reliability and complex flex-centric electronic interconnect assemblies to the U.S. defense and aerospace markets, purchased a FOX2 multi-function combined pick-and-place and dispensing system.

CyberOptics Reports Record Q2 Sales ▸

CyberOptics Corporation reported record sales of $25.2 million for the second quarter of 2021 ended June 30, an increase of 58% from $16.0 million in the second quarter of 2020.

Electrolube's PU Resin Selected for New Car Park Sensor Application ▸

Smart Cities are rapidly evolving and sensor technology plays a vast role in the new IoT revolution that's unfolding before us. Electrolube, a global manufacturer of electro-chemicals, has collaborated with a customer on a new car park sensor application with great success.

AIM Announces Implementation of Solar Power at US Facility ▸

AIM Solder, a global manufacturer of solder assembly materials for the electronics industry, is pleased to announce the implementation of solar power at its Cranston, Rhode Island, facility.

Element Solutions Reports Q2 2021 Financial Results ▸

Element Solutions Inc., a global and diversified specialty chemicals company, announced its financial results for the three and six months ended June 30, 2021.

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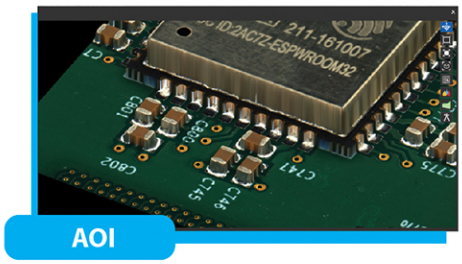

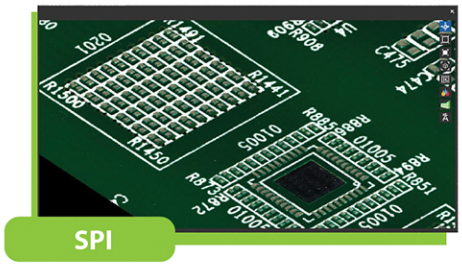

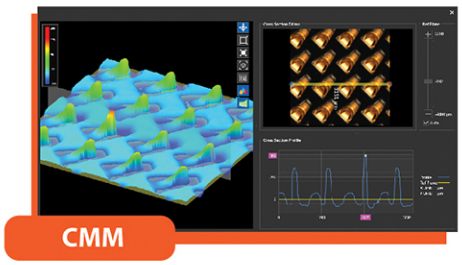

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X-ray Imaging and BGA Rework

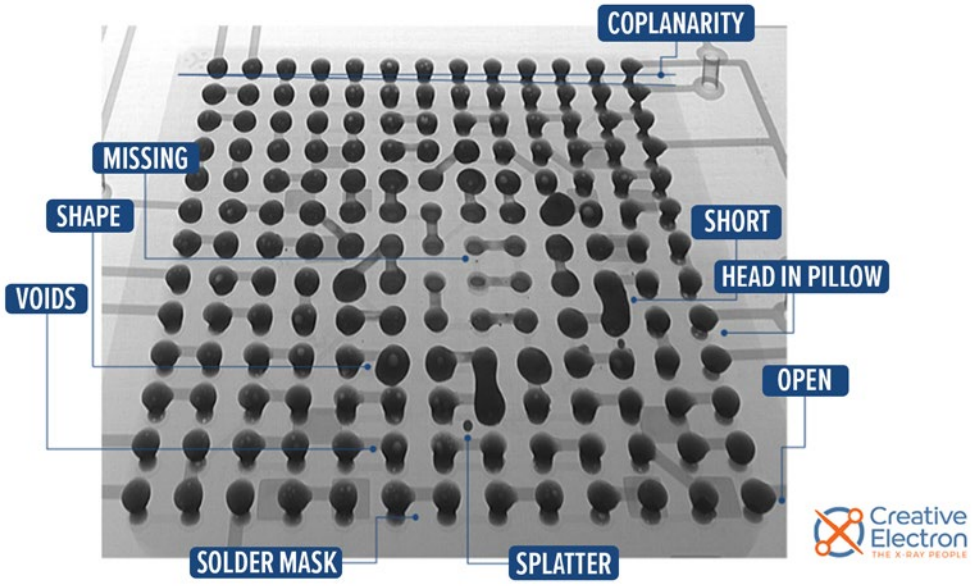
Knocking Down the Bone Pile

by Bob Wettermann, BEST INC.

X-ray imaging prior to the removal of a BGA for rework will help the rework technician point out potential issues which may be challenges to successfully removing and replacing the BGA. X-ray imaging of the actual BGA location, as well as the surrounding area, is used to confirm rework challenges such as the proximity of neighboring devices, starved solder joints, and solder balls causing electrical shorts. These images can point to potential root causes for the BGA rework including broken bond wires, or the popcorning or delamination of the package. Furthermore, soldering anomalies such as head-in-pillow or graping defects, which may be causing intermittent connections, can be the cause of the failure. Devices on the opposite side of the BGA location will determine potential problem areas due to heat effects of the rework process.

For example, if a BGA is underneath a shield, X-ray will help determine the location of the BGA and the neighboring devices, as well as the margins for getting a nozzle into the rework location (if using a hot air rework reflow source). X-ray imaging will also provide clues to the physical board problems such as lifted pads or solder that has wicked down the dog bone of the PCB due to mask damage, as well as other anomalies.

Not only does X-ray imaging provide some clues prior to rework of some of the challenges that may lie ahead, but it also confirms that the rework was completed correctly. After visual and endoscopic inspection has been completed, the BGA rework location is inspected by manipulating the controls of the X-ray to where the component of interest is seen in



Defects are clearly visible with the use of X-ray inspection. (Image courtesy of Creative Electron.)

As we celebrate our 35th anniversary, we'd like to thank our SMT partners for their support in fulfilling the manufacturing needs of our customers in the electronics industry.

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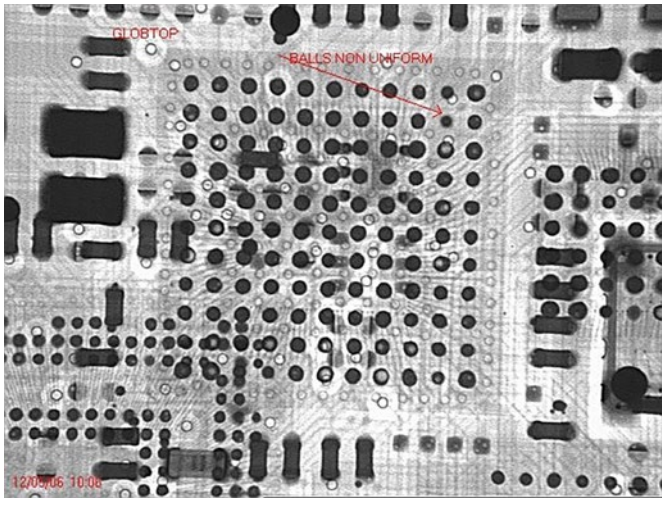

Figure 1: Undersized solder balls.

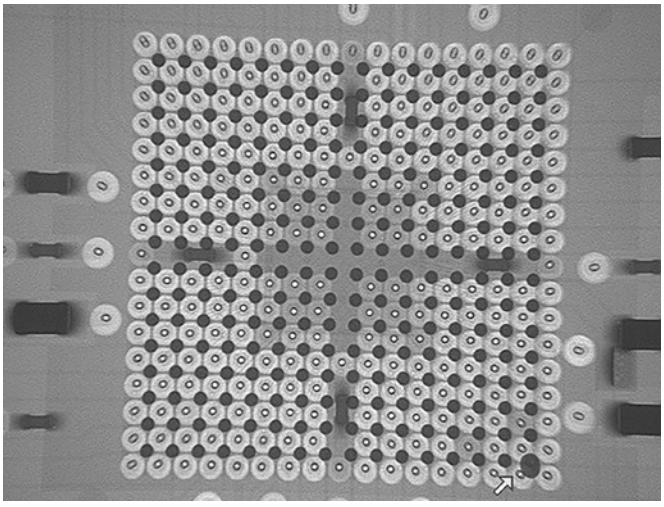

Figure 2: Oversized solder balls.

a large field of view. The technician then manipulates the X-ray system to where numerous solder balls can be seen on the screen as the rows are scanned back and forth. The technician reviews the overall ball sizes to make sure they are consistent in size and shape.

Anomalies such as small balls (Figure 1), oversized balls (Figure 2), and misshapen balls all will be caught by an experienced X-ray operator. Especially critical to observe are the corner solder ball locations. If these locations are full and round, then as a rule the overall ball collapse is sufficient. Smaller-sized balls may be a direct result of solder wetting down a dog bone pattern where the mask has been damaged, or in cases where a thermal via has wicked the solder down into the via hole. Oversized balls may be a result of neighboring balls having their solder squirt over to a neighboring ball location.

Obvious anomalies like solder shorts, missing balls, or misshapen balls will also be picked out during this part of the investigation. At this field of view the technician will next investigate areas around the device of interest. Skewed components, solder balls, or handling damage can all be picked up by examining the X-ray image. Solder may have "squirted" out of neighboring locations; such is the case when the board has been conformally coated or neighboring or mirrored devices that are underfilled also show up clearly on X-ray images. Once this larger field of view inspection has been successfully completed, the BGA technician zooms in to review details about the solder balls and their collapse. The technician is looking for misshapen balls, smaller or larger balls, a high voiding percent-

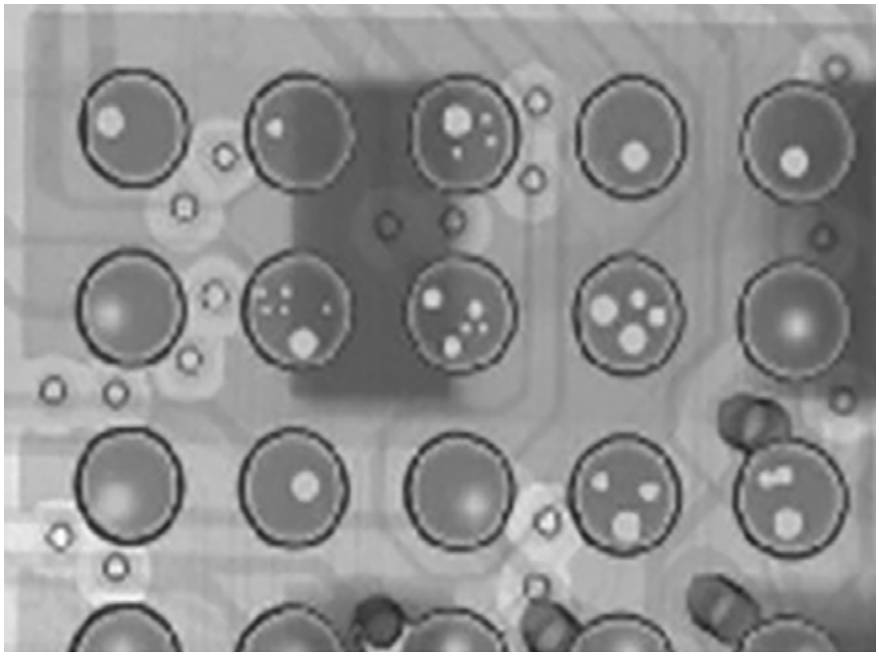

Figure 3: Solder voids during close up (large field of view) inspection.

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age, and solder shorts as well as numerous other anomalies. X-ray imaging really is a necessity to "see" these defects and anomalies after BGA replacement.

X-ray inspection of reworked BGAs prior to the rework operation, and both far and near field analysis of the X-ray images, are important to confirm that the BGA rework process has yielded success. Without the use of X-ray imaging, it is very difficult to confirm that the inspection criteria have been satisfied. SMT007

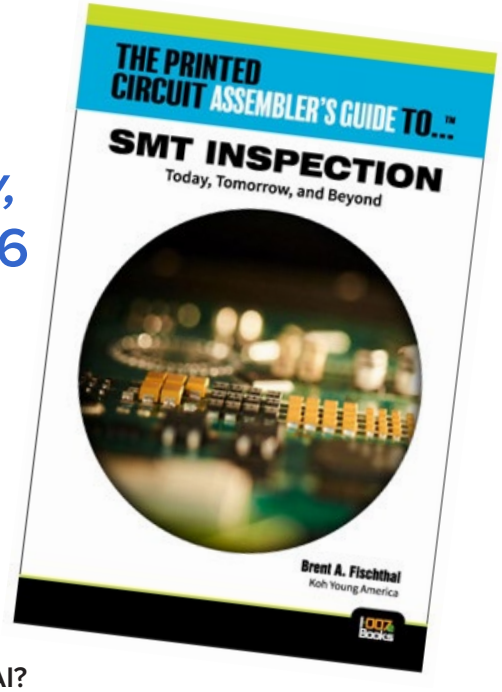
Resources

1. IPC-7095 Design and Assembly Process Implementation for BGAs
2. IPC-A-610H Acceptability of Printed Wiring Boards

Bob Wettermann is the principal of BEST Inc., a contract r ework and repair facility in Chicago. For more information, contact info@solder.net. To read past columns or contact Wettermann, click here.

EXCERPT:

The Printed Circuit Assembler's Guide to... SMT Inspection: Today, Tomorrow, and Beyond, Chapter 6



How Far Can AI Take Us?

Artificial Intelligence is more than a buzzword associated with business and industrial technologies. In recent times, it has demonstrated promising potential across a variety of industries, from self-driving vehicles to virtual doctors, and it has far-reaching applications within the manufacturing sector.

By using the right mixture of AI technologies, manufacturers can boost their efficiency, improve flexibility, speed up processes, and even achieve self-optimizing processes. The SMT industry is no exception, and while it is facing a chronic shortage of skilled labor, AI seems a natural fit. Equipment providers are enabling the smart factory of the future by adopting AI to generate "knowledge" from "experience."

Machine-to-machine communications are quickly changing the manufacturing process by aggregating process data such as first pass yield and throughput. By strengthening large-scale data sets using the highest quality data captured through industry-leading 3D metrology, AI algorithms necessary for smarter manufacturing processes can be trained by utilizing the data sets. Equipment manufacturers are adapting and adopting AI in the inspection technology.

What Is AI?

Artificial intelligence is a multidisciplinary field of science with the goal to create intelligent machines by making them "smarter." Historical applications of this goal include natural language processing and translation, visual perception, pattern recognition, and decision making, but the number and complexity of applications have been quickly expanding. Out of all the advancements researchers have made, the current driver of the AI inflection point is thanks to major advances in deep learning. Deep learning is an algorithm with a hierarchy of "deep layers" of large neural networks fed by data without feature engineering. From practical solutions to improve measurement quality and inspection accuracy, equipment vendors are utilizing AI to meet the rising demand and challenges in the SMT industry.

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MilAero007 Highlights

Catching Up With AMI's Jim Barry ▸

I met Jim Barry 25 years ago when we worked on a project at Eltek Ltd. Since then, I have followed his career with a great deal of interest, believing that he is one of the best technical sales professionals in our industry. When Jim recently accepted the position as vice president of business development at AMI right here in Maine, I knew it was time to catch up.

Adventures in Engineering: Test Points—The Other Side ▸

In many instances test points are a critical part of the process for launching, producing, and maintaining a successful product. Sadly, many times test points are left as an afterthought and squeezed/pushed into a design after PCB layout is "complete," signal integrity analysis is "done," and all but the final design review remains. Now, let's see what we can do to effectively place test points in our CCAs.

Mars Rover Mission Only Just Beginning One Year After its Launch ▸

Of all the exciting aspects a space mission entails for a planetary scientist who makes a living studying the outer limits, it's still the launch from ground zero that gets Briony Horgan's heart-pounding the most.

Micross, C-MAC Partner to Service U.K. Aerospace and Defense Market ▸

Micross Components Ltd., a leading global provider of mission-critical microelectronic components and services for high-reliability aerospace, defense, space, and industrial applications, based at Norwich, U.K., and C-MAC Electromag BVBA are pleased to announce a formal partnership, to offer a greater range of products and services to the U.K. Aerospace & Defense industry.

Ventec, Taiyo America Sign Exclusive Distribution Agreement for Mainland Europe, UK ▸

Ventec International Group Co., Ltd., is pleased to announce it will be taking over the exclusive distribution of Taiyo products in mainland Europe, the UK and Ireland.

Raytheon: A Radar for Any Mission ▸

Raytheon Technologies is redefining the radar with what's known as the "software-defined aperture," making single arrays far more capable and flexible through secure software upgrades. The digital transformation in radar development offers benefits in every domain—land, sea, air, space, and cyberspace.

New Algorithm Flies Drones Faster Than Human Racing Pilots ▸

For the first time an autonomously flying quadrotor has outperformed two human pilots in a drone race. The success is based on a novel algorithm that was developed by researchers of the University of Zurich. It calculates time-optimal trajectories that fully consider the drones' limitations.

Celestica Releases Q2 2021 Financial Results ▸

Celestica Inc., a leader in design, manufacturing, and supply chain solutions for the world's most innovative companies, announced financial results for the quarter ended June 30, 2021 (Q2 2021).

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A Conversation With Javad EMS

Interview by Nolan Johnson
I-CONNECT007

Nolan Johnson speaks with Gary Walker, vice president and co-founder of Javad EMS, about who they are as a company, where they came from, and where they're going.

Nolan Johnson: Hi, Gary. Would you introduce us to Javad EMS?

Gary Walker: I started the business in 2010 with Javad Ashjaee, with whom I had become friends when I was working at SMTC, and he was a customer of mine. When I left SMTC to do consulting, Javad and I stayed friends. He was bouncing around among different CMs, struggling to find someone that could make his high-precision GPS products. It was a real challenge to find someone who had the technical expertise and capabilities to build those products in the volumes and requirements that he needed at that time. It is a very demanding product and as such a very demanding account.

After many discussions, Javad and I decided to open an EMS facility. We thought that if we could build products for the sister GNSS company, then we could more than meet the needs of other customers. We wanted to provide a different level of service and support than was traditionally being offered back in 2009 and 2010 by other CMs here in the Bay Area.

The building and equipment were all bought and owned by the company with no outside financing. There was that commitment right from the start. If we were going to provide a different level of service, the facility would reflect that. We have an atrium feel in our lobby, for example, as well as a large auditorium; we've just done things which make this facility different than others. That doesn't necessarily translate to building a printed circuit board, but it reflects on us as a company, who we are, our level of professionalism, and how we want to be perceived.

We want anyone who walks through the front door to feel that they were treated very well and view us as very professional. That includes employees, customers, and suppliers.

JEMS manufacturing facility, San Jose California.

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Gary Walker

We've had an excellent retention rate because of it. We decided we wanted to be all things to a chosen few as opposed to trying to be all things to all people. That was our approach. The key is always to exceed their expectations so when they grow, we grow with them.

Johnson: You're looking for a very specific kind of fit, somebody who values you as much as you value them. That makes good sense; I'm curious how you characterize your ideal customer.

Walker: I don't think we've trapped ourselves into saying that the customer must be at a certain revenue level or must be doing this or that. Instead, we look at all the different accounts and determine the best fit for us as we are looking for customers that will stay with us for some time.

Johnson: I'm hearing qualitative reasons and measures for an ideal customer.

Walker: You can have all the systems you want in place, but at the end of the day, you have to work with other people. You must be engaged and feel that they value you as much as you value them. Too often, companies are just looking for revenue generators, but if that customer doesn't value you, how long does that revenue generator last with you?

We don't do a lot of the NPI prototyping work here in the Bay Area just for the sake of just prototyping. We'll do prototyping if it's going to translate into production, but if someone is just looking to get 50 or 100 prototypes done and then send it offshore, we're not the right supplier. For anyone that we engage with, we apply the same amount of focus with the big guys as the small guys. Once we're committed to someone, there's a lot of upfront work that we put into it, and we would just never recoup the value and the time and effort we put in to build 50 or 100 pieces. I couldn't charge anyone enough for that. So that's kind of the approach that we take.

Johnson: We've just come through 18 months of very interesting times to be in business. How has it been for you at Javad?

Walker: We've had some good days and bad days. Unfortunately, my friend Javad succumbed to COVID in May 2020. It came upon us very quickly. Not only did I lose a business partner, but he was a very dear and close friend. That was one of the things that hit home. Aside from the personal heartbreak of that and what it did to the company, since May of 2020 to today, it has reinforced that everything Javad and I decided to do 10 years ago when we started and continued for the past 10 years laid the foundation for a very solid company. We still have a thriving company and one that I know he would still be very proud of. You don't expect COVID to hit, you don't expect a loss to happen the way it did, but the fact that we're still progressing is a testament to everything that we put in place here at JEMS.

Now, on a business level, we do a lot of work for military, aerospace, and medical, so those clients didn't have the same COVID impact as others would have. That softened the blow for us. We were down for just a matter of weeks. Once back operational, with all our COVID

4 SM lines. High mix, high complexity, low to medium volume production.

protocols in place, and production maintained under the "new normal" way of things, we continued to move forward as before, and then now through 2021, we're doing very well. We assume there is a pent-up demand, and we are hoping that it's not a bubble, so we'll see how it plays out.

Johnson: You're growing. Did you find new market opportunity in the COVID experience?

Walker: We did not. And that kind of goes back to the small group of customers who we chose to work with. When COVID hit, we had a solid group of customers; we supported them, and they supported us through the whole process. We did not go out and engage in trying to reinvent ourselves. We understood who we are as a company, the engineering resources we have in place and everything else, so it wasn't right for us to go into another business, such as ventilators.

Overall, 2020 was a solid year: Some accounts went up, others went down. The balance kept us reasonably consistent with the year before. But no, there were no new opportunities. We were not out actively soliciting new accounts. We hunkered down and supported the existing customers we had.

Johnson: One of the new norms for the next couple of years, if the forecasters are to be believed, is that of disruptions in the supply chain, especially from the chip manufacturers. How is that affecting business?

Walker: It wasn't affecting us at first, but we're definitely seeing component availability collapse and lead times stretch out. Increased cost and supplier de-commits are becoming more the norm, but we are managing our way through this and continue to meet all our customer needs. It goes back to your customers, who they are, and where they fit into your overall picture. We have a small group of accounts, and we can give them 100% of our focus, time, and energy. When these supply chain issues come up, we work together with

Smart material handling systems significantly improved manufacturing efficiencies.

them and are very transparent. It takes just as much time to buy 100,000 resistors as it does 10,000 resistors. When problems arise, you're dealing with a smaller subgroup, and one conference call. You're not dealing with 50 conference calls with issues, because that all takes time and time is a precious commodity.

Johnson: Well, that stands to reason. You have long-standing customers with a predictable behavior pattern who allow you to do component and material procurement much more predictably, thereby addressing some of the issues. When a company starts to get particularly transactional is when they find themselves having to do spot buys for something they just snapped up.

Walker: I agree. We have long relationships; we forecast out. We can talk to customers about buying certain devices (with lead times now going into 2022) and we have a comfort level and an understanding with them to do what is right. They value us as much as we value them, so when committing these dollars to these buys you must have that type of relationship.

Johnson: Gary, how does your company approach process optimization? There's the technical side of optimizing processes, which trickles down into your bottom line, but are there other strategies you're exploring at Javad to maintain, and maybe even grow, your profitability?

Walker: We continually challenge how we do business and whether that approach makes sense going forward. The worst thing anyone can ever say to us is, "Well, that's the way we've always done it." We're constantly looking at everything we do to make our process and people more productive. For example, we went paperless. It's a better process control way of doing it. You control what people are using much better than pieces of paper that get slipped under ESD mats and no rev control. The benefit is you get the process control, but you also get much more productivity. One feeds the other.

All the information systems and everything we have are geared toward making things much easier for people to communicate together as teams, to work together moving information. We're an information company. If

you're in manufacturing, you collect and analyze data all the time so what are you doing with that data? Who's working with the data? What's the most efficient way to work with it? We're always looking at doing something with that as well.

We started the company with vertical carousels, which most people walking through a factory don't normally see. They see the traditional stockrooms with shelves and boxes and carts. We thought it was a better way to store material and bring material to a person, but as time moved on, we still see the value in the carousels but felt there are even better ways to manage materials. Many years ago, we implemented the use of unique IDs for all parts.

We viewed that as a better way of managing product once it's in the building. But we constantly look at how we can evolve to make ourselves a better and smarter company. We've implemented smart material handling carts. We've customized software to be able to track components anywhere in the factory so you could literally key in a part number for a capacitor and you would be able to know exactly where it is in the factory, down to a feeder location on a trolley cart on a machine. It's finite traceability.

We put in an X-ray component counter before it was the trendy thing to do. And we just implemented a smart incoming inspection table. It takes our incoming inspection time down by 60–70%, but even more importantly, it makes it a much more accurate incoming receiving inspection process. The smart feeder carts and the smart inspection table vendor has worked very closely with us on improving how we move and track material through our system, allowing us to state with confidence that it is world class. So, we gain the added benefit of having a more accurate way of moving material, but it also is a faster, more efficient way. A lot of what we have focused on the past few years is managing materials internally much better and that rolls over to everything we do. A surface mount machine can't be too productive if it doesn't have all the necessary parts to run.

Johnson: Is everything still fitting inside your original facility or are you growing out of it?

Walker: It still fits inside as of now. When we originally laid out the building, we spaced things out, but our mix has changed. We have the same type of customers, but the type of products that we're building for them has somewhat changed. Top line revenue-wise, we are at a much higher level now than we used to be with more staff and running more equipment. Things are getting a little tighter here, and we still have room to grow. Our shifts are not evenly split, but at the end of the day, to grow the business we must look not only here in San Jose but outside the Bay Area to see what makes the most sense for us. If we really want to achieve the growth goals, more than likely it will require a footprint outside of the Bay Area.

Johnson: Resilience in manufacturing as well as in the supply chain. Do you have some plans in mind or some new processes that you've already implemented?

Walker: A few years ago, we started sourcing machine parts in Vietnam because of the chal-

Javad Ashjaee and Gary Walker, sharing a laugh prior to opening the San Jose facility in January 2010.

Paperless manufacturing improves workflow, eliminates non-value added tasks, and enhances operator productivity.

lenges in getting product sourced out of China due to tariffs and other things. It was cheaper than what we could get in China and the quality met or exceeded everything we were getting out of China previously. That's now grown to be well over a million dollars spent each year, and it has continued to grow as we source some machine parts and metal stamp parts out of Vietnam.

We set up a small office in Vietnam and we were able to move tasks that didn't make sense to be done here in the Bay Area. It allowed everyone to remain here in San Jose, but at the same time also grow the business. Our front-end office, all the documentation BOM loads—that type of work is done in Vietnam. We have a staff of eight people over there, and it works very well. Because of the 14-hour time difference, they are working while we're sleeping, and vice versa. The systems we have set up are very transparent and seamless.

Domestically, we're looking at different geographies outside the Bay Area that are lower cost, but still meet the Built-in-USA footprint. We have some customers where that is a requirement, so it would make sense for us to supplement what we do here in San Jose. That is something we need to investigate.

Another option is Mexico. I oversaw a very large manufacturing operation in Mexico so I'm very comfortable with what goes into setting up and running a manufacturing facility there. That might be another avenue that we approach as we look to grow our business.

Johnson: Look out 12 to 24 months and tell me what you see for Javad.

Walker: I believe we will see substantial growth in the next 12 months, and I predict that we will be manufacturing in one of those three places that I mentioned within 24 months. We need to move in that direction, and we are pretty committed.

Johnson: Great. This has been very informative. Sometimes the technology transfer works so much better when you have a relationship over a transaction.

Walker: I agree. I think when it becomes purely transactional, then you're only as good as your last transaction. I've always said, "People buy from people. People want to work with people. People want to partner with people." Then transactions are part of that partnership. I don't think it's the primary aspect of a relationship.

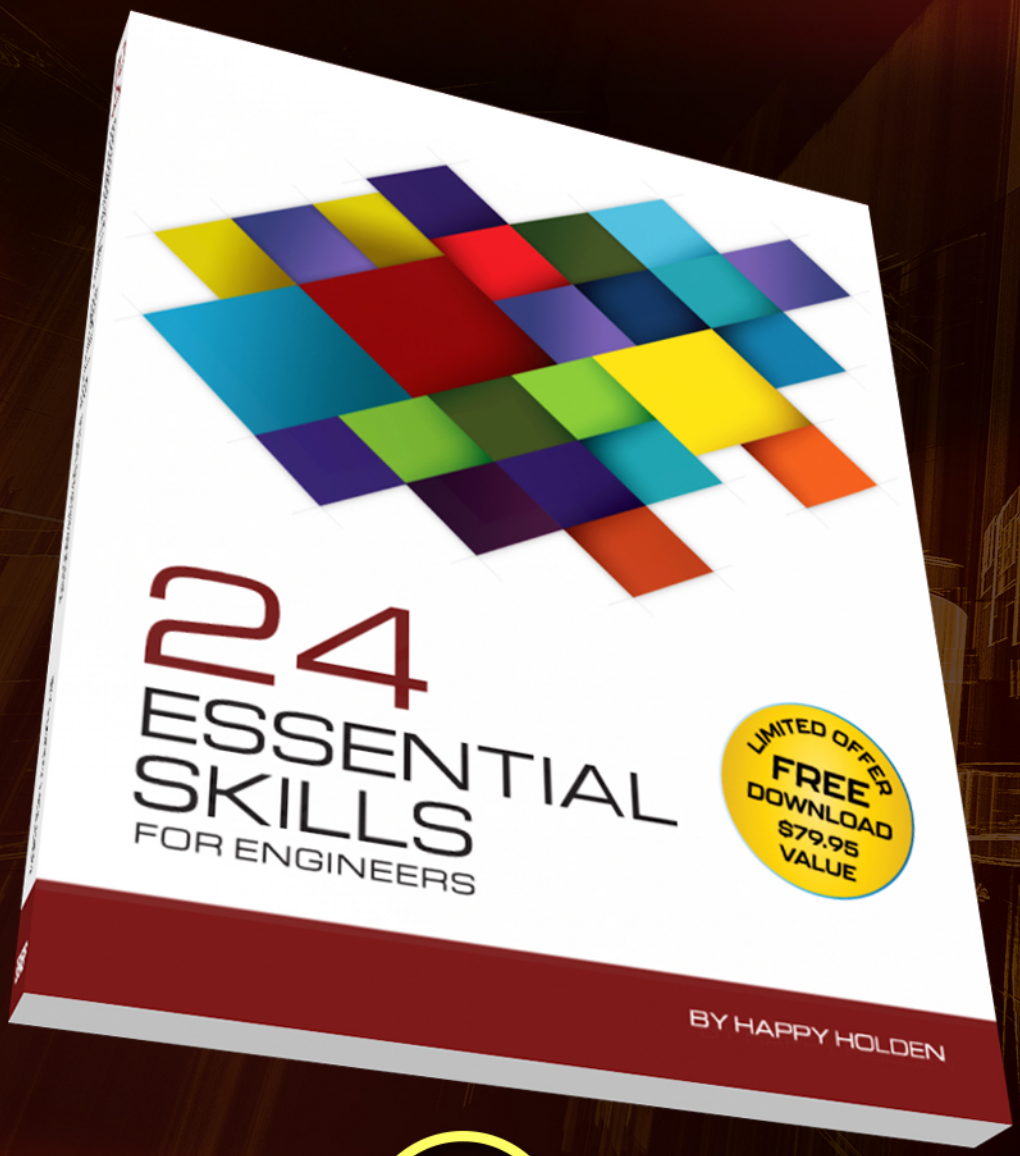
Johnson: Thank you so much for taking the time.

Walker: Thank you for giving me the opportunity to tell you about Javad. SMT007

Sponsored Link: Javad.com

Engineers: Here are 24 Real-world Skills You Didn't Learn in School

Industry veteran Happy Holden shares his strategies for overcoming engineering challenges.



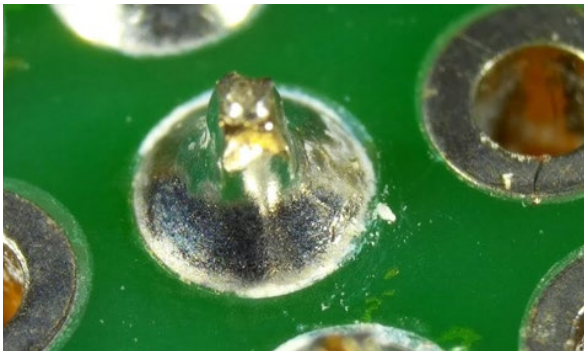
TOP TEN

Foundations of the Future: IPC's Generous Support to Upskill Students

The electronics industry faces the challenge of attracting talent. The IPC Education Foundation (IPCEF) aims to help solve this challenge by increasing awareness of the industry and equipping students with valuable industry-standard education to better prepare motivated students for careers in electronics.

Knocking Down the Bone Pile: Cleaning of 'No Clean' Fluxes in PCB Rework

The original intention of a "no clean" solder was to eliminate the post PCB assembly cleaning process while still not risking any performance or long-term reliability degradation. Some industry surveys indicate that about one-half of assemblers using no clean flux chemistries clean the PCB after assembly.



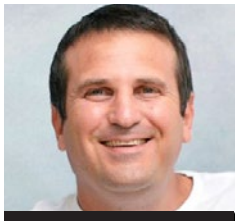
SMT Perspectives and Prospects: Digital Manufacturing—Just-in-Case or Just-in-Time

Under the dynamic global-macro factors and the burgeoning digital manufacturing platforms, the construct that is solely based on just-in-time inventory management as a stand-alone practice could be proven inadequate. Considering both just-in-time and just-in-case appear to be a pragmatic model to operate in the digitized enterprise; perhaps a "comforting" approach as well.

XRF Analysis Adds to Spirit's Test Services

Spirit's new Hitachi EA6000VX bench analyzer can inspect the material composition of your product. XRF inspection is essential in military and aerospace supply chains to verify that leads and finishes contain the correct ratio of lead to prevent whiskering.

Leveraging Data Analytics in Recall Scenarios


Yuval Polishuk

Minimize the impact of product recalls by using smart data to uncover the root cause. One of the most effective ways to minimize the impact of a recall is to define the root cause of the defect quickly and accurately, thereby minimizing the number of products that need to be recalled.

Knowledge Continuity in Manufacturing

"Why do we do it that way?" "Because we always have." Those can be some of the most dreaded words on the manufacturing floor. It means that someone decided at one point to do things a certain way, and you don't know whether it's a critical aspect of the assembly process, or just another roadblock to improvement.

Communicating Effectively with EMS Providers

For the past several decades, OEMs have used outside EMS providers to build a multitude of products from PCBAs to complete box and cable assemblies. Communicating effectively is the key to success in getting products from concept to reality. For companies that want to form a good working relationship with EMS providers, there are several steps that should be followed to ensure a successful product build.

Her Voice: The Intractable Ceiling


Christine Davis

It has not been easy to be a woman-owned business in the electronics industry. Most people assume that my company was handed down to me by my father. That's far from the case. My desire to start CAMtek from scratch came about after a series of events that left me bewildered and frustrated.

How to Troubleshoot Your Testing Processes

There are a multitude of electronic circuit assembly manufacturers, high-volume/low-product mix to low-volume/high-product mix. Only you will know where you are in that definition.

IPC Commends U.S. Senate on Passage of Bipartisan Infrastructure Bill


John Mitchell

IPC issued a statement from President and CEO John Mitchell on the expected passage of the bipartisan infrastructure bill in the U.S. Senate.

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In addition, your ad will:

- be featured in at least one of our newsletters
- appear on our jobConnect007.com board, which is promoted in every newsletter
- appear in our monthly Careers Guide, emailed to 26,000 potential candidates

Potential candidates can click on your ad and submit a resume directly to the email address you provide, or be directed to the URL of your choice.

No contract required. Just send over your copy and company logo and we'll do the rest!

Contact barb@iconnect007.com to get your ad posted today!

+1 916.365.1727

I-Connect007
GOOD FOR THE INDUSTRY

smt007 pcb007 pcb design007

Career Opportunities

Fuji America Corporation is a rapidly growing electronics assembly equipment distributor. We support the factories of the future and smart factories globally. We offer an exciting and challenging career for a software support engineer and an applications engineer who want to join our growing company.

Software Support Engineer

As a software support engineer for Fuji America Corporation, you will be a customer-facing technical advisor with the opportunity to solve technically complex problems for our proprietary software. As a trusted advisor to our customers, you will have influence over a broad range of solutions that create business value. As a valued member on our team, the software support engineer will use advanced troubleshooting methods and tools to solve technically complex problems. These highly complex, escalated problems require broad and in-depth product knowledge, as well as exceptional troubleshooting skills.

- Field installation of proprietary software/automation equipment throughout North America
- Field troubleshoot, repair, training, and process support of proprietary software
- Provide remote and on-site technical support
- Troubleshoot Windows 10/Windows server installing, configuration, and support
- Networking experience—setting up and supporting networks.
- Exposure and/or experience with Oracle or Microsoft SQL server databases
- Strong verbal communication skills with both customer and other technical depts.
- Flexibility to travel and perform job assignments on short notice
- Strong aptitude with current computing applications and networking processes

Experience

- Bachelor of Science in computer science or related field preferred

Applications Engineer

As an applications engineer, you will be responsible for doing cycle time and studies in preparation to make recommendations of Fuji products for customers' applications. Support implementation of activities within the technical center such as customer visits, demonstrations, evaluations, testing, inspection of Fuji products, including peripheral equipment from other vendors.

- Assist sales representatives in technical aspects relating to machine and software functions and utilization.
- Assist sales representatives and customers with providing CTA (Cycle Time Analysis) to them for recommending Fuji products to customers' specific applications. This includes the sFAB machine as well as all other SMT machines.
- Schedule and perform product demonstrations on all available types of equipment and software to potential and existing customers.
- Test and evaluate existing as well as new technologies on equipment and software performance and reliability.
- Assist in the coordination of any new FAC projects by utilizing your full potential.
- Responsible for the setup of the equipment and its demonstration for various trade shows.
- Assist FAC staff in any technical issues which may require attention.
- Assist in the coordination of design and manufacture of customs tooling for placement equipment.
- Perform inventory checks every six months according to the schedule and manner regulated by the company, if applicable.

Experience

- Minimum five years programming/computer experience
- Bachelor's degree preferred

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Career Opportunities

Application Engineer (m/f/d)—Fulltime, Germany

Our company is expanding its product portfolio into custom made products. This creates the need for an Application Engineer to provide technical support to our existing sales team and customer base.

Responsibilities:

- Analysis of incoming technical data and handling of engineering questions
- Technical consultation of customers (incl. new customer specifications and discuss with relevant technical and quality teams worldwide)
- Support and consultation for new projects
- Lead and/or participate in local, cross-location/global cross-department projects of various scale
- Develop and provide function-related trainings to existing and new staff in order to transfer and optimize know-how
- Provide technical solutions

Skills:

- Technical expertise in battery power solutions and technologies for Rechargeable and Primary cells and Battery Packs
- Mechanical background or knowledge to be able to discuss and manage other products, like custom made connectors, cable assemblies and keypad touch panels.
- Written and spoken English and German, any other European language a plus.
- Highly technical with a commercial flare.
- Self-motivated, ambitious, and eager to grow in a dynamic organization.

Interested? We are looking forward to your application!

Please send your application to **hr@cmit.support**. For any inquiries, please contact Mrs. Amélie Filler. For more information visit www.cml-globalsolutions.com

apply now

Sales Manager (m/f/d)—Worldwide Locations

CML Group is a leading provider of Printed Circuit Boards. We develop tailor-made sourcing concepts for our customers worldwide creating strong partnerships and reliable connections.

For the expansion of our target markets, we need you to generate new business, drive new projects from RFQ stage and manage the customer relationship.

Your Profile:

- Profound sales and technical expertise in printed circuit board industry
- Local market knowledge and ideally a customer base of contacts in one or more of the listed countries
- Have successful track records in developing new business opportunities
- Excellent command in spoken and written English and one additional local language
- Highly self-motivated, ambitious, eager to grow in a dynamic organization
- Able to work independently and have good communication skills and leadership skills
- Self-employed/contractor/commission-based agent also welcome

Your Target Markets:

- Europe: Spain, France, Germany, Netherlands, UK, Denmark, Sweden, Norway
- USA: New Jersey, Florida, Georgia, Michigan, San Jose, Bay area, Pacific Northwest and Canada
- Others: Singapore, Thailand, Malaysia, Australia, Brazil, Turkey, Russia, and South Africa

Interested? We are looking forward to your application!

Please send your application to **hr-china@cml-eurasia.hk**. For any inquiries, please contact Ms. Grace Feng. For more information visit www.cml-globalsolutions.com

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Career Opportunities

The Test Connection, Inc.

Rewarding Careers

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

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

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

Associate Electronics Technician/ Engineer (ATE-MD)

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

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

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Test Engineer (TE-MD)

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

- Candidates must have at least three years of experience with in-circuit test equipment. A candidate would develop and debug our test systems and install in-circuit test sets remotely online or at customer's manufacturing locations nationwide.
- Candidates would also help support production testing and implement Engineering Change Orders and program enhancements, library model generation, perform testing and failure analysis of assembled boards, and other related tasks.
- Some travel required and these positions are available in the Hunt Valley, Md., office.

apply now

Sr. Test Engineer (STE-MD)

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

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

We proudly serve customers nationwide and around the world.

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

apply now

Career Opportunities

Prototron Circuits

Sales Representatives

Prototron Circuits, a market-leading, quick-turn PCB shop, is looking for sales representatives for all territories.

Reasons you should work with Prototron:

- Serving the PCB industry for over 30 years
- Solid reputation for on-time delivery (99% on-time)
- Excellent quality
- Production quality quick-turn services in as little as 24 hours
- AS9100
- MIL-PRF- 31032
- ITAR
- Global sourcing
- Engineering consultation
- Completely customer focused team

Interested? Let's have a talk.
Call Dan Beaulieu at
207-649-0879
or email to
danbbeaulieu@aol.com

apply now

ICAPE GROUP

PCB Field Engineer– North America Operations

ICAPE Group is a European leader for printed circuits boards and custom-made electro-mechanical parts. Headquartered in Paris, France, we have over 500 employees located in more than 70 countries serving our +2500 customers.

To support our growth in the American market, we are looking for a PCB Field Engineer.

You will work in our North America technical center, including our U.S. technical laboratory, and will be responsible for providing technical and quality support to our American sales team.

You will have direct customer contact during all phases of the sales process and provide follow-on support as required.

RESPONSIBILITIES INCLUDE

- Feasibility recommendations
- Fabricator questions and liaison
- Quality resolutions
- Technical explanation (for the customer) of proposals, laboratory analysis or technology challenges

REQUIREMENTS

- Engineering degree or equivalent industry experience
- 5 years' experience with PCB manufacturing (including CAM)
- Excellent technical understanding of PCBs
- Experience with quality tools (FAI, PPAP and 8-D)
- Good communication skills (written and oral)

Communication skills are essential to assist the customer with navigation of the complex process of matching the PCB to the application.

SALARY

Competitive, based on profile and experience. Position is full time in Indianapolis, Ind.

apply now

Career Opportunities

EAGLE electronics Inc.

MANUFACTURERS OF QUALITY PRINTED CIRCUIT BOARDS

Maintenance Technician

Inspects work-related conditions to determine compliance with prescribed operating and safety standards. Operates power-driven machinery and uses equipment and tools commonly used to maintain facilities and equipment. Replace filters, belts, and additional parts for repairs and preventive maintenance. Moves objects weighing up to 150 lbs. using a hand truck or pulley. Cleans work area and equipment. Works with cleaning fluids, agents, chemicals, and paints using protective gear. Works at elevations greater than ten feet, climbing ladders, while repairing or maintaining building structures and equipment. Assists skilled maintenance technicians/workers in more complex tasks and possible after-hours emergency repairs. Must meet scheduling and attendance requirements.

apply now

Plating Operator

Plating operator for printed circuit boards. No experience necessary, will train. Must be able to work with chemicals, lift up to 50 pounds, and have good math skills. Minimum high school/GED or equivalent. All shifts (1st, 2nd, 3rd), 8 hours per day minimum, Monday thru Friday. Saturday and Sunday work is common allowing for steady overtime pay.

apply now

EAGLE electronics Inc.

MANUFACTURERS OF QUALITY PRINTED CIRCUIT BOARDS

Water Treatment Operator

Responsible for operating waste treatment plant, our operation that converts wastewater in drains and sewers into a form that's metal free to release into the environment.

Control equipment and monitor processes that remove metals from wastewater. Run tests to make sure that the processes are working correctly. Keep records of water quality and pH. Operate and maintain the pumps and motors that move water and wastewater through filtration systems. Read meters and gauges to make sure plant equipment is working properly. Take samples and run tests to determine the quality of the water being produced. Adjust the amount of chemicals being added to the water and keep records that document compliance.

apply now

Drilling Operator

Drilling operator for printed circuit boards. Minimum 2 years of experience. Minimum high school/GED or equivalent.

All Shifts (1st, 2nd, 3rd), 8 hours per day minimum, Monday thru Friday. Saturday and Sunday work is common allowing for overtime pay.

apply now

Career Opportunities

ARLON ELECTRONIC MATERIALS

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

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

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

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

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

For additional information please visit our website at www.arlonemd.com

apply now

KOH YOUNG TECHNOLOGY

Logistics Assistant

Koh Young America is looking for a Logistics Assistant to assist and oversee our supply chain operations. Working alongside a Logistics Specialist, you will coordinate processes to ensure smooth operations using a variety of channels to maximize efficiency. You must be an excellent communicator and negotiator well-versed in supply chain management principles and practices. Also, you should be meticulous with a focus on customer satisfaction. These attributes are ideally complemented by a Bachelor's in Supply Chain Management or equivalent professional experience in the manufacturing industry.

This position is in our Duluth, Georgia, headquarters, where we serve our customers within North and South America. We offer health, dental, vision, and life Insurance with no employee premiums, including dependent coverage. Additionally, we provide a 401K retirement plan with company matching, plus a generous PTO policy with paid holidays.

Koh Young Technology, founded in 2002 in Seoul, South Korea, is the world leader in 3D measurement and inspection technology used in the production of micro-electronics assemblies. Using patented 3D technology, Koh Young provides best-in-class products in Solder Paste Inspection (SPI) and Automated Optical Inspection (AOI) for electronics manufacturers worldwide.

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Career Opportunities

MivaTek Global

Product Manager

MivaTek Global is preparing for a major market and product offering expansion. Miva's new NG3 and DART technologies have been released to expand the capabilities of Miva's industry-leading LED DMD direct write systems in PCB and Microelectronics. MivaTek Global is looking for a technology leader that can be involved guiding this major development.

The product manager role will serve as liaison between the external market and the internal design team. Leadership level involvement in the direction of new and existing products will require a diverse skill set. Key role functions include:

- **Sales Support:** Recommend customer solutions through adaptions to Miva products
- **Design:** Be the voice of the customer for new product development
- **Quality:** Verify and standardize product performance testing and implementation
- **Training:** Conduct virtual and on-site training
- **Travel:** Product testing at customer and factory locations

Use your 8 plus years of experience in either the PCB or Microelectronic industry to make a difference with the leader in LED DMD direct imaging technology. Direct imaging, CAM, AOI, or drilling experience is a plus but not required.

For consideration, send your resume to N.Hogan@MivaTek.Global. For more information on the company see www.MivaTek.Global or www.Mivatec.com.

apply now

MivaTek Global

Field Service Technician

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

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

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

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

More About Us

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

apply now

Career Opportunities

A Flex Company

Sheldahl, a leading provider of flexible interconnect products and electronic materials, is seeking candidates to join their diverse and skilled team.

We are looking for people who demonstrate:

- Intense collaboration
- Passionate customer focus
- Thoughtful, fast, disciplined execution
- Tenacious commitment to continuous improvement
- Relentless drive to win

Positions in America include:

Project Manager – Northfield, MN

Candidate will provide timely cost estimation and project budget definition, be responsible for maintaining customer relations, participate in meetings, etc.

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Program Manager – Specialty Films

Candidate will work with our Specialty Films in the Aerospace, Medical, and Commercial Aviation markets providing timely cost estimation and project budget definition, maintaining customer relations, participate in meetings, etc.

apply now

Program Manager

We are looking for a candidate with a passion for customer service and a commitment to continuous improvement.

Responsibilities:

- Provide timely cost estimation and project budget definition; recommend pricing and estimate lead time.
- Maintain excellent relations with both new and existing customers.
- Review new applications and provide technical support.
- Keep apprised of relevant applications, quality and regulatory standards.
- Participate in contract review and price negotiations.
- Ongoing margin analysis; identify potential necessary price adjustment opportunities and cost reduction projects.
- Participate in the creation and maintenance of technical documentation.
- Manage the coordination of product life cycle activities with team including account management, customer service, purchasing, operations and quality on customer matters.

Requirements:

- Effective technical communicator
- Four-year Engineering degree or equivalent work experience
- PMP preferred
- 7-10 years Product Engineering or Product Management experience
- Well versed in Advanced Technical Materials (Aerospace and Defense preferred)
- Self-starter with trouble shooting/problem solving skills
- Computer savvy, quick learner
- Open to travel

Preferred Experience:

- Project management and planning, ERP systems, CRM Software, spreadsheets
- Experience with cost and project modeling

Benefits:

- Full range of medical benefits
- Life Insurance
- Matching 401K
- PTO
- Tuition reimbursement
- Employee discounts at local retailers

apply now

Career Opportunities

ventec
INTERNATIONAL GROUP
騰輝電子

Technical Support/ Sales Engineer, UK

We are looking to expand our UK technical & sales support team. As a technical support/sales engineer (home office/Leamington Spa) you will assist potential and current customers in appreciating the benefits of using--and optimizing the use of--Ventec materials in their printed circuit board manufacturing processes, and so enhance customer loyalty and satisfaction, spread the use of Ventec materials, and grow sales. You will provide a two-way channel of technical communication between Ventec's production facilities and UK/European customers.

Skills and abilities required for the role

- HNC, HND, degree or equivalent in a technical/scientific discipline
- Sales experience/negotiating skills
- Printed circuit board industry experience an advantage
- Good written & verbal communications skills
- Ability to work in an organized, proactive and enthusiastic way
- Ability to work well both in a team and independently
- Good user knowledge of common Microsoft Office programs
- Full driving license essential

What's on Offer

- Excellent salary and benefits commensurate with experience

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

Please forward your resume to
anthony.jackson@ventec-europe.com

apply now

SIEMENS

Marketing Coordinator/Writing Strategist: Embedded Software

Location: Portland, Oregon or USA (remote)
Job Number: 242982

Seeking a technology communications change maker! Siemens Digital Industries Software is looking for a content creator for its embedded software group. The ideal candidate for the Brand Marketing coordinator/writing strategist position will work closely with engineers and managers to write, edit and produce compelling technology marketing content (magazine articles, blogs, technology papers, multi-media, customer success stories and promotional materials). Do you possess creative energy and enjoy storytelling with an energetic team?

Requirements:

- Strong writing and editing skills
- Education and/or experience in technology, science, journalism and/or English
- A technical background or experience (such as a BS or an associate's degree in engineering or computer science) is preferred
- 1-3 years of experience in writing about technology solutions
- Basic knowledge of online publications, digital platforms and social media is useful to meet project specifications in a fast-paced environment
- Ability to research and collect data, repurpose existing materials, collaborate with subject matter experts, and translate technical information into compelling marketing communications content that engage audiences

Creative materials will be used globally, in a high-energy environment, supporting the world's leading industrial software company.

apply now

Career Opportunities

SIEMENS

Siemens EDA
Sr. Applications Engineer

Support consultative sales efforts at world's leading semiconductor and electronic equipment manufacturers. You will be responsible for securing EM Analysis & Simulation technical wins with the industry-leading HyperLynx Analysis product family as part of the Xpedition Enterprise design flow.

Will deliver technical presentations, conduct product demonstrations and benchmarks, and participate in the development of account sales strategies leading to market share gains.

- PCB design competency required
- BEE, MSEE preferred
- Prior experience with Signal Integrity, Power Integrity, EM & SPICE circuit analysis tools
- Experience with HyperLynx, Ansys, Keysight and/or Sigrity
- A minimum of 5 years' hands-on experience with EM Analysis & Simulation, printed circuit board design, engineering technology or similar field
- Moderate domestic travel required
- Possess passion to learn and perform at the cutting edge of technology
- Desire to broaden exposure to the business aspects of the technical design world
- Possess a demonstrated ability to build strong rapport and credibility with customer organizations while maintaining an internal network of contacts
- Enjoy contributing to the success of a phenomenal team

***Qualified applicants will not require employer-sponsored work authorization now or in the future for employment in the United States. Qualified Applicants must be legally authorized for employment in the United States.*

apply now

U.S. CIRCUIT

Plating Supervisor

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

Competitive benefits package. Pay will be commensurate with experience.

Mail to:
mfariba@uscircuit.com

apply now

Career Opportunities

Now Hiring

Director of Process Engineering

A successful and growing printed circuit board manufacturer in Orange County, CA, has an opening for a director of process engineering.

Job Summary:

The director of process engineering leads all engineering activities to produce quality products and meet cost objectives. Responsible for the overall management, direction, and coordination of the engineering processes within the plant.

Duties and Responsibilities:

- Ensures that process engineering meets the business needs of the company as they relate to capabilities, processes, technologies, and capacity.
- Stays current with related manufacturing trends. Develops and enforces a culture of strong engineering discipline, including robust process definition, testing prior to production implementation, change management processes, clear manufacturing instructions, statistical process monitoring and control, proactive error proofing, etc.
- Provides guidance to process engineers in the development of process control plans and the application of advanced quality tools.
- Ensures metrics are in place to monitor performance against the goals and takes appropriate corrective actions as required. Ensures that structured problem-solving techniques are used and that adequate validation is performed for any issues being address or changes being made. Develops and validates new processes prior to incorporating them into the manufacturing operations.
- Strong communication skills to establish priorities, work schedules, allocate resources, complete required information to customers, support quality system, enforce company policies and procedures, and utilize resources to provide the greatest efficiency to meet production objectives.

Education and Experience:

- Master's degree in chemical engineering or engineering is preferred.
- 10+ years process engineering experience in an electronics manufacturing environment, including 5 years in the PCB or similar manufacturing environment.
- 7+ years of process engineering management experience, including 5 years of experience with direct responsibility for meeting production throughput and quality goals.

apply now

Now Hiring

Process Engineering Manager

A successful and growing printed circuit board manufacturer in Orange County, CA, has an opening for a process engineering manager.

Job Summary:

The process engineering manager coordinates all engineering activities to produce quality products and meet cost objectives. Responsible for the overall management, direction, and coordination of the engineering team and leading this team to meet product requirements in support of the production plan.

Duties and Responsibilities:

- Ensures that process engineering meets the business needs of the company as they relate to capabilities, processes, technologies, and capacity.
- Stays current with related manufacturing trends. Develops and enforces a culture of strong engineering discipline, including robust process definition, testing prior to production implementation, change management processes, clear manufacturing instructions, statistical process monitoring and control, proactive error proofing, etc.
- Ensures metrics are in place to monitor performance against the goals and takes appropriate corrective actions as required. Ensures that structured problem-solving techniques are used and that adequate validation is performed for any issues being address or changes being made. Develops and validates new processes prior to incorporating into the manufacturing operations

Education and Experience:

- Bachelor's degree in chemical engineering or engineering is preferred.
- 7+ years process engineering experience in an electronics manufacturing environment, including 3 years in the PCB or similar manufacturing environment.
- 5+ years of process engineering management experience, including 3 years of experience with direct responsibility for meeting production throughput and quality goals.

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Career Opportunities

Manncorp™

SMT Operator
Hatboro, PA

Manncorp, a leader in the electronics assembly industry, is looking for a **surface-mount technology (SMT) operator** to join their growing team in Hatboro, PA!

The **SMT operator** will be part of a collaborative team and operate the latest Manncorp equipment in our brand-new demonstration center.

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
- Some mechanical assembly of lighting fixtures
- Assist Manncorp sales with customer demos

Requirements and Qualifications:
- Prior experience with SMT equipment or equivalent technical degree preferred; will consider recent graduates or those new to the industry
- Windows computer knowledge required
- 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
- Ability to lift up to 50 lbs. repetitively

We Offer:
- Competitive pay
- Medical and dental insurance
- Retirement fund matching
- Continued training as the industry develops

apply now

Manncorp™

SMT Field Technician
Hatboro, PA

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

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

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

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

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Career Opportunities

BLACKFOX
Premier Training & Certification

IPC Instructor

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

Independent contractor, possible full-time employment

Job Description

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

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

Qualifications

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

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

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

Send resumes to Sharon Montana-Beard at sharonm@blackfox.com.

apply now

INSULECTRO

Are You Our Next Superstar?!

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

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

View our opportunities at Insulectro Careers (jobvite.com)

apply now

Career Opportunities

American Standard Circuits
Creative Innovations In Flex, Digital & Microwave Circuits

CAD/CAM Engineer

Summary of Functions

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

Essential Duties and Responsibilities

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

Organizational Relationship

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

Qualifications

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

Physical Demands

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

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Innovative Circuits, Inc.
Real Quality Is Innovative!

Multiple Positions

Innovative Circuits, a quick-turn, high mix, low-volume PCB manufacturer located in Alpharetta, Georgia, is growing and looking for talented individuals to join the team.

Front End Engineering Manager

Oversee CAM, programming/production engineering and quoting departments. Ideal candidates will have 15 years' experience working in a printed circuit board front-end department with flex and rigid flex circuit board construction.

Process Engineer

Responsible for the implementation and maintenance of chemical and/or mechanical processes used to produce flex circuits, rigid flex and rigid printed circuit boards.

Third Shift Production Manager

Oversee third shift productions workers, product schedule and reporting.

Wet Lab Tech

Perform all lab analysis using burettes, pipettes, pH/ion meters, atomic absorption spectrophotometer, laboratory balance, hydrometers, hull cells, CVS, and all other lab-related equipment.

CAM Operator

Inspect, modify, and contribute to the initial development of producing flex circuits, rigid flex and rigid printed circuit boards based upon customer requirements and data files.

Quality Inspector

Responsible for verifying that the product meets customer requirements prior to shipping.

Wastewater Technician

Operate, monitor, maintain and troubleshoot the wastewater treatment facility and its processes.

Production Worker

Machine operator and light chemistry in a PCB manufacturing environment.

Please visit the link below to view our opportunities and apply.

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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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CAM / Process Engineer

The JHU/APL PCB Fabrication team is seeking a Computer Aided Manufacturing Engineer to support front-end data processing of APL manufactured hardware. You will directly contribute to hardware fabrication in support of National Security, Military Readiness, Space Exploration, National Health, and Research related to fundamental scientific advancement. This position includes a variable mix of core CAM work scope with additional opportunities for hands-on support such as bare board electrical testing, laser drilling, and mechanical CNC drilling and routing.

Responsibilities:

1. Computer Aided Manufacturing for rigid PCB, rigid-flex, and flexible circuits
   a) Perform design checks, panel layout, coupon generation, file generation, stackups
   b) Support manufacturability reviews with internal APL engineers (customers)
   c) Generate work travelers
   d) Communicate status to supervisors and internal customers
2. Support transition of software tools (Genesis 2000 to InCAM Pro)
   a) Edit design rules checks and generate automation scripts
   b) Develop new ideas to further the technical progress of our product
   c) Develop CAM area through continuous improvement initiatives
3. Interface and inform APL Engineers on PCB design for manufacturing guidelines
4. Operate bare board electrical tester
5. Backup operator for CNC drilling, routing, laser drilling (on-site training)

For more details and to apply:
http://www.jhuapl.edu/careers and search for CAM.

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Career Opportunities

EAGLE electronics Inc.

MANUFACTURERS OF QUALITY PRINTED CIRCUIT BOARDS

Pre-CAM Engineer

Illinois-based PCB fabricator Eagle Electronics is seeking a pre-CAM engineer specific to the printed circuit board manufacturing industry. The pre-CAM Engineer will facilitate creation of the job shop travelers used in the manufacturing process. Candidate will have a minimum of two years of pre-CAM experience and have a minimum education level of an associate degree. This is a first-shift position at our Schaumburg, Illinois, facility. This is not a remote or offsite position.

If interested, please submit your resume to HR@eagle-elec.com indicating 'Pre-CAM Engineer' in the subject line.

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Process Engineer

We are also seeking a process engineer with experience specific to the printed circuit board manufacturing industry. The process engineer will be assigned to specific processes within the manufacturing plant and be given ownership of those processes. The expectation is to make improvements, track and quantify process data, and add new capabilities where applicable. The right candidate will have a minimum of two years of process engineering experience, and a minimum education of bachelor's degree in an engineering field (chemical engineering preferred but not required). This is a first shift position at our Schaumburg, Illinois, facility. This is not a remote or offsite position.

If interested, please submit your resume to HR@eagle-elec.com indicating 'Process Engineer' in the subject line.

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Become a Certified IPC Master Instructor

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

Qualifications and skills

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

Benefits

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

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Career Opportunities

U.S. CIRCUIT

Sales Representatives (Specific Territories)

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

- Florida
- Denver
- Washington
- Los Angeles

Experience:

- Candidates must have previous PCB sales experience.

Compensation:

- 7% commission

Contact Mike Fariba for more information.

mfariba@uscircuit.com

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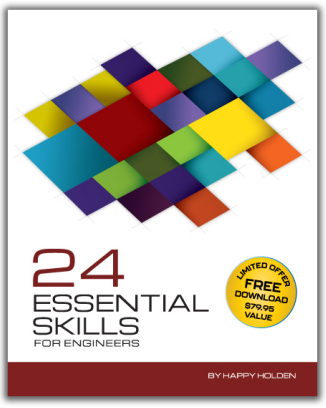

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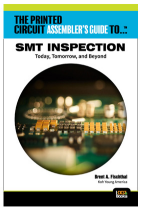

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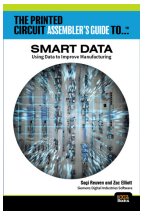
An in-depth insight into new and exciting true 3D inspection technology is provided in this book, along with a look into the future of leveraging big data management and autonomous manufacturing for a smarter factory.



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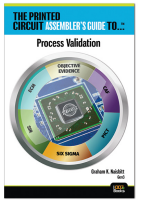

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by Graham K. Naisbitt, Gen3

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

Advanced Manufacturing in the Digital Age

by Oren Manor, Siemens Digital Industries Software

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

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