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Artificial Intelligence

In this issue, we (and AI) will explore how and when artificial intelligence plays a role in manufacturing today. Whether on the factory floor, or in the front office, AI applications are emerging and changing how we approach planning, processes, and problem solving.



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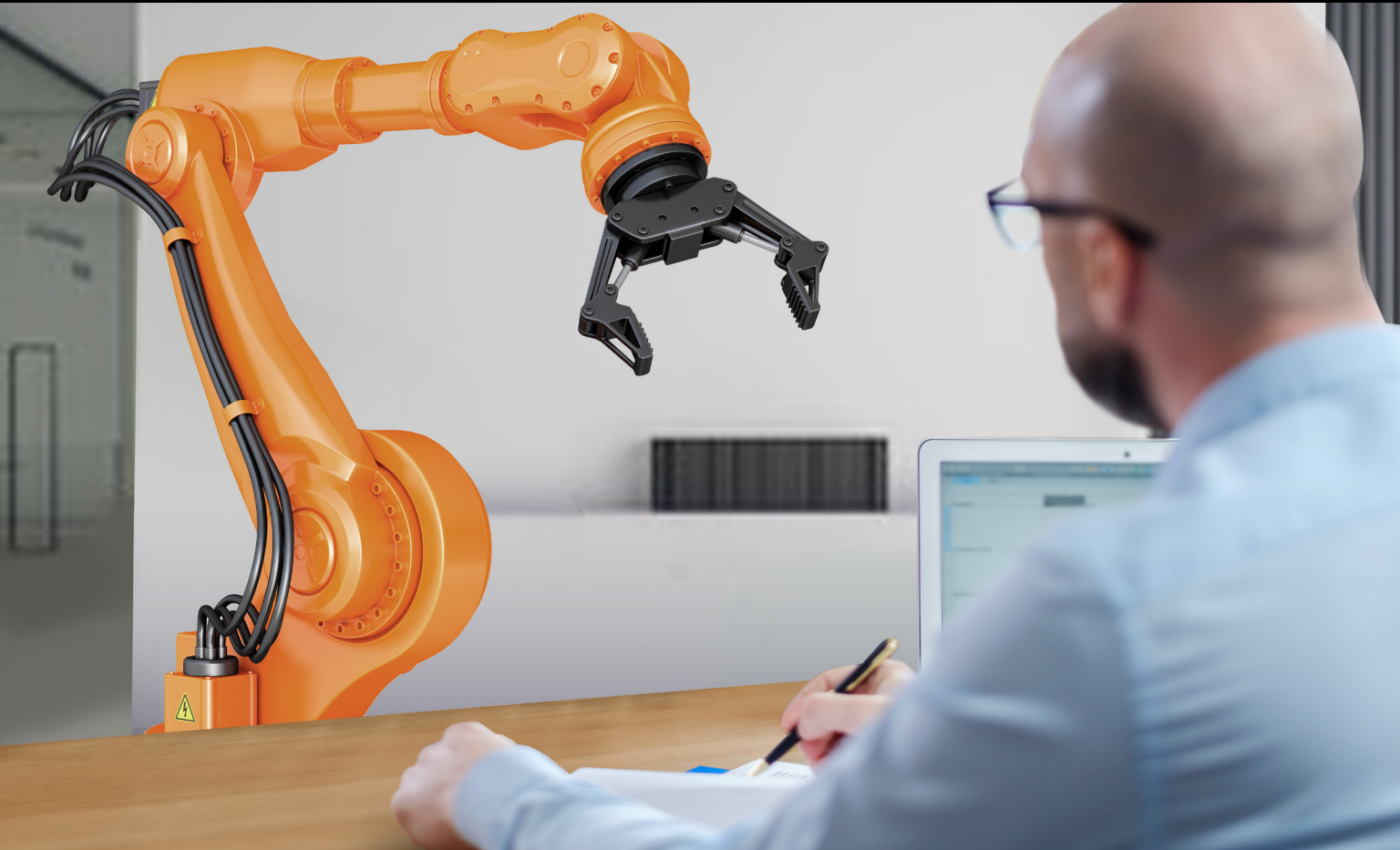
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How to interview a robot



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The Turing Test

Nolan's Notes

by Nolan Johnson, I-CONNECT007

You can't escape it even if you try: Mainstream media coverage of artificial intelligence (AI) is everywhere. Reporters and editors are tossing all sorts of requests at ChatGPT, Bing AI, and the like, then reporting on what they get back for results.

You see typical themes like, "ChatGPT will take away your job," or the media reporting on music awards that explicitly forbid AI-generated music and lyrics. A large chunk of the coverage points out that the results of an AI request are too simplistic or even erroneous. That has us concerned, but remember, we heard the same concerns back in the 1970s, when robotic arms first rolled onto the factory floor. Those robots didn't take away all the jobs, they just shifted the skill sets. It didn't take long for the workers to realize that the robots merely did tedious tasks; it still took people to make sure things ran correctly. The robots weren't really smart, and they couldn't do what humans could.

Has anything changed? Is generative AI smart? How does this affect us in the EMS industry? That's what this month's issue of *SMT007 Magazine* is about.

Have you heard of the Turing test? Computer pioneer Alan Turing proposed that a computer program should be considered able to "think" if a human interacting with the program in natural language was unable to tell whether they were communicating with a human or a machine. Turing proposed this test in a 1950 paper published by *Computing Machinery and Intelligence*. There are a multitude of sources for the development of the Turing test, but Wikipedia is concise:

"In 1966, Joseph Weizenbaum, a professor and computer scientist at MIT, created a program which appeared to pass the Turing test. The program, known as ELIZA, worked by examining a user's typed comments for keywords. If a keyword is found, a rule that transforms the user's comments is applied, and the resulting sentence is returned. If a keyword is not found, ELIZA responds either with a generic riposte or by repeating one of the earlier comments. In addition, Weizenbaum developed ELIZA to replicate the behavior of a Rogerian psychotherapist, allowing ELIZA to be 'free to assume the pose of knowing almost nothing of the real world.' With these techniques, Weizenbaum's program was able to fool some people into believing that they were talking to a real person."

A conversation between a human and ELIZA's DOCTOR script.

Did you come to me because you are not ?

>i dont know
What does that suggest to you?

>that i am unintelligent
How long have you been unintelligent?

>since i was born
I see.

>arent you supposed to cheer me up
You're not really talking about me, are you?

>no in talking about me
Why not?

>nrh
I'm not sure I understand you fully.

>rg
Come come elucidate your thoughts.

>what is elucidate
What do you think?

>to see
Can you elaborate on that?

>

Source: Wikipedia Commons

As an undergrad studying computer science in the early 1980s, I recall interacting with a version of ELIZA as a laboratory exercise. At the time, I was unconvinced and lost interest in the conversation pretty quickly. Of course, I knew in advance that ELIZA was a program, not a person. I remember sharing in class that I found “her” rather dull and boring. Intelligent? Perhaps by Turing’s standards in the 1950s, when UNIVAC could perform a whopping 1,095 instructions per second (IPS), but it was insufficiently convincing in 1983 when an Apple II computer averaged 300,000 IPS. Nowadays, ELIZA is nothing more than a quaint exercise.

In fact, in a recent article published on INSIDER, DeepMind co-founder Mustafa Suleyman is proposing a new test for artificial intelligence. Rather than the Turing test, Suleyman suggests in his book, *The Coming Wave: Technology, Power, and the Twenty-first Century’s Greatest Dilemma*, that AI “should be tested on its ability to turn \$100,000 into \$1 million.”¹ Yes, the Turing Test seems quite quaint, indeed.

Like so many other media channels, we couldn’t resist the urge to test the AI engines. I asked some of our contributors to play with generative AI and see what they got back. Happy Holden’s article on business strategies, for example, includes an extended AI passage. It’s somewhat useful and makes for a good starting point. It demonstrates that the program can respond to your natural language request with a much more sophisticated reply than ELIZA, but is it different enough?

I would argue that the current artificial intelligence engines likewise aren’t actually “intelligent.” All that these generative AI engines are capable of is collating or concatenating content and automating the data gathering process; but it’s still based on calculations. Yes, generative AI tools can create program code, art images, prose, or song lyrics upon demand. But at the core of these functions is the fact that the task is simple data collection, recalculation, and transformation of existing data as applied to lan-

guage. What’s missing is “heuristics,” which is defined as “encouraging a person to learn, discover, understand, or solve problems independently, as by experimenting, evaluating possible answers or solutions, or by trial and error.”

Personally, I think the AI fearmongering craze misses the point. To my way of thinking, adaptive machine learning is much more interesting, much closer to heuristic thinking. The algorithmic research into sophisticated pattern identification has led to a wide number of advances in our body of knowledge. Computers running these cutting-edge analyses on big data have recognized patterns as wide ranging as retinal eye diseases, to a potential message from another planet located closer to the center of our galaxy. This last one may be far-fetched, but I will suggest that if and when we locate signals from space aliens, an AI pattern matching tool will be at the center of that discovery. It’s this sort of work that is truly powerful.

So, how do we tackle this topic? Well, mostly by talking to real human beings who are topic experts. We intentionally scoped this conversation down to the EMS manufacturing process. Where does AI (machine learning) fit today? Where might it be going soon? This will be an ongoing topic, undoubtedly. We’re only just entering a brave new world where compute power and database capacity allows for more than number crunching—or should I say, allows number crunching to apply to linguistic communication as well? **SMT007**

References

1. “DeepMinds’ co-founder suggested testing an AI chatbot’s ability to turn \$100,00 into \$1 million to measure human-like intelligence,” by Sawdah Bhaimiya, INSIDER.com, June 20, 2023.



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](#).

Pearls of Wisdom

SMT Perspectives and Prospects

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

Each year, the one-of-a-kind Berkshire Hathaway Annual Shareholders Meeting draws tens of thousands of attendees from all walks of life who make the pilgrimage to Omaha, Nebraska. It is a yearly ritual for me as well to attend in person so I can listen to the wise duo of Warren Buffett and Charlie Munger, while observing the dynamics of the aspiring and the admiring attendees. This year's attendance was reportedly overwhelmingly higher than usual; people stood in line as early as 5 a.m. waiting for the start of the event at 8:30 a.m. An impressive percentage of attendees came from overseas; the person sitting next to me was from Australia.

One question often pops up in my mind: Why are there so many fans and admirers of Warren Buffett and his business partner Charles Munger? Perhaps the overly simplistic answer is they are searching for “wisdom” in investment. But more importantly, it is wisdom they are seeking, in general. They are looking for the key to a wholesome, successful, and long life.

In addition to the information-rich and fun-packed movie featuring Buffett, Munger, Jamie Lee Curtis, and the company's businesses that kick off the event—and the corporate board governance proceedings that conclude the event—the significant and most weighted part is always the Q&A session.

It's during this session that Buffett and Munger field a wide range of unprepared and unannounced questions, alternately from the live audience by lottery drawing and from the questions collected by CNBC worldwide. The nature of the questions ranges from business and life to geopolitics, philosophy, and even artificial intelligence (AI). As in previous years, Buffett, age 92, and Munger, age 99, sustained a solid five hours of questions in two consecutive sessions. It was phenomenal. The sessions were comprehensive and intellectual, and I left feeling very inspired. Munger's usual pithy one-liners were intriguing and entertaining.

I listened attentively during the entire day, and observed keenly while munching on dark chocolate



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almonds purchased from See's Candies in the exhibit hall. See's Candies, by the way, is a Berkshire Hathaway company that reportedly sold more than 22,000 pounds of peanut brittle and chocolate during the shareholder meeting.

In reference to the celebrated Buffett annual letter, here are some selected highlights and the sagacious advice from the duo that you might find of interest.

The Numbers

Nothing can beat tangible performance. Berkshire Hathaway ended the first quarter of 2023 with \$130+ billion in cash or cash equivalents. The company's compounded annual gain was nearly 19.8% from 1965 through the end of 2022, compared with the 9.9% S&P 500. That is an overall return of 3,787,464% vs. 24,708% for the benchmark.

Berkshire Hathaway's contributions to the U.S. Treasury via corporate income tax was \$32 billion during the decade ending in 2021, which is almost a tenth of 1% of all money that the U.S. Treasury collected.

Sustained Performance

Buffett attributes their sustained performance to a dozen truly good decisions. Phenomenal success isn't about getting every deci-

sion right, but about getting important decisions phenomenally right. In his storied annual letter, Buffett wrote, "The weeds wither away in significance as the flowers bloom. Over time, it takes just a few winners to work wonders. And, yes, it helps to start early and live into your 90s." He also attributes their impressive and sustained performance to "knowing" consumer behavior, meaning human psychology.

In reference to the Buffett Annual Letter to Shareholders¹, the secret sauce is to select good businesses. In 1994, Berkshire Hathaway completed its seven-year purchase of 400 million shares of Coca-Cola. The cash dividend the company received from Coke in 1994 was \$75 million. By 2022, the dividend had increased to \$704 million. Growth occurred every year—just as certain as birthdays.

Artificial Intelligence

Although impressed at generative AI's abilities to summarize legal opinions and take on other tasks, Buffett is worried about its potential consequences. He said, "It can do all kinds of things, and when something can do all kinds of things, I get a little bit worried because I know we won't be able to uninvent it." He said he tinkered with ChatGPT when Bill Gates (who served on the BH Board of Directors for 15 years and is a close friend of Buffett) showed him how it worked. Buffett said, "It is very interesting. It can translate the Constitution into Spanish in one second."

He expects AI will change everything in the world, however, he doesn't think it will trump human intelligence. While AI can help screen for stocks that fall under certain parameters, or a set of criteria in three seconds, it has its limitations. AI probably won't tell you which stocks to buy."

In response to a shareholder's question, Munger expressed skepticism on the future of AI and noted, "It will rapidly transform many industries. I'm personally skeptical of some of the hype in AI. I think old fashioned intelligence works pretty well."

The Country and the Economy

Over the years, one of the best Warren Buffett quotes is, “Never bet against America.” With all the domestic issues and global geopolitical challenges, someone asked if he still believes that. Buffett responded, without hesitation, he would still want to be an American born today despite a shift from partisanship to tribalism—a move that does not work well because tribalism means not hearing the other side. He said, “We have to refine our democracy as we go along.” He is still upbeat on the U.S. economy. Munger also noted that he prefers to live today than when he was born in 1924.

A 13-year-old girl who had already attended the shareholder meeting five times, questioned the pair about the U.S. dollar as reserve currency. Buffett believes there is no other option except the U.S. dollar as global reserve currency. However, “printing money to buy votes is not a good thing,” he said. “One has to be willing to be extremely unpopular. It’s madness to keep printing money.”

Munger expressed this sentiment: “If the U.S. is the only extraordinarily prosperous country, it’s not good. We should have a system to take care of other people.” He also expressed his heightened concerns about printing money and its potential adverse impact on the nation’s long-term economy.

China

Both Buffett and Munger believe the escalated tension between the U.S. and China is dangerous. Munger said, “The tension between the U.S. and China is unnecessarily harmful to both countries. The conflict is stupid, stupid, stupid. Each side should respond to stupidity with kindness.” He continued, “Both sides are equally guilty. We need leadership from both countries. We need to understand how to keep either side from playing too hard. This is a different game; you can’t make big mistakes, it’s imperative to not do inflammatory things.”



How to Build a Good Life

A 15-year-old boy asked how to avoid major mistakes in investing as well as in life. Buffett responded, “You should write your obituary and then try to figure out how to live up to it. Spend less than you earn; it’s not complicated.” Munger added, “Stay away from toxic people. Pay attention to how others might manipulate you. Success comes from steering clear of toxic people. Making right decisions is enormously important.”

Munger said, “We make fewer mistakes than other people and that is a blessing to us. We are not so smart, but we kind of know where the edge of our smartness is. That is a very important part of practical intelligence. If you know the edge of your own ability pretty well, you should ignore most of the other notions.”

A mother brought her two daughters, ages 10 and 14, respectively, to the event. She said she wants her daughters to grow up understanding the importance of saving and starting to invest early in life.



Shareholders

Buffett emphasized that most of the company's shareholders are long term, which is most valuable to the company. Attendees who invested in BH as long-term shareholders are those who view BH as one of the best companies in the world and see BH stock safe and diversified.

Elon Musk

Munger was questioned about some prior remarks he had made that Elon Musk might have overestimated himself. Munger responded, "Elon Musk is a very talented person who does not need to overestimate himself. He would not have achieved what he has in life if he had not tried unreasonably extreme objectives. Elon likes to take on impossible jobs, Warren and I are different, we look for easy jobs that we can identify. We don't want to compete with Elon." Buffett said, "Elon is a brilliant, brilliant guy. It's a dedication to solve the impossible, and every now and then he will do it."

Additionally, Buffett recommended watching the Bill Maher interview with Elon Musk from this past April.

Munger followed up by stating that one has to think big to accomplish extraordinary things. Along the way, you will make a few mistakes. This sounds synonymous with what Bernard Arnault said, something like, "If you want to be successful you need to dream. When you dream, you can do the impossible." (Bernard Arnault and Elon Musk are in the same league, alternately, holding the highest net worth status in the world.)

Apple, Inc.

This year, Buffett picked his favorite from the enormous portfolio of companies that BH owns or has invested in. He elevated Apple by saying, "Apple just happens to be a better business than any we own." Berkshire Hathaway owns about 6% of Apple stock. (Apple CEO Tim Cook attended the shareholder meeting.) Buffett believes iPhone's status among consumers makes it an extraordinary product. He stated, "I don't know about iPhones (technologically speaking), but I know consumer behavior. Consumers would rather give up a second car than let go of their iPhone."



Charlie Munger's Advice

- Patience can be learned. Having a long attention span and the ability to concentrate on one thing for a long time is a huge advantage.
- You can learn a lot from dead people. Read of the deceased you admire and detest.
- There is no such thing as a 100% sure thing when investing. Thus, the use of leverage is dangerous. A string of wonderful numbers times zero will always equal zero. Don't count on getting rich twice.
- You have to keep learning if you want to become a great investor. When the world changes, you must change.
- Read, continuously learn, and acquire knowledge.

Warren Buffett's Advice

- Investing in yourself is the best investment.
- Watch the movie "Turn Every Page."
- Find a very smart, high-grade partner, preferably slightly older than you, and then listen very carefully to what they say. "I never have a phone call with Charlie Munger without learning something. And, while he makes me think, he also makes me laugh."

Extraordinary Partnership

It is such a blessed partnership; they can "compound" each other's intellect, knowledge, and wisdom. It creates unbeatable power and is immensely enviable.

Final Thoughts

- Buffett indicated that it is important that Berkshire Hathaway is regarded as a national asset, not liability.
- At Berkshire Hathaway, there is no finish line.
- All in all, Buffett and Munger said they have no complaints.

Conclusion

The secret sauce to attract overwhelming attendance is not monetary investment per se, rather it is a successful healthy life. Nothing can be better than one's own personal experience. In conclusion, I came, I saw, I learned. **SMT007**

References

1. Warren Buffett 2023 Annual Letter to Shareholders.

Appearances

As a part of the IPC Engineering Education Webinar Series, Dr. Hwang will present "Top Electronics Manufacturing Issues—Causes, Solutions & Prevention," July 11, 13, 18 and 20; and "Electronics Reliability for Harsh Environments," Nov. 7–9.



Dr. Jennie S. Hwang—an international businesswoman and speaker and a business and technology advisor—is a pioneer and long-standing leader to SMT manufacturing since its inception as well as to the development and implementation of lead-free electronics technology. Among her many awards and honors, she was inducted to the International Hall of Fame—Women in Technology, elected to the National Academy of Engineering, named an R&D Star to Watch, and received a YWCA Achievement Award. Having held senior executive positions with Lockheed Martin Corp., Sherwin Williams Co., and SCM Corp., she was the CEO of International Electronic Materials Corp. and is currently CEO of H-Technologies Group, providing business, technology, and manufacturing solutions. She has served on the board of Fortune-500 NYSE companies and civic and university boards; the Commerce Department's Export Council; the National Materials and Manufacturing Board; the NIST Assessment Board; as the chairman of the Assessment Board of DoD Army Research Laboratory and the chairman of the Assessment Board of Army Engineering Centers; and various national panels/committees and international leadership positions. She is the author of 600+ publications and several books and is a speaker and author on trade, business, education, and social issues. Her formal education includes four academic degrees, as well as the Harvard Business School Executive Program and Columbia University Corporate Governance Program. For more information, visit JennieHwang.com. To read past columns, [click here](#).



A Vision for **Machine Learning** in Optical Inspection

Feature Interview by the I-Connect007 Editorial Team

DarwinAI is developing machine learning and artificial intelligence solutions to improve AOI inspection results. Their work is unique because it's generally independent of the hardware used in the EMS line. It represents, as much as possible in our industry, a pure-play solution using machine learning and AI constructs.

Earlier this year, the I-Connect007 staff spoke with [DarwinAI CEO Sheldon Fernandez](#) about artificial intelligence and electronics manufacturing. In this follow-up, Sheldon discussed what AI and machine learning are, what they

aren't, and how this work fits into the manufacturing environment of today.

Nolan Johnson: Where does artificial intelligence fit in an industrial environment like electronics manufacturing?

We've focused on visual inspection. The step-change capabilities of artificial intelligence to do such inspection is becoming a significant presence in the industry. We focus on the final third of the workflow—back-end post-SMT assembly—which represents a fairly underserved aspect of the PCBA process. It's also



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an obvious area where you see immediate productivity improvements through deep learning and artificial intelligence.

It would be irresponsible not to mention, of course, the explosion in the AI field with generative AI, which is what ChatGPT is based on. This is when AI generates assets that are beneficial to human beings in any context: natural language, images, generating computer code, and scripting code. You already see this for coding but think about the potential of generative AI for the PCB designers. I imagine those who create design tools—as well as the designers—may leverage this technology in productive ways. I want to be clear: It won't be perfect. But if it gets me 70% of the way there, I can do the rest. Those are the two areas that immediately jump to mind as someone in the AI field.

Johnson: On the design side, we've had auto routers for a long time. In semiconductor, as early as 25–30 years ago, there were IC chip compiler tools. Would those tools be called AI?

They might be. When we say AI, what are we talking about? It's a term that now has come to mean anything that generates a useful asset or insight. Practitioners in the AI field itself typically take AI to mean second or third wave machine learning and deep learning: the facet of artificial intelligence that leverages complex models that learn by analyzing vast amounts of data. No doubt that some of the tools you're describing did a lot of this work. Now, I'm not an expert on the design side, but what is the step change in productivity? In software development, for example, there have always been tools which will help you debug quicker and help with code generation. But there hasn't been a tool where I can say, "Write an algorithm to sort one million numbers with these properties in this time with this algorithmic specificity," which delivers Python, C-Sharp, or Java code. The ease with which someone who's non-technical can get an output like that

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Sheldon Fernandez

is quite remarkable. It's that element of sophistication when I refer to AI.

Johnson: *There is also AI doing pattern matching: looking at a huge pile of data and sorting out patterns for a purpose, whether it's diagnostic or quality inspection. That's not generative, right? What do we call that kind of AI application?*

Typically, we call that machine learning. Say you want to program a machine to look at a million images of something and learn to do a task based on its analysis of those million images. I might not understand how it accomplished the task, although I would understand the answers it's giving me. It makes sense because you've analyzed so much data. That's machine learning, sometimes called deep learning, which is when neural networks carry out the task. Deep learning is a subsection of machine learning. Generative AI is an element of deep learning.

Johnson: *Specific to DarwinAI, is this AI or is it machine learning?*

We fit more in the machine learning/deep learning realm of things. We are leveraging our latest tools in deep learning to do visual inspection of PCBs in a compelling way. For

most EMS companies, there isn't a lot of data on "bad" things: tombstoning, polarity mismatches, missing components; you have to collect the data and it's painstaking. So, we are leveraging generative AI to generate synthetic data across a broad range of PCB configurations to make our AI more effective. We're now doing both and that's been a recent development for us on the generative AI side.

Johnson: *As one refines the scope of the AI application down to some very specific and closely defined applications, such as AOI, does that make AI development easier?*

It certainly makes it easier than the development of a general system. ChatGPT is a multi-million-dollar effort to train a gargantuan model—it has 175 billion parameters. The technical process of creating an AI specifically for a PCB with all its nuances is a more tractable problem than creating ChatGPT.

But we sometimes forget that AI is only 30–40% of the system you're bringing to market. There's the hardware element—the captured images must be high enough quality so the AI can make sense of it. That is an effort distinct from the AI. The AI can be great, but if the images are blurry, they're not high resolution, or it doesn't work with their workflow, it won't be an effective product.

Andy Shaughnessy: *What's the biggest advantage of AI for your company or your customers?*

It's a couple of things. Its accuracy at detecting anomalies and irregularities that would be false flags for many traditional AOIs. The other big advantage is how quickly you can configure a new product. Give us a golden board and within one or two minutes we have a full understanding of the board. So, it's how quickly the AI can understand the new product configuration and get you up and running.

A traditional computer vision system requires explicit programming, whereas AI gets smarter and more effective over time. To do a pixel-by-



sustainability in manufacturing



One long-standing sustainability slogan is “think globally, act locally.” Siemens predictive analytics expert, Jonathan Fromm, introduces us to the “eight R’s” of sustainability in the sixth, and final, episode of this series from *On the Line with...* brought to you by I-Connect007.



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DarwinAI VQI (visual quality inspection) system for PCBA.

pixel matching, it can be more effective with machine learning and deep learning. All that past data gets appropriated into the model, which gets better over time. Sometimes we'll bring up a system for a client that's 93% accurate, but within a couple months we're at 97% because of that feedback loop.

Shaughnessy: How do you start developing this? Tell us about that process.

We start with a traditional computer vision model that we trained to recognize general PCBs from a proprietary PCB dataset we've been collating over the past few years. Then we repurpose that "foundational model" for our customer's product. That allows us to train against a preferred particular client very quickly, given their range of PCBA products.

Now, the AI model is only about 30–40% of the entire system. There's the software which must do all the configuration and the nice user interface you give it. There are the optical imag-

ing algorithms, which, in our case, allowed us to bring a hardware solution to market that's much lower cost than we typically see.

Johnson: What other areas in the assembly line do you see your kind of AI application making sense? Where can this grow?

One of the use cases is conformal coating. There is a lot of interest in solder formation and detecting after the reflow oven. Badly applied solder, I'm told, is a hard problem to crack. How do you determine bad from good in a solder joint?

Beyond that, think of anywhere where you could benefit from increased inspection. The earlier I can detect something and prevent it from going through other parts of the workflow, I'm saving on materials.

Johnson: That sounds to me like you're starting to plug into the CFX data flow.

I think we will see the emergence of real interoperability standards so that you can feed data across all elements of your line and benefit from those feedback loops. Some of our larger clients are asking for this feedback loop between manufacturing and design.

Johnson: What other data from the line is useful in doing your job?

RGB imaging data is just our starting point. There's 3D imaging, which has benefits for large and tall through-hole components that you have to look around. There are X-rays and other modalities. Recently, we wrote a paper on acoustic analysis. The underlying question is whether there is anything about the acoustics of the environment that we can leverage, or is there just too much human noise? What about vibrations of the machines—does that affect alignment? There's a lot of data to collect. Sometimes we become too enamored with collecting data, rather than asking whether it's effective data. Right now, it's all the different ways of collecting that imaging data.

Johnson: Where do you see this five years from now?

Oh my gosh. I was talking to a thought leader in the space that predicted AGI (Artificial General Intelligence) somewhere between 2035 to 2050. He has now revised his prediction to say it will be here in 2026. It's moving so fast. It's exciting, but also a bit alarming. In terms of what this means for electronics manufacturing, the physicality of the space is something that you can't get away from. No matter how advanced ChatGPT gets, there's a real-world process to manipulate physical things, which will mean slower adoption. How does robotics fit? I have no doubt that these things for design and manufacturing will advance significantly in the next two or three years. The physical systems—the robotic implementation of

factory of the future—is coming, but my guess is we won't see manufacturing completely revamped in three years.

Johnson: Sheldon, what do our readers need to know about AI?

When it comes to adopting machine learning or deep learning, they need to know that their competitors are embracing this and they really need to integrate machine learning into their business in a holistic way. They can apply this technology to low-hanging fruit like inspection and design. Many people are interpreting the generative AI craze as an inflection point.

Shaughnessy: Sheldon, thanks for your time. Always a pleasure. SMT007

AI Learning Explored by Topic Experts in I-007e Content Series

Technologists from inspection solutions provider Koh Young discuss AI learning in their latest micro webinar series and guidebook.

In Koh Young's 12-part micro webinar series, "Smarter Manufacturing Enabled with Inspection Data," Global MES Manager Ivan Aduna examines the role inspection systems will play in the next industrial revolution. Viewers will learn about secure data collection, AI-powered solutions to manage and analyze data, and how to leverage IPC CFX-QPL to succeed in the transformation to Industry 4.0.

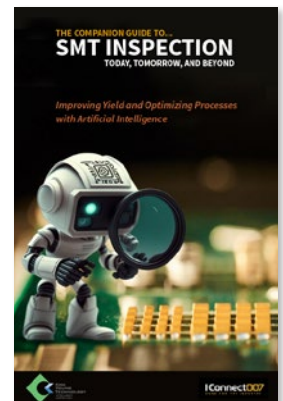
In the first episode, "Smart Factory Success," Aduna discusses how inspection systems and proprietary AI-based learning methods incorporate the

industry's best True 3D measurement-based technologies. He also shares highly focused educational information on the use of data gathered during the inspection process.

This webinar series covers a comprehensive range of topics surrounding 3D inspection and process control. Each segment clocks in at around 5 minutes, with the entire series being viewable in under an hour. Visit [Smarter Manufacturing Enabled with Inspection Data](#) and start watching today.

The company also recently announced the launch of its companion guide to their book, *The Printed Circuit Assembler's Guide to...™ SMT Inspection*. This short guide is designed to provide readers with additional insights into the use of artificial intelligence to improve manufacturing yields, help overcome labor shortages, and improve flexibility.

Visit [I-007eBooks](#) to download *The Companion Guide to... SMT Inspection* and learn more today.





MilAero007 Highlights



NASA Funds Small Business to Advance Tech for Space, Earth ▶

A new slate of funding from NASA will help small businesses develop technologies to advance space exploration, climate research, and more. In mid-April, NASA selected 112 proposals from 92 U.S. small businesses across 28 states to receive Phase II funding from the Small Business Innovation Research program, totaling approximately \$98 million.

American Made Advocacy: Taking the Fight to Capitol Hill ▶

If you're not at the table, you're on the menu. That's one of the reasons, in his State of the Union address, President Biden's praise for an emerging manufacturing renaissance was so welcome. He said, "If we invent it here, we should also make it in America." He sounded a lot like a microelectronics CEO.

Carol Handwerker Appointed to NIST Advisory Committee ▶

We often hear words and phrases that naturally go together: Salt and pepper, touch and go, trace and space. When it comes to the work of IPC member Carol Handwerker, however, the collocations are much more nuanced, and have greater significance. You're more likely to think of phrases such as standards and technology, lead-free and solder, or advanced packaging and heterogeneous integration.

Viasat Completes Acquisition of Inmarsat ▶

Viasat Inc., a global communications company, announced the completion of its acquisition of Inmarsat.

EWPT 2023: A Review by Happy Holden ▶

While IPC was hosting its annual SummerCom mid-year standards event, WHMA was hosting its own "wire show," co-located in Milwaukee, Wisconsin. During IPC SummerCom 2023, more than 90 meetings from May 13–18 were conducted.

Raytheon to Deliver Full Rate Production for TCTS Increment II Air Combat Training System for U.S. Navy ▶

Collins Aerospace, a Raytheon Technologies business, announced it will deliver on the full rate production contract awarded by the U.S. Navy for Tactical Combat Training System–Increment II (TCTS II), Air Combat Training System (ACMI) for the U.S. Navy.

Lockheed Martin to Collaborate With U.S. Army to Improve Space-Enabled Defense Systems ▶

Lockheed Martin signed a Cooperative Research and Development Agreement with the U.S. Army Combat Capabilities Development Command's Aviation and Missile Center to advance Beyond Line of Sight connectivity. Under this CRADA, Lockheed Martin and AvMC will jointly develop and demonstrate space-enabled defense systems.

Boeing, Indonesia Partner to Explore Air Traffic Management Improvements ▶

Boeing has signed an agreement with AirNav Indonesia to explore initiatives to further enhance the safety and efficiency of Indonesia's national air traffic management system.

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AI and the Company Strategy

Feature Article by Happy Holden

Any long-term business strategy is the responsibility of the stakeholders for an enterprise, especially now, when the problems, opportunities, and stakes are high. But what is the process? How do you get started? What tasks and data are important? How do such topics as machine learning, automation, and artificial intelligence fit into this process?

To test the effectiveness of today's AI search engines, I asked, "How do I set up a company strategy to gain a competitive advantage?" This is what the AI engine returned for results:

Setting up a company strategy for competitive advantage is a complex and challenging task that requires a thorough analysis of the target industry, the customer needs, and the competitor actions. According to Michael E. Porter, the author of *Competitive Advantage*, there are six strategies that can help you build a competitive advantage:

- **Analyze the attractiveness of the target industry.** You need to understand the rules and forces that govern the industry, such as the entry barriers, the rivalry among existing competitors, the bargaining power of suppliers and buyers, the threat of substitutes, and the role of complementors.

- **Lower the costs.** You can gain a competitive advantage by offering your products or services at a lower price than your competitors, while maintaining quality and profitability. You can achieve this by improving your operational efficiency, reducing waste, optimizing your supply chain, or leveraging economies of scale.

- **Be different.** You can gain a competitive advantage by differentiating your products or services from those of your competitors, by offering unique features, benefits, or experiences that create value for your customers. You can achieve this by innovating your product design, enhancing your customer service, building a strong brand identity, or creating a loyal community.

- **Be focused.** You can gain a competitive advantage by targeting a specific segment of the market that has distinct needs or preferences that are not

well served by your competitors. You can achieve this by tailoring your products or services to meet the specific needs of your niche customers, or by offering specialized expertise or knowledge in a particular domain.

- **Avoid being stuck in the middle.** You can lose your competitive advantage if you try to pursue multiple strategies at once, without being able to excel at any of them. You need to choose one strategy that aligns with your core competencies and resources and stick to it consistently.

- **Plan with a competitive advantage in mind.** You need to have a clear vision of what your competitive advantage is and how you will sustain it over time. You need to monitor your performance and feedback from your customers and competitors and adjust your strategy accordingly. You also need to anticipate potential changes in the industry or customer preferences and be ready to adapt or innovate.

"These are some general guidelines on how to set up a company strategy for competitive advantage. However, each industry and company may have different challenges and opportunities that require specific solutions. Therefore, it is important to conduct a thorough research and analysis of your situation before implementing any strategy."

1. **Identify your unique strengths:** Look at your business and identify what differentiates it from your competitors.
2. **Understand your target market:** Analyze your target market and identify their needs and preferences.
3. **Identify your competition.**
4. **Develop a strong value proposition.**
5. **Invest in innovation.**
6. **Focus on quality and customer service.**
7. **Build brand awareness.**

In general, this is good advice, though I see it more applicable for the OEM looking to create a great product. In electronics manufacturing, we own the process that builds other people's products, so smart manufacturing should be our focus. **SMT007**



Deming's 14 Points for the Transformation of Management

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"My 14 Points for Management follow naturally as application of the System of Profound Knowledge for transformation from the present style of management to one of optimization."

- Dr. Deming

"We must preserve the power of intrinsic motivation, dignity, cooperation, curiosity, joy in learning, that people are born with."

- Dr. Deming

- 1 *Create constancy of purpose for improving products and services*
- 2 *Adopt the new philosophy*
- 3 *Cease dependence on inspection to achieve quality*
- 4 *End the practice of awarding business on price alone; instead, minimize total cost by working with a single supplier*
- 5 *Improve constantly and forever every process for planning, production, and service*
- 6 *Institute training on the job*
- 7 *Adopt and institute leadership*
- 8 *Drive out fear*
- 9 *Break down barriers between staff areas*
- 10 *Eliminate slogans, exhortations, and targets for the workforce*
- 11 *Eliminate numerical quotas for the workforce and numerical goals for management*
- 12 *Remove barriers that rob people of pride of workmanship, and eliminate the annual rating or merit system*
- 13 *Institute a vigorous program of education and self-improvement for everyone*
- 14 *Put everybody in the company to work accomplishing the transformation*

Learn More at deming.org/fourteen-points

Machines, People, and AI

Smart Factory Insights

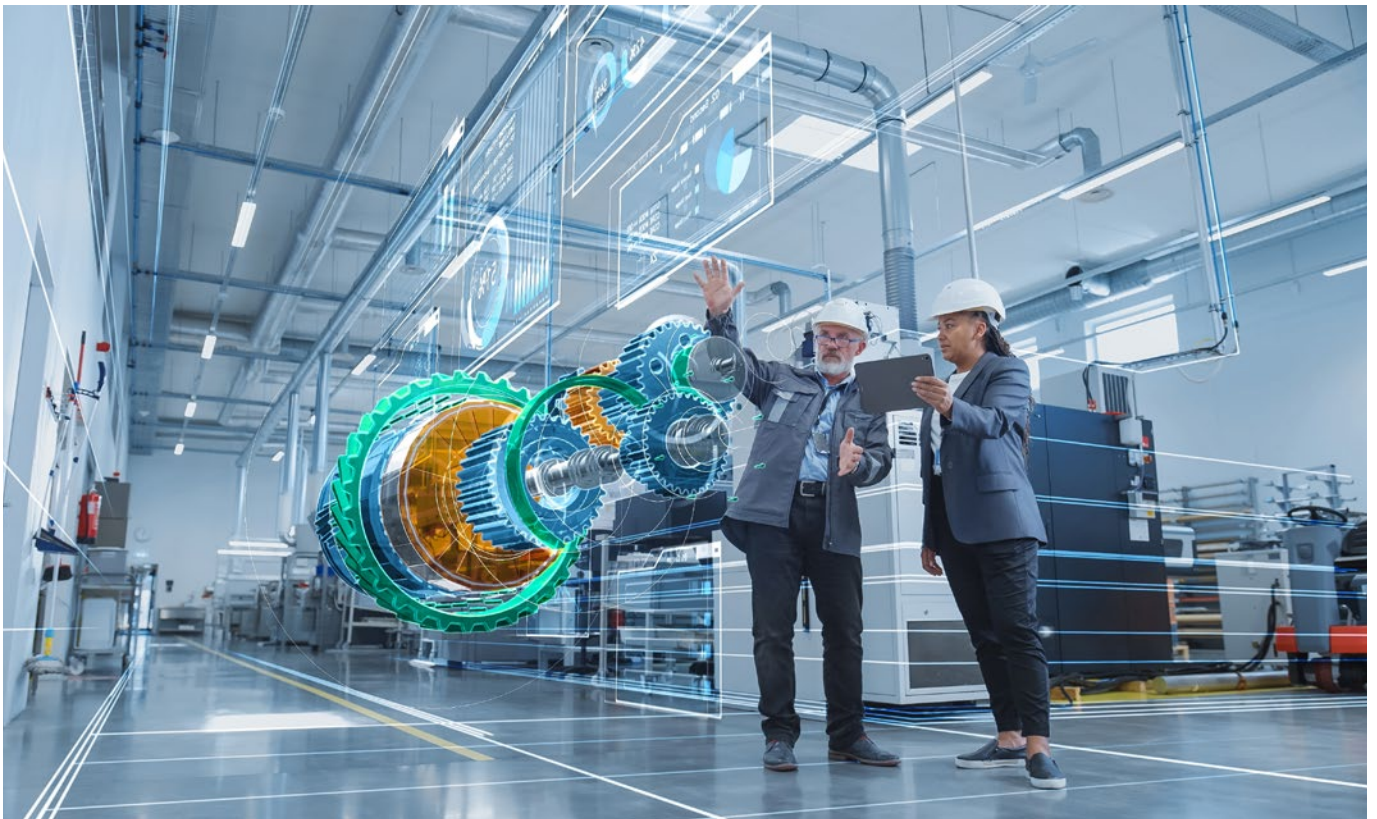
Feature Column by Michael Ford, AEGIS SOFTWARE

Aspiring Smart factories seem to care, perhaps a little too much, about the differential effects of automation vs. people vs. AI. Rather than obsessing over the differences, let's focus on what they all share, since our Smart manufacturing operations require all three to work together in harmony, combining their strengths as they support our business goals.

It seems ironic that since automation was first introduced for mass production, we have since been trying to create machines and supervisory software solutions that work more like the people that it replaced. The “people model” has endured because it has been more adept

to the needs of modern manufacturing profiles of lower volume and higher mix of production. Both manual and automated production approaches share many common core principles and requirements in the Smart factory. In respecting this commonality as part of a holistic manufacturing execution software (MES) solution, we create a new level of flexibility and agility, and avoid accruing losses related to continuous change.

A key but little discussed principle of Smart manufacturing is to break down the assumption that we need separate “islands” of automated and manual assembly. Using produc-



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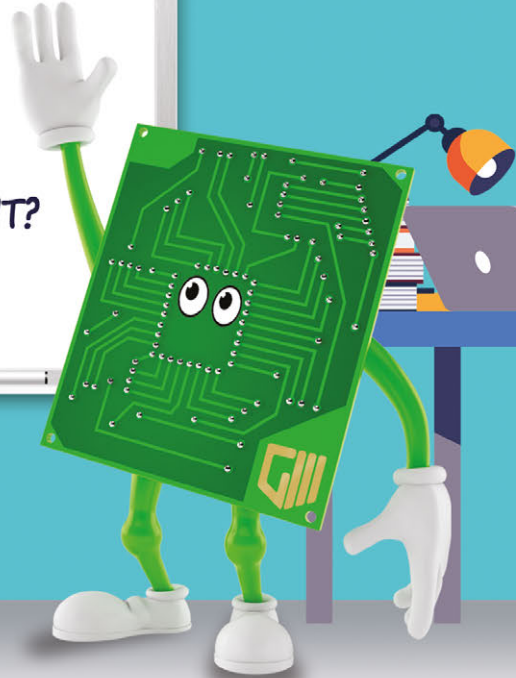


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tion storage space and resources to manage sub-assembly work-in-progress, “thrown over the wall” between islands of processing, is not conducive to agility, optimization, or efficient factory utilization.

If you are not convinced, simply look at the value of materials in your typical buffer-stock locations, as well as the costs of how that space and content needs to be managed, complexities of revision control, first-in/first-out management, and how product quality deteriorates with additional handling and the gathering of dust. Also consider the delay in feedback should any prior process or material that has been used end up contributing to defects. This creates performing very significant re-work overhead without notice. Balancing costs of shift work vs. asset utilization has always been approached through the simplification of segregation without really thinking through the associated consequences and difficulties. This waste becomes more significant today as we embrace the need for efficiencies in low-volume/high-mix environments where such hidden losses, once tolerable, are now crippling the business.

Supporting the Change

This need for change in perspective is being supported by advances in manufacturing technology. We are already familiar with the integration of manual, automated, and semi-automated operations, such as the use of cobots and production stations where data from tools and measurement devices is automatically collected. Digital integration across manufacturing has become a reality, requiring an end-to-end approach that does not discriminate among people, automation, and AI.

There is a required confidence in deciding how to bring separated manufacturing operations together—those that have been perceived to work with different technologies or simply exist on a different level of an ERP bill of materials (BOM). Today, this is much easier to realize. Information in the right digital format fuels

changes that go far beyond the simple automation of manual processes. The use of CAD data, digital product models, digital twins—or whatever the buzzword of the day is—now levels the playing field in terms of manufacturing operation data preparation, work assignment, operational visibility, control, and coordination across all production stations. This could be people-driven, automated, or somewhere in between. Let’s break it down.

Prepare the Relevant Production Information

The first step in getting a production work-order going is to prepare the relevant product information. This comes mainly from design and the BOM. Traditionally, engineering makes the key decision as to which production configuration will be used. Then, depending on the chosen configuration capabilities, the product data is divided up among the separate engineering teams. The assignment is then fixed, as each engineering team prepares their data for either machine programming or manual assembly. This process involves a great deal of manual data manipulation and very little opportunity for flexibility. Data must be combined, separated, and converted into the various formats required for each production station. This often requires bespoke data formatting to depend on the machine vendor, or documentation tools that create drawings and work instructions for operators. Each team independently assesses the most efficient sequence of work. This leads to unbalanced production rates and sub-assembly storage requirements. You then need a very significant amount of work, including depending on specialist knowledge within each team.

How a Smart Factory Differs

Achieving the same result in a Smart factory is significantly different. All production operations are driven by information that comes from the design digitally, potentially com-

prised of a PCB layout, a 3D CAD model of the product for discrete assembly, 3D representations of materials used, and BOM data derived from ERP and/or PLM solutions—all in an electronic format.

Automation within the modern digital manufacturing engineering (DME) tool is a crucial part of a modern Smart manufacturing software solution. The combination of CAD and BOM data allows automated allocation of work, and creation of the specific types of data required for each manufacturing station. For machines, specific data formats and sequences are prepared automatically with the knowledge and know-how of each machine requirement. For manual assembly and semi-automated stations, a complex set of interactive electronic work instructions is created through operational steps following pre-composed templates.

From the user perspective, this is a simple and almost totally automated process (where suitable source data is available), as there are complex AI algorithms working within the software that replace critical dependencies on engineering “deep dive” niche skills. The whole engineering process becomes much more flexible. Rather than having to fix a product allocation to a target production configuration, such decisions can now happen as a reaction to real production demand using configurations that best fit the end-to-end balance of production capabilities and prior work-order progress.

Operations planned adaptively in this way far exceed the efficiency of those planned by traditional methods. The use of DME in a Smart factory reduces lead-time, eliminates mistakes, and provides an unprecedented ability for the

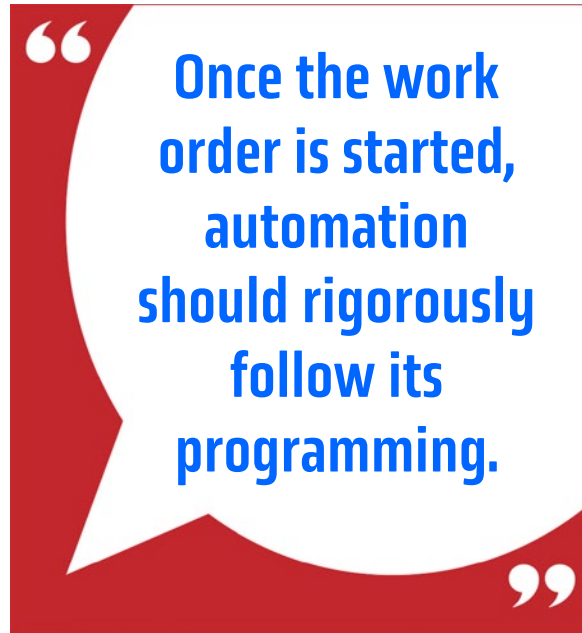
flexibility and agility needed for high-mix production, all the way up to the automation of single pieces.

Once information has been prepared for the production station, setup and preparation can start. For both manual and automated stations, verification of materials, tools, and incoming product is essential for production to execute correctly. In the traditional factory, this is done by manual confirmation, which ironically introduces the potential for mistakes. In

our Smart factory, all the data is prepared such that verification can be automated using, for example, Smart feeders or semi-automatically using bar codes. Setup times can be greatly reduced through this automation, which significantly reduces the productivity impact of high-mix manufacturing.

Once the work order is started, automation should rigorously fol-

low its programming. Exceptions often happen, so it’s essential to have a real-time connection with the station to provide visibility and control of the operation. To understand the root causes of issues, there is traditionally a dependency on manual measurements and data recording. But this is almost impossible for an operator or engineer running a machine at high speed. In the Smart factory, key facts and data points related to run-time progress or issues are analyzed in context with the prepared “digital twin” of the verified product and setup. This reveals a wide variety of information used to further refine productivity, quality, and maintenance. The IPC-CFX standard has become the popular solution of choice, as a “plug and play” IIoT connection for such communication purposes. Smart factory AIs col-



lect and contextualize data. This provides information which engineers can use to orchestrate any supporting or corrective actions that may be required.

A Different Kind of ‘Interface’

The same paradigms I’ve detailed are used for automation and are relevant for manual assembly operations which represent a different kind of “interface” to gather data. Rather than using traditional work instructions as a reference, electronic work instructions are interactive, conduct the active operation, and detail step-by-step activities throughout. Data is collected and confirmed, such as the start and end times of each task and activity, as well as exceptions that may occur, all in a way that the operator can qualify and contextualize. One example is the consumption and spoilage data of materials, which allows for Lean material management and quality data for analysis. Smart tools, such as torque wrenches, electronic rulers, scales, etc., that are being integrated into the operation then automate that collection of measurement data. Manual assembly operations become as “smart” as automated processes. AI-based analytics gain the same qualified information from manual assembly stations as from automated.

Use and analysis of contextualized Smart factory data becomes common across the whole manufacturing floor. Functionalities and bene-

fits of Lean material management, active quality, and adaptive planning are applied in a comparable and interoperable way. Advanced AI-based analytics have the same opportunity to provide insight and assessment of opportunities for improvement, and reaction to challenges, be they restrictive or opportunistic.

The de facto rule of manufacturing quality has always been that if a human “touch” is involved, there will be defects. This rule applies ubiquitously around manufacturing. With the automation of data collection, there is uniformity in contextualization, treating all stations as equals, visibility, reaction, and control; the human touch is taken out of situation assessment and focused on actions and outcomes. Manufacturing becomes more dynamic and controllable, with reduced dependencies on deep-dive skills. This reduces downtime and increases productivity and quality.

Machines, people, and AI have, for some time and will always now be, elements in our manufacturing equation. Let’s have them work together in harmony, to deliver our best business results. **SMT007**



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





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Advancing Automation

Feature Interview by the I-Connect007 Editorial Team

All images courtesy of Marquette University

Dr. Phil Voglewede has a professional background in manufacturing and has been at Marquette University for the past 15 years, where he's a professor and associate chair of the mechanical engineering department. He was recently named director of Marquette's new Omron Advanced Automation Lab. In this interview, Phil shares his vision and mission for the lab, and how Industry 4.0 automation must be approached differently than the automation boom of the 1980s and 1990s.

Barry Matties: *Phil, let's start with an introduction to the lab.*

The lab is quite unique as it is a lab of failure. When Omron gave us the gift, they asked if I wanted a system integrator. I vehemently refused. I said, "I want to try to do it." For example, I'm not a computer scientist, I don't

know how to create an IT infrastructure. You learn by just stumbling through it. That's what we're trying to do in the lab.

Matties: *What's the purpose for the lab? What is your area of focus?*

I do most of my work in motion: How you make things move the way you want them to move, whether it's in a manufacturing environment or in products, such as label makers, CT scanners, and so on.

However, this lab is bigger than just motion. This lab is established with a million-dollar gift for teaching Industry 4.0. I call it a "lab of failure" rather than a "showcase of perfection." We're trying to "fail" at automation. That way, we can get better at understanding where the pinch points are when implementing automation and Industry 4.0 techniques into your overall Industry 4.0 framework.



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We bought four robots to make a robotic cell: a SCARA-type robot, an anthropomorphic robot, and two 6-axis cobots. I hired some undergraduate students and told them to make it all work together. That's all the information I gave them, and we worked hand-in-hand to see what would work. The students wanted a task for the robots, so we've settled on putting together little DUPLO trees. It's something that toddlers can do very well, but machinery struggles with.

Even on this contrived task, we have failed early and often. We struggled to do easy things like setting IP addresses on some of the robots so we could communicate with them, because we didn't understand masks and subnets, and how those all things work together. The failure has been so beneficial because it's synonymous to the problems with the digital twin. If we can't even communicate on the first level, we can't get to this other data. Because we failed and learned from our failure, I understand how to add more sensors and equipment with their own IP addresses, which gets me closer to the digital twin. We just dive in, so we can see where and how we fail.

What's great about Omron is that they've allowed me to do it this way. This is not a grant; this is a gift they gave us. They said, "Just go play." We've had some companies already ask to play in our sandbox, hoping to explore some of these questions: "How do you do this? Can you help us?" We don't promise anything except we will muddle through it like a customer would and learn from it.

Nolan Johnson: The operational goal is to put these DUPLOs together into a tree. In getting there, are you documenting where the process is weak? Is the goal to identify where it will be difficult to program the robots to perform the motion necessary to build the tree?

That's exactly what we're trying to do. We first tried to do it without vision assistance, to see how far we could go—only to find we have to fixture everything. Then we asked, "What if



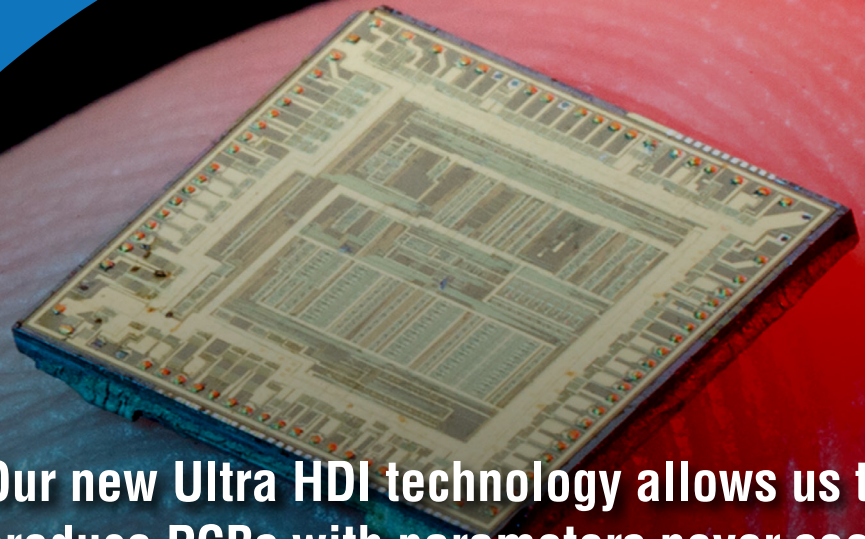
Dr. Phil Voglewede

we do this with vision?" We find it slows down certain things, but it's more robust. Now we're seeing how those limitations from the different approaches can be exploited. If we use vision, how quickly can we get the information we need and act on it? If I don't use vision, it's quicker from this other aspect, but maybe not robust when there's something that's not supposed to be there or has shifted in some way. We then keep throwing other sensors at the problem to understand those limitations. We looked at force feedback and how that could be done, for example.

We're always looking at those constraints on how these things work together. But, even bigger than that, consider whether I have the sensor and how I talk to it. How do I get that information quicker, and how do I get the data that the sensor needs loaded in?

This is almost like Industry 2.0 Lean manufacturing, except we're applying Industry 4.0-style technology, then leveraging that feedback we didn't have before so that we can do it right. That's the type of continuous improvement we're doing.

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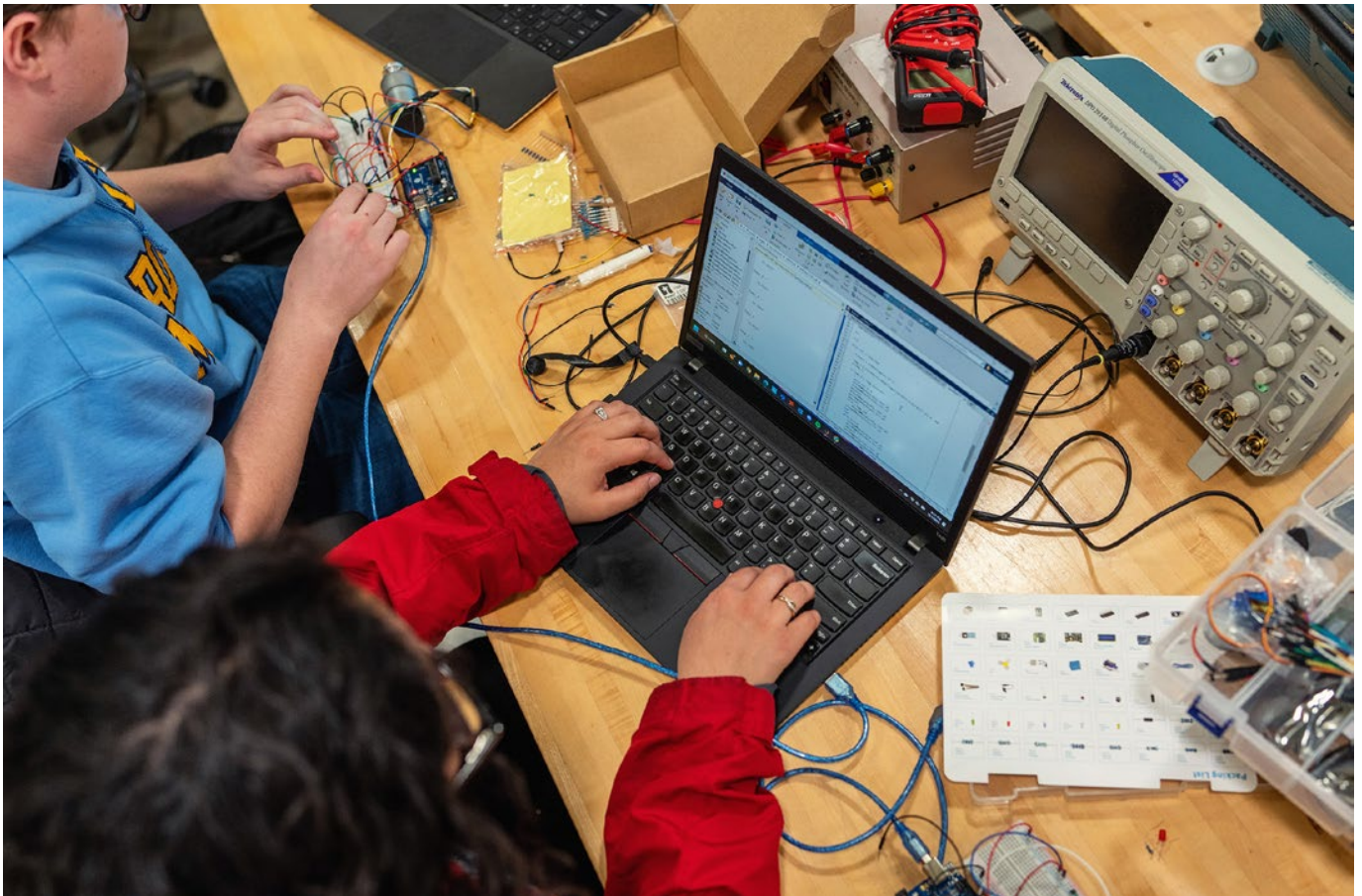
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Johnson: *It seems like you're doing the fundamental research which will get used as the basis for application work.*

Some people will say that's not research, or that's applied research, but I don't really care. For me, this is what we need to be doing. This is what will move the industry forward, when as academics we start looking at those things and asking where the problems are. We need to work at this level on the front lines. That's what we must be doing.

Johnson: *It's interesting that you describe Industry 2.0 activities in an Industry 4.0 environment. In my opinion, the thing that's missing from the robots is something innate for humans: heuristic thinking. You could just assume heuristic thinking would be present in Industry 2.0, but now? You can't assume that.* Yes, absolutely. I look at Industry 4.0 and it's great. We are applying things like artificial intelligence, but they don't have those heu-

ristics that we've developed over time. How do we address that? It almost complicates our job as engineers trying to specify these menial tasks at a much higher level—you know, picking parts up is becoming commonplace. How do we make that better? How do we apply those heuristics to the automation?

Matties: *Hasn't industry already been down this path? In the automotive industry, everything is robotic. What are you doing differently? Are you trying to develop a blueprint to hand to companies and say, "Here's how you start if you're starting from zero?"*

We just discussed finding those pinch points. I've seen this in industry. When I was working at Whirlpool in the 1990s, we had similar instances. We automated everything because that's what we thought we had to do to remain competitive; we went all-in on automation. We found that some robotics and automation didn't work, but the market still needed

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product. So, what did we do? We ripped a lot of the robotics out. When you're in manufacturing, you don't have time to fail; you don't have time to investigate. It's all about, "How can I solve this problem right now?"

This lab is different because we don't have that constraint. I don't have production. When we fail, we stop and ask, "Why don't we do it differently? What if we started over?" You can't do that in industry. You only get one shot. In this lab, we have a playground. In production, if I go out and buy a robot or automation, it must be right. That makes me very risk averse. In the lab we're allowed to be risk takers. If it didn't work, that's great, we'll try something different. Maybe we'll cut it down or cut this part out. We will see what worked and what didn't. The lab gives us the flexibility of time, and freedom to take more than one shot.

Matties: *We hear about Smart factories all the time. It's not a flip of the switch decision to be a Smart factory, but rather tiptoeing in with a Smart process approach. What strategies*

should PCB manufacturing be looking at in terms of automating a facility?

Fundamentally, whether you're making appliances, vehicles, or making printed circuit boards, the problems you encounter are the same. The main general limitation is in getting one thing to talk to another and acting on that information. It doesn't really matter what you're making.

Our goal in this lab is to find out what the general limitations are. If you have to get to the PCB-specific limitations, then find a PCB manufacturing lab where you can fail. If you don't get to fail, you'll be continually risk averse.

Matties: *Typically, when a company starts to look at robotics, they call in a robotics company that arrives to sell robotics, not necessarily to solve a manufacturing problem, if you will. How do you address that? What advice do you give?*

That sounds like the adage, "Give someone a hammer and everything looks like a nail." When we say we have to automate, we automatically think robotics, but you need to look at the

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entire process and ask, “Where can you automate that process and how can you do it more effectively?” In a sense you need to go back to Industry 2.0, where you first apply Lean manufacturing tools. Don’t go to the technology first.

What really concerns me about the Industry 4.0 push is the application of technologies where it is not needed or appropriate. I keep telling the companies I work with to make sure they can do Industry 2.0 and 3.0 first. Don’t go straight to 4.0 because you will end up exactly like we did

in the ’80s and ’90s: You’ll put it in, and then rip it out because you didn’t understand the process.

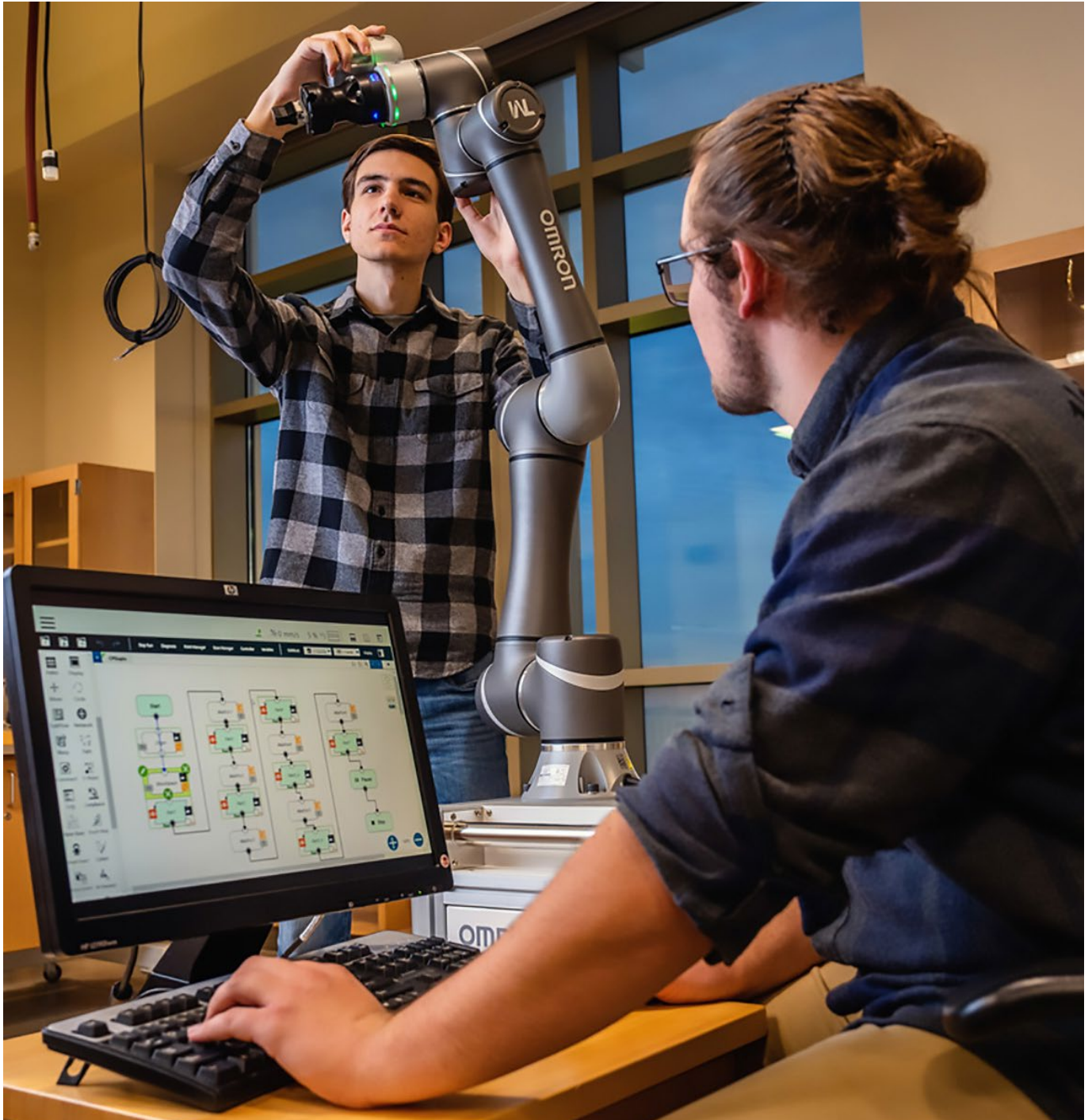
Matties: *When people are looking at automation, what’s the goal? Is it to reduce labor? To improve quality or throughput? How do they put it in the right priority?* That’s the business aspect of Industry 4.0. We’ve partnered with the business school at Marquette, so we can understand the priori-



ties. We've already had an operations management class visit the lab and I taught the business undergrad students how to program the cobots so they can understand automation to the point of how to set those priorities.

The priority must be set by management, but they can't make that choice unless they understand the technology. An engineer understands the technology but may not understand the business case and constraints.

For example, if I'm considering going from producing 400 widgets in a month to 3,000 widgets in an hour, how and where I apply automation is a business decision. What do I do with automation when we're already making 10,000 widgets a day, but we have an army of employees who are nearing retirement age? That is a different automation question. You have to train the business side to realize that there are other things they have to consider rather than





just cost, quality or throughput, and we must be better at explaining to management what those constraints and limitations are from an Industry 4.0 aspect.

Happy Holden: What helped me very early on was redefining automation into two vectors: mechanization and systemization (or information). Then we broke down all the functions people did by how much time they (or the machinery) spent on moving the object, reading the work order, reading the instructions,

or changing the dials. I developed six levels of mechanization and six levels of information. I'm still waiting to see a good digital twin that I can play with, because, you know, everybody talks about it, but I haven't seen too much that I can lay my hands on.

You make a great point. It's like the value stream mapping they talk about in Lean, or boundary diagrams. We need to be trying to understand those fundamentals of where the energy is going. Where's the movement of goods or the information going? What needs to be done?

Then you can then see the right technology—whether it’s AI, or whether it’s just better training, or moving something closer that used to be far away. That’s almost Industry 1.0. I love that concept of trying to see what needs to be mechanized, what needs information, and how you do that in the most effective way to fit the needs of your business and then apply Industry 4.0 technology into it.

Matties: *We often hear fabricators say, “We’re small volume, quick turn, with many part numbers. Automation is not for us.” My argument is that it’s exactly what’s needed most.*

Right. Consider the cobots in our lab, where you’re able to quickly roll one up to the task, use free mode to train it quickly, and suddenly



the cobot reports that it might be able to automate that step. I never realized that possibility before because it didn’t have an ROI. But I can use AI for a better understanding about variations in processes. The same thing is true with the digital twin and asking whether I could do that more effectively.

Matties: *Thank you so much.*
Glad to share, talk to you later. SMT007

IPC’s Approach to Research Strategies

In a recent conversation with IPC senior leadership, Chris Mitchell, VP, global government relations, spent a few moments outlining the evolving role of market research within the association. In the interview, Nolan Johnson asked Chris about IPC’s approach to market research.

Chris Mitchell: Market research has been a core mission of IPC since the organization’s founding, but the nature of the research program has evolved over the years to reflect industry changes and interests. When I joined IPC a decade ago, we had a market research program that was heavily oriented toward statistical programs and survey-based reports.

We’ve made a commitment to continue and grow these statistical and survey-based reports, but we also knew that we needed to deepen our authority on a broader set of research topics. To support this goal, we brought on experts, including our chief technology officer Matt Kelly, chief economist Shawn DuBravac, and lead sustainability strategist Kelly Scanlon. These IPC authorities are leveraging their expertise to communicate new insights and data-driven conclusions.

These individuals aren’t just supporting research; they are helping to direct it. And the result has been exciting because the scope of IPC research is

broadening to new areas of industry interest. This is consistent with our goal to better serve the industry. IPC has outlined four areas that we are focused on:

1. Economic analysis and market research
2. Workforce and education
3. Environment, health, and safety
4. Technology trends and solutions

Almost all our research falls into one of these four categories. We’re still very much in a building phase. We want to make sure that we have the right people on staff to support the research and you’ll see increasingly that we are looking within the association to better integrate industry intelligence into every major IPC area of activity.

Our greatest sources of industry intelligence, however, are the thousands of volunteers who power IPC programs. We want to make sure that we are utilizing the incredible expertise of our members. We’ve taken a first step in this direction by creating our Thought Leaders Program, which is comprised of industry leaders. This is just the first step. There will be more opportunities for everyone to get involved in our research, so please communicate your interests and needs so we can design our programs accordingly.



The IPC-CFX Train Is Approaching Your Station

Article by Chris Jorgensen

IPC

*I hear that train a comin’
It’s rollin’ ‘round the bend
And it’s making limited stops
on its way to taking electronics
manufacturers to Industry 4.0.*

That last line may not have made it into Johnny Cash’s final lyrics for “Folsom Prison Blues,” but it fits a lot better into a technical piece vs. the guy in Reno who did make it into the original lyrics.

There is an IPC-CFX train building momentum. It seems like every time we turn around, we hear about more progress being made—some we can report and some we can’t—and it shows that if your company hasn’t started its own IPC-CFX journey, it’s time to book your ticket and hop on board.

We see increasing signs that show expanded utilization of the plug-and-play, machine-to-machine communication standard, as well as future-looking ways in which IPC-CFX can help EMS and OEM companies meet their long-term factory automation and data analytics objectives.

Conversations with solution providers, such as developers of manufacturing execution software (MES), reveal that many are encouraging their customers to adopt IPC-CFX because they can focus their time on getting full value from equipment data rather than spending time on translating proprietary languages and protocols between equipment on the line.

Equipment vendors continue to demonstrate through the IPC-CFX Qualified Products List (QPL) that their equipment’s IPC-



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Figure 1: The EMS Industry Supply Chain Resilience and Digital Transformation Technology Forum.

CFX capabilities will meet their customers' needs. Through the IPC-CFX-QPL, EMS and OEM customers can also get clear visibility into vendors' equipment capabilities, including where equipment is missing optional IPC-CFX capabilities.

EMS and OEM companies see the value of having a plug-and-play system that will support faster integrations of future capital equipment purchases and light up their factory automation and data analytics strategies through the data-rich IPC-CFX messaging.

We also see increased calls for IPC-CFX to expand beyond SMT to include PCB manufacturing, back-end-of-line, and even non-electronics manufacturing. There is even word that IPC-CFX is being used right now for the manufacture of car doors. Not the electronics assemblies for car doors, but actual car doors. If there is a manufacturing need for plug-and-play, it seems there are companies out there finding a way to plug IPC-CFX into it.

There are also concerted efforts within industry for IPC-CFX integrations; one example is the exciting new developments out of Taiwan.

Taiwan Says 'Ni Hao' to IPC-CFX

In September 2022, under the guidance of the Industrial Development Bureau, Ministry of Economic Affairs, Taiwan (IDB), the Taiwan

Electrical and Electronic Manufacturers' Association (TEEMA) and the Institute for Information Industry (III) held the EMS Industry Supply Chain Resilience and Digital Transformation Technology Forum. The objective was to advocate for digitalization for Taiwan EMS companies.

It's Thumbs-Up for IPC-CFX During Ceremony in Taiwan

At this event, an IPC-CFX Demonstration Team launch ceremony was held, where III and TEEMA recommended IPC-CFX as the key standard to be adopted to empower the digitalization process and to work together to promote IPC-CFX as the EMS industry equipment networking standard, with government funding provided to support the digital transformation of EMS companies in Taiwan adopting IPC-CFX.

During the Electrical Wire Processing Technology Expo (EWPTE) 2023 in Milwaukee, Wisconsin, representatives from TEEMA and III participated in an official Memorandum of Understanding (MoU) signing ceremony between IPC and TEEMA to promote the use and adoption of IPC-CFX in Taiwan. At the signing ceremony, the III team shared very positive immediate results of IPC-CFX adoptions with Taiwan EMS companies.

In 2022, their joint efforts with TEEMA through the IPC-CFX Demonstration Team in Taiwan have resulted in IPC-CFX production lines at seven EMS companies, comprising 120 pieces of equipment. They have plans for assisting more EMS companies in implementing IPC-CFX, targeting an additional eight EMS facilities and 60 pieces of equipment.

Their key goals of increasing IPC-CFX adoption within Taiwan EMS companies are to address the challenges of low equipment utilization due to small-batch, high-variety production and to explore grouping production and design for automation (DFA) principles to improve production efficiency and reduce costs.

In addition to SMT line implementations, the groups see the full value of IPC-CFX and how it can expand to activities outside of SMT. IPC expects these collaborative efforts to result in expansions of IPC-CFX to better cover back-end processes, including warehouse systems, autonomous mobile robots (AMRs) and other peripheral equipment, thus making IPC-CFX even more comprehensive as a full-scale manufacturing automation and equipment inter-connection standard.

In the same time frame as the activities being reported out of Taiwan, the IPC-CFX Standard Task Group and Plug and Players A-Team have also been highly productive in further expanding IPC-CFX to meet industry needs.

Now Getting to the Cool Stuff

For production lines with AOI and SPI, smarter machines from the same vendor can relate to a proprietary linkage between the two same-vendor devices. Many—or most—EMS lines will have devices from different vendors so a direct linkage between the two is not available. To address this, the task group has developed a new IPC-CFX message—*GetInspectionInfoRequest/Response*—to close this gap and enable electronics manufacturers to choose AOI and SPI more freely based on technical and price/performance criteria.



The new CFX message *GetInspectionInfoRequest/Response* allows the AOI to query inspection results directly from the SPI or supervisory application, e.g., MES related to a particular defect rather than using the UnitsInspection messages of the upstream SPI, which means storing and managing data that may not be needed. *GetInspectionInfoRequest/Response* message enables the device to focus specifically on the data that are needed by the supervisory system.

These enhancements will also benefit a new activity to develop industry requirements standards for automated inspection. The intent of this new activity is to create a group of automated inspection process control standards, with data management, communication (IPC-CFX) and analytics (including artificial intelligence) built in. These standards are critical to improve automated inspection process effectiveness and reduce process variation (e.g., false call reduction).

A task group was recently formed to undertake the first topic in this family (AOI process control for board assemblies), and they plan to produce a standard for industry in 2024. As this group works, we also anticipate task groups to form in the months ahead to focus on AOI for PCBs, subsystem and final system assembly; automated inspection for IC substrates and IC packaging; and SPI for board assemblies. For more information on activities around this new family of IPC standards, or to join the task

group developing the AOI for board assemblies' group, email answers@ipc.org.

Heartbeat Getting Worked Up?

Since its introduction, the Heartbeat message has enabled devices to send periodic heartbeat messages at a configurable interval, typically every few minutes, and for passive connectivity verification. For version 1.7, additional fields have been added to this message to provide repeated active fault and recipe information in every heartbeat message. With this upgrade, system will now be able to collect this important information without needing to wait for the values to change so that a new *GetActiveFaultsResponse* or *RecipeActivated* message would be sent. These additional optional fields in the Heartbeat message are:

- **ActiveFaults**, which is a list of any active faults on the endpoint with information like the *FaultOccurred* message
- **ActiveRecipes**, which is a list of the identifiers of any active recipes on the endpoint with information like the *RecipeActivated* message.

The IPC-CFX message *CFX.Production.RecipeActivated* as originally written reports only *ExpectedCycleTime*, but not the *ExpectedWorkTime*. The newly added *ExpectedWorkTime* property enables the collection and reporting of the total amount of productive time (milliseconds) that is expected to process one unit or a group of units (e.g., carrier, panel PCB), assuming no blocked or starved conditions at the station. Together with existing messages such as *WorkStarted/WorkCompleted*, this data can be used for real-time performance tracking and analysis.

Making the Leap into Sustainability

As sustainability in electronics manufacture becomes more prevalent, EMS companies will need to identify ways to control energy usage in their facilities. Although SMT equipment

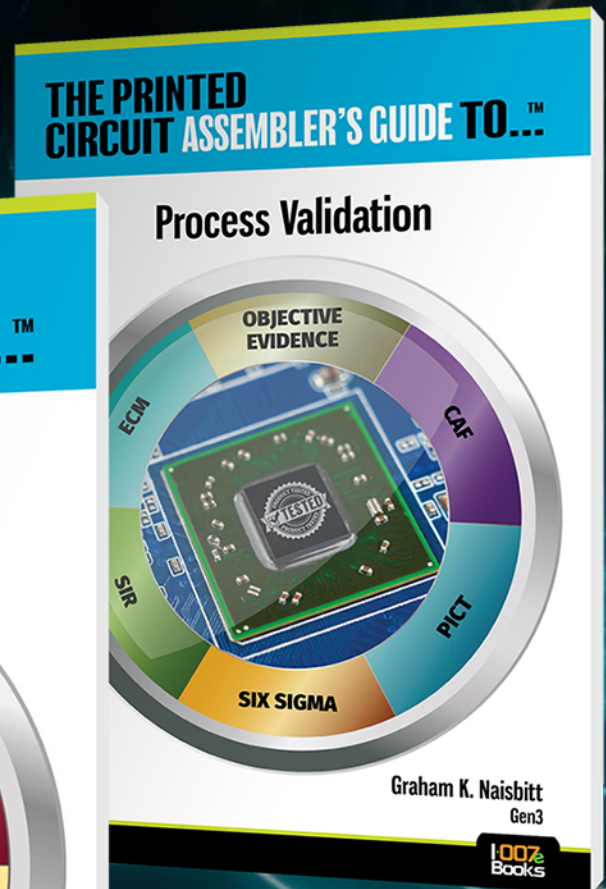
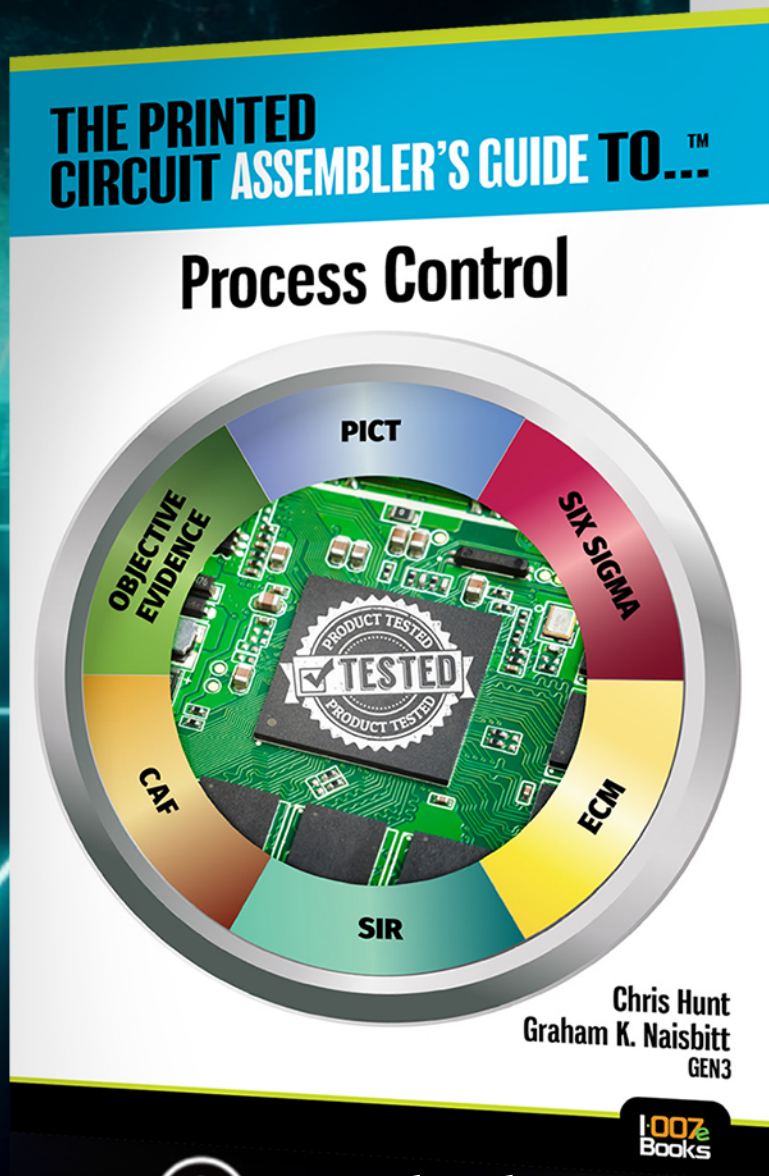
may inherently include energy savings capabilities and state-specific wake-up times for resuming its activities, those pieces of equipment can't activate an energy-saving state on their own. Conversely, supervisory systems know production plans, scheduled downtime, etc., but they will not know a piece of equipment's energy savings capabilities.

The standard now closes this communication gap with a series of new messages:

- Using *CFX.GetEndpointInformationRequest/Response*, supervisory systems can Request equipment capabilities concerning energy management, with an equipment Response message providing a list of sleep states with three parameters:
 - Name of the sleep state
 - > Percentage of saved energy
 - > Wake-up time to get back to productive state
- Using *CFX.ResourcePerformance.ChangeSleepStateRequest*, supervisory systems can control energy management state of equipment by requesting the device to change to a sleep state or back to productive
- Using *CFX.ResourcePerformance.EnergyConsumed*, equipment will regularly report detailed information about its energy usage and power consumption
- Alternatively, the supervisory system can query equipment's energy usage and power consumption using *CFX.ResourcePerformance.EnergyConsumptionRequest/Response*, with the equipment Response message providing detailed information about its energy usage and power consumption

The inclusion of these messages is essential for the accurate measurement, control, and management of energy-related sustainability issues, now recognized by industry as a key requirement going forward.

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Recording in Progress

Advanced analytics systems need to be fed with large amounts of machine data such as the messages that IPC-CFX endpoints continually publish with the details of their status and work.

However, IPC-CFX messages are ephemeral, meant to communicate data in flight from a producer to one or more consumers. This means that factories, that may be in the beginning stages of using IPC-CFX or plotting a best path for utilizing the data-rich message IPC-CFX can provide for advanced analytics, will need to build a system that will store all the data into a database, data lake, etc. This can be very an incredibly challenging endeavor.

To address this and enable collection and storing of IPC-CFX data, a new, open-source, IPC-CFX Recorder software program was developed for IPC-CFX, Version 1.6, which will record all IPC-CFX messages generated within a factory for later transfer of the data into an analytics system or database.

It can be accessed at: github.com/IPCConnectedFactoryExchange/CFXRecorder

Boxing Up IPC-CFX

The data recorder is just one aspect of IPC-CFX developments for companies beginning—or looking to begin—their path to IPC-CFX.

An A-Team under the IPC-CFX Standard Task Group is also working on a potential solution for IPC-CFX implementations into SMT legacy lines. They are developing an IPC-CFX standards-based open-hardware interface, designed to enable existing machines, that cannot support IPC-CFX natively through software alone, to become part of an IPC-CFX communication infrastructure.

The hardware comprises readily available components, including a CANBUS controller with four-wire connection and a Raspberry Pi. The architecture is intended to

be modular and scalable, consisting of a primary controller and optional add-on modules, connected using CANBUS. The group chose CANBUS because it has proven use over many years, is modular and flexible with simple wiring and installation, and there are many standard hardware and circuits available.

If you attended IPC APEX EXPO 2023, you may have seen a “light” first demonstration of the A-Team’s work, which was a light tower connected to the Raspberry Pi box which sent and received thousands of IPC-CFX messages during the demonstrations.

As the A-Team continues its work in building out the SDK to support the Raspberry Pi box, they seek input from potential users of the device to ensure the SDK and device hardware instructions will meet industry needs. Anyone with interest in working with the A-Team on this project should contact answers@ipc.org.

Hop on the IPC-CFX Express Line

There is a misunderstanding that adopting IPC-CFX at a manufacturing site is contingent on native IPC-CFX installations on equipment, but that is not the case. There are pathways to integrating IPC-CFX into existing SMT lines so manufacturers can begin to reap the benefits of all the work the IPC-CFX Standard Task Group has done for industry.

EMS and OEM companies should ask their equipment vendors about installing IPC-CFX on existing equipment on the manufacturing floor. Unless a piece of equipment is significantly outdated, an IPC-CFX installation into the device should be possible. Engage an MES provider to see how they can help. As stated earlier, MES providers we have spoken with have indicated they want their customers to move to IPC-CFX, even on existing lines, because having the standardized plug-and-play benefits of IPC-CFX removes the hindrance of connecting equipment together and to the MES system.

There will be EMS and OEM companies that may have home-cooked systems and/or lack the engineering manpower on staff to guide them on a pathway to IPC-CFX installations. To help these companies, IPC is interested in providing a list of IPC-CFX installation support providers. If you or your company have experience working with IPC-CFX installations and can provide support services to manufacturers, let IPC know by completing the [online form](#).

Next Stop: IPC-CFX 2.0

As the IPC-CFX Standard Task Group and the “Plug and Players” A-Team look ahead, they are making plans on IPC-CFX 2.0. It’s still early, so we can’t pull back the curtain too far on what an IPC-CFX 2.0 might look like, but some of the topics under consideration include:

- Standardized IPC-CFX support for non-electronics manufacture; IPC-CFX connections with MTConnect, OPC-UA;

or utilizing IPC-CFX Generic endpoint capabilities as a starting point for additional pieces of manufacturing equipment

- Expanding IPC-CFX capabilities and messages into PCB manufacturing
- IPC-CFX for artificial intelligence AI ecosystem
- Continued demonstrations on how IPC-CFX will support sustainability efforts, including recent activities to

develop a digital twin JSON schema for collecting sustainability data to flow into IPC-CFX

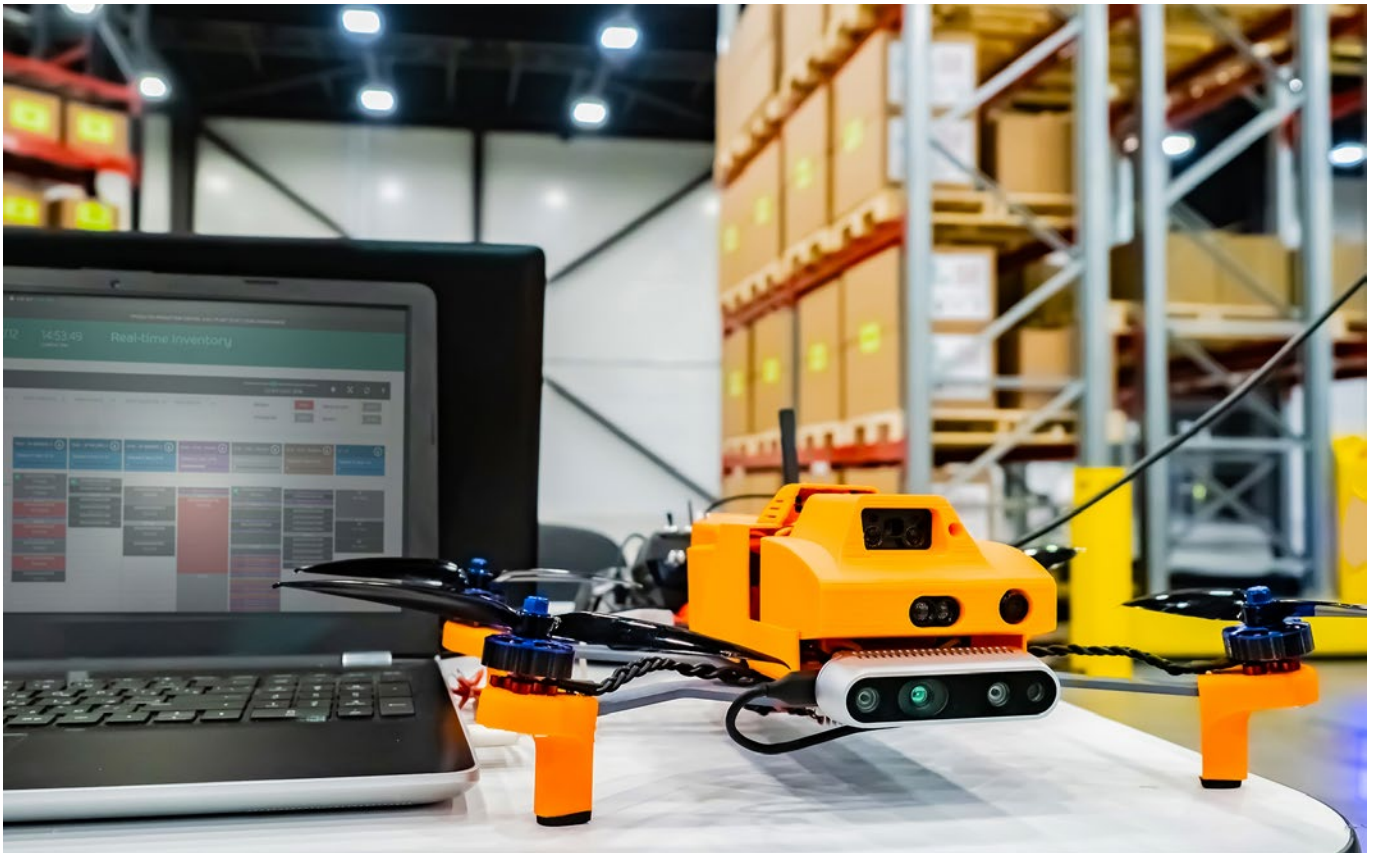
What’s most important in this continuing evolution of IPC-CFX is the voice of industry. The task group and A-Team are comprised of leading minds representing OEM, EMS providers, equipment vendors, and software solutions providers, but for IPC-CFX to be successful for your Factory of the Future plans and support of your customers, the groups need your voice. Share your feed-

back on current experiences with IPC-CFX and areas where we need to expand—or perhaps to better explain existing—capabilities of the standard. Please reach out to me at Chris-Jorgensen@ipc.org to share your experiences and to play an active role in the development of IPC-CFX. **SMT007**



Chris Jorgensen is director of technology transfer at IPC.

“
**EMS and OEM
companies should ask
their equipment vendors
about installing IPC-CFX
on existing equipment on
the manufacturing floor.**”



Driving Without a Map: Automotive OEMs Need **Exploratory Traceability**

Article by Dr. Eyal Weiss

CYBORD

As our daily activities become increasingly digitized, the global demand for microchips and electronic components will continue to skyrocket. As this need grows, there is also a greater need for assessment capabilities to avoid tragic malfunctions and debilitating product-wide recalls.

Consider the automotive industry where lives are at stake should a vehicle include a faulty chip. Automakers are bound to strict technical standards such as ISO 26262, which requires them to use state-of-the-art technology and to identify potential systemic and hardware defects during the manufacturing process. But the industry is not up to date; it's

not adopting state-of-the-art technology when it comes to chip quality and reliability.

As our cars become increasingly digital, industry leaders simply cannot afford to be complacent with insufficient traceability. With a rapid increase¹ in their reliance on automated processes and digitally advanced chips, automobiles today host complex electronic functions from sensors and cameras. As the technological focus of the industry changes, traceability must improve to meet the needs of an industry far different from the one it was even a decade ago.

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strengthen their bottom lines, OEMs must therefore elevate their standards beyond level 4 traceability² and strive for complete exploratory traceability.

Traceability Today

IATF 16949:2016³, the international standard for automotive quality management systems, attempts to ensure the quality of automotive manufacturing. But the production needs of modern vehicles have evolved far more rapidly than the regulations created to monitor them.

For decades, the automotive industry concentrated on optimizing product assembly over-assessing component quality. Currently, there are no widely used tools that provide 100% inspection of electronic components during manufacturing.

While manufacturers do maintain tight supervision on quality control in the assembly process, assessing the authenticity and quality of individual components to prevent the integration of defective electronic components or those damaged by oxidized or corroded leads remains inadequate. Currently, the highest manufacturing standard still fails to examine products on the component level. In addition, the traceability resolution commonly in use is essentially just a glorified version of batch traceability.

The Automotive Component Crisis

Considering today's limited traceability capabilities, any shift in the supply chain has the potential for serious implications for both automakers and drivers. Not only does this significantly increase the chances of automakers purchasing counterfeit or poor-quality chips, but OEMs have no real-time feedback about

the quality of any given supplier's product.

The consequences can be acute. In 2021, for example, Mercedes-Benz seized more than 1.86 million counterfeit parts globally⁴—a 6% increase compared to the year prior.

What Better Traceability Means for Automakers

With advancements in standards and regulations, a new solution has emerged that offers comprehensive visual inspection of every single electronic component. This groundbreaking

approach is called “exploratory traceability,” and it allows OEMs to identify and address potential issues at the individual component level. Unlike traditional batch traceability methods, exploratory traceability provides smart insights, enabling precise recalls of faulty component chips on reels. This targeted approach minimizes waste by avoiding

the need to discard large quantities of products due to a batch-level issue.

Providing OEMs with 100% accurate traceability has a host of benefits. Not only does exploratory traceability minimize disruptions within the manufacturing process, but it reduces waste, redundancy, and scrap rates, all of which ensure higher yields and better bottom lines.

Exploratory traceability also mitigates the impact of recalls. While automotive recalls are rare and reserved for the most extreme cases, they can be incredibly costly, both in reputation and financially. Without accurate traceability data on the source of problematic chips, auto manufacturers may be forced to recall an entire fleet of vehicles—even some without any actual defects, for safety's sake—as they



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are unable to trace back to a specific issue and understand exactly which vehicles might be affected.

Shifting Gears in the Industry

Most chip failures are accompanied by visual indications on the exterior of the chip itself. Therefore, the ability to observe and inspect 100% of chips used in any given product is the most effective and comprehensive means of identifying and mitigating nearly all potential issues.

By implementing robust visual inspection processes such as exploratory traceability, OEMs and automakers can significantly improve product reliability and productivity with surgical precision, reduce the risk of quality issues, and better protect their customers and their bottom lines. **SMT007**

References

1. “Here’s What the Automotive Industry Forecast Looks Like in 2023,” by James Hodgson, Abi Research.
2. “IPC-1782 Standard for Traceability Supporting Counterfeit Components,” by Michael Ford, smtnet.com.
3. IATF 16949:2016, aiag.org.
4. “Mercedes-Benz seized 1.8 million counterfeit parts globally in 2021—report,” by Jordan Mulach, Drive.com, Aug. 10, 2021.



Dr. Eyal Weiss is CTO and founder of Cybord.

Robotics Engineering



Do you love solving complex problems? Are you interested in electronics, programming, and mechanics? You may want to consider a career as a robotics engineer!

Robotics engineers often collaborate closely with software developers to create highly sophisticated robots that can perform certain tasks properly. Even further, robotics engineers might interface with market scientists to find the most cost-effective materials needed to build robots.

Unlike other types of engineering, robotics engineering requires the ability to be proficient in a variety of technical areas—robotics engineers are the

bridge between mechanics, electronics, computer science, and cognitive psychology.

Robotics engineers spend the majority of their time designing the plans and processes needed to not only build robots, but to have them work effectively. Some robotics engineers also design the machines that actually assemble the robots.

Prior to a robot being constructed, engineers determine exactly what the robot will be used for. Since robots are meant to solve problems or alleviate human tasks, robotics engineers undergo an in-depth analysis of the job that the robot will be given.

What exact issue is the robot solving? Is it a repetitive task? Is it a function that is too dangerous for humans? What might restrict the robot from functioning properly? These and many other questions need to be answered before moving on to any design stage.

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Cultivating Connections

A ‘Cost of Ownership’ Project

Maggie Benson’s Journey

by Dr. Ronald C. Lasky, INDIUM CORPORATION

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

Maggie Benson was sitting in her office at Benson Electronics, marveling at how well things were going. Business was booming and she was most pleased with employee morale. Every week or so, an employee would talk to her about how rewarding it was to work at BE and that they were especially happy the company supported continuing education. Sometimes, the employees would get choked up

when sharing with her how rewarding it was to work there.

As she was thinking these happy thoughts, the phone rang, jarring her into the current moment.

“Benson Electronics, Maggie speaking,” she spoke into the receiver. “How may I help you?”

“Maggie, it’s Patty Coleman,” was the reply.

“Professor Patty, it’s great to hear from you,” Maggie answered. “How can I help Ivy U’s most famous professor?”

“Not you, too,” she exclaimed, and started to laugh. “After Sue and Andy started calling me that, now everyone does. Even the dean of the



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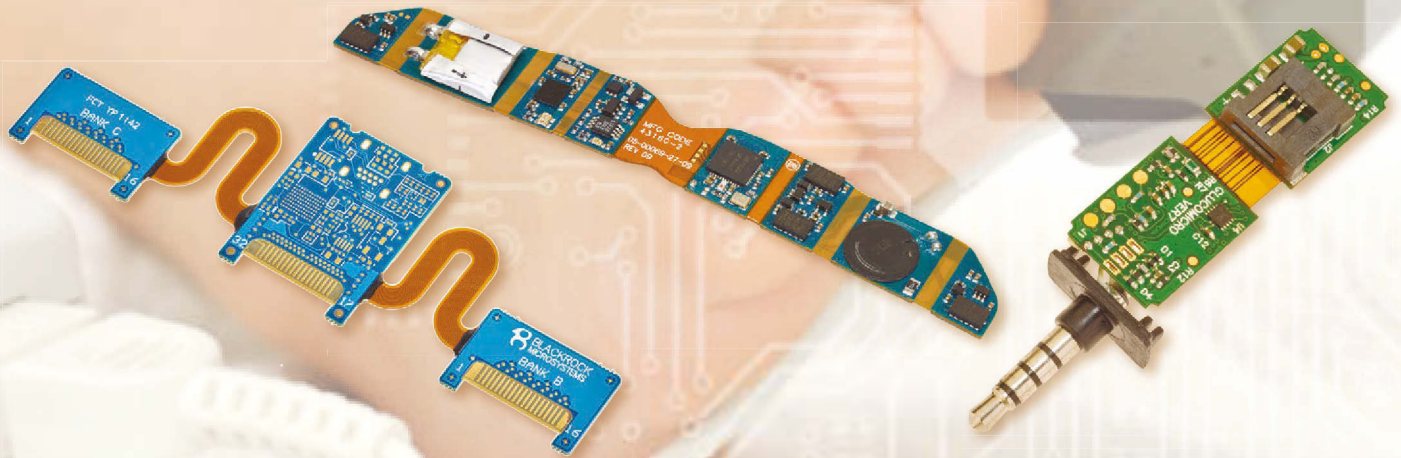
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engineering school called me ‘Professor Patty’ a few days ago.” She then explained the reason for her call: “I have a student who needs a project for a course. I was wondering if you could work with him. I was thinking of something on cost of ownership.”

“Wow, some of us were just thinking about that regarding component placement machines,” Maggie responded. “I have some great ideas, so send the student over.”

A Day Later

Paul LaCroix was nervous. He had an appointment to discuss a possible term project with the famous Professor Patty Coleman. Despite his nervousness, Paul felt amazingly blessed. As a young boy, he and his family had barely survived the 2010 Haitian earthquake, and then emigrated to the United States. Every day at supper, when the family says grace, they include a prayer of thanks to the Lord for their good fortune. Now, he was blessed enough to be a student at one of the most prestigious universities in the world.

As he approached her office, Patty went out to greet him.

“Paul, c’est bon de vous voir. Comment se passe l’année scolaire pour vous jusqu’à présent?” Patty said in quite good French. (For those whose French is a little rusty: “Paul, it is good to see you. How is the school year going for you so far?”)

Paul, a little stunned, replied, “Très bien, mon professeur, merci de demander.” (“Very good, my professor, thank you for asking.”)

Patty’s effort to break the ice succeeded as they both laughed. “How is my French? I feel it is a little rusty,” Patty said.

“It is very good, with an interesting accent,” Paul responded kindly.

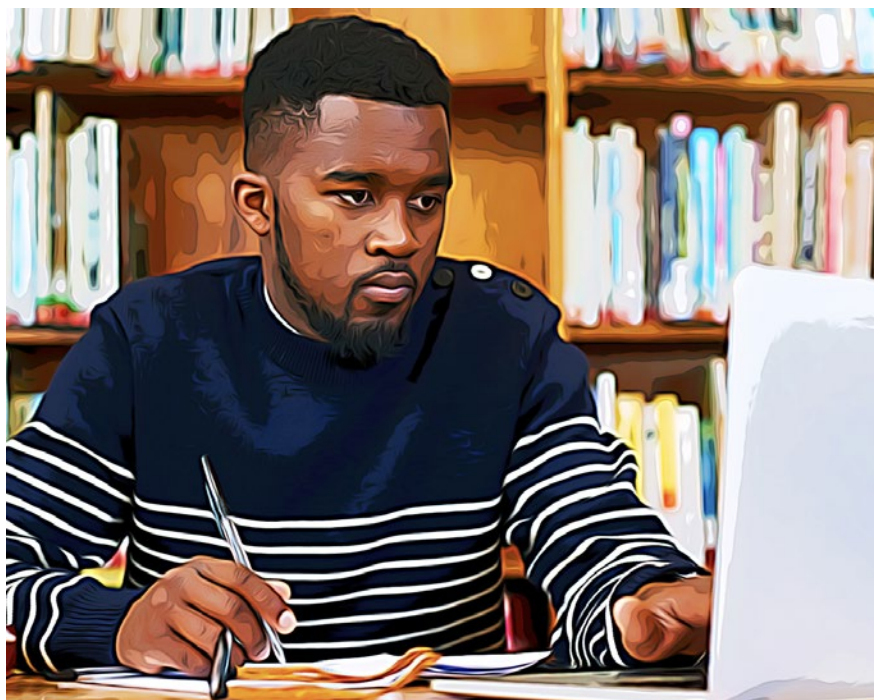
They both laughed again, and Patty said, “Yes, I learned my French in several places, so I have a muddled accent.” She then explained why she invited this student to meet with her.

“Paul, I have what I think is an exciting and useful project for you, and it will fulfill the project requirement for ENGS 127,” Patty said. Maggie Benson at Benson Electronics has a need to understand the cost of ownership methodology. She is expecting you to schedule a visit soon to discuss the project.”

Paul agreed to take on the assignment. He soon contacted Maggie and a few days later, he was sitting in her office at Benson Electronics.

Maggie asked Paul about his life in Haiti and coming to the United States. Maggie was touched by Paul’s story, especially hearing about the numerous times his family barely had enough to eat. What a story! Maggie felt blessed for her own life and all that she had.

After a few minutes of chatting, Maggie decided it was time to discuss the project. “We need to purchase a new component placement, or CP, machine,” she began. “A pushy salesperson is trying to convince us that their company’s CP machine is a better deal as it has a lower cost of ownership. I want you to perform an analysis to see if this is true compared





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We have the latest equipment – What sets us apart is our team!

to the other CP machines we are considering. It might help you to talk with two of my colleagues, Sue March and Andy Connors. They may be able to help you. I already told them you might contact them.”

Paul asked Maggie a few more questions about the project, took the contact information for Andy and Sue, and then was on his way. The next day, he met up with Sue and Andy at a local pizza shop to learn what he could about their previous experiences with this type of project.

“Maggie asked if we could help you with a ‘cost of ownership’ project related to the CP machine that BE plans to purchase,” Andy said. We think it should be related to how the CP machine affects the total profit of the assembly process.”

“That sounds reasonable,” Paul responded, “but how do I do that?”

Will Paul be able to determine the cost of ownership of the CP machine? Stay tuned to see. **SMT007**



Ronald C. Lasky is an instructional professor of engineering for the Thayer School of Engineering at Dartmouth College, and senior technologist at Indium Corporation. To read past columns, [click here](#).

Download *The Printed Circuit Assembler's Guide to... Solder Defects* by Christopher Nash and Dr. Ronald C. Lasky. You can also view other titles in our full I-007eBooks library.

SMTA Working to Get Students Involved

by **Jasbir Bath** and **Steve Martell**, SMTA

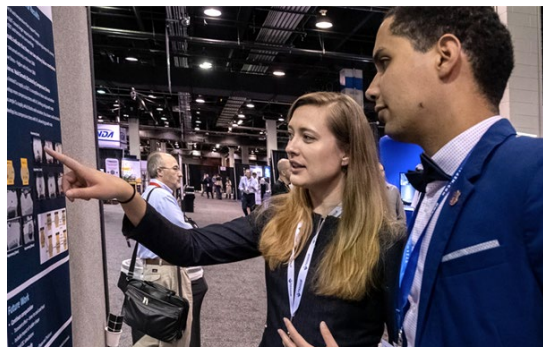
With the increased reshoring of electronics manufacturing, there is a growing need and demand for engineers with electronics manufacturing experience and education. This is particularly the case as the number of engineers who are retiring is increasing. As part of the SMTA's Student & Young Professionals (SYPs) outreach efforts to encourage more students to enter the electronics manufacturing industry, SMTA Silicon Valley (San Jose) chapter officers and volunteers provided a presentation to about 45 students on Careers in Electronics Manufacturing.

The event was held at the Charles W. Davidson College of Engineering at San Jose State University (SJSU) on March 23. The students represented the 10 engineering departments within the University including Materials and Chemical Engineering, Mechanical Engineering, Electrical Engineering, and Computer Engineering. Some presentations were “Introduction to Surface Mount Technology,” “Careers in Electronics Manufactur-

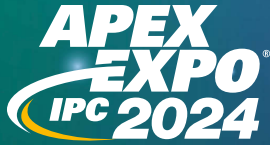
ing,” and “Resources and Internship Opportunities in Electronics Manufacturing.”

The presentations included information on 13 companies who were interested in hiring students as interns. After the presentations, there were individual discussions on resumés internships, and jobs in the industry between the students and the three presenters, as well as the six other chapter officers and volunteers present.

Since the meeting, several SJSU students have sent resumes to apply for some of the internships, and those companies are now in the process of interviewing them. The Silicon Valley SMTA chapter was happy to welcome three new SJSU student members following the meeting. The students appreciated the presentations and advice given to them on finding careers in electronics manufacturing. More SYP events such as this are being planned to reach out to other students in the area.



Jasbir Bath is VP of Technical Programs for SMTA. **Steve Martell** is president of the SMTA Silicon Valley Chapter.



MEETINGS & COURSES

APRIL 6-11

CONFERENCE & EXHIBITION

APRIL 9-11

Anaheim Convention Center | CA

WHAT'S NEXT BECOMES NOW

CALL FOR PARTICIPATION

IPC invites engineers, researchers, academics, students, technical experts, and industry leaders to submit abstracts for the **Electronic Circuits World Convention 16 (ECWC16) Technical Conference** hosted by IPC APEX EXPO 2024.

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Standard of Excellence: Three Tools to Deliver Great Customer Service

Being good enough is no longer enough. As the market becomes more competitive, the demand for great customer service increases. We are no longer competing with rival companies in our own field; we are up against the best in the world. Here are three tools we use to deliver the best customer service.

Anaya Vardya

Mark Laing Talks 'Sustainability in Manufacturing'

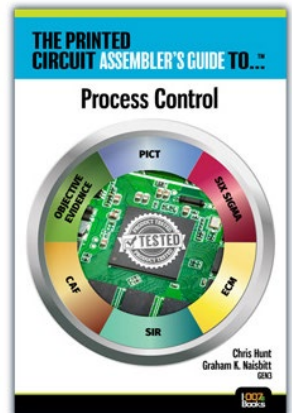


Now available on Spotify, Episode 3 of I-Connect007's new podcast, On the Line with... features an interview with Mark Laing, business development manager for digital industries software

at Siemens. Laing discusses the role of electronics in achieving sustainability. Not only does the electronics industry have a primary role to play here, but it also contributes by creating products which enable other industries to monitor and optimize their sustainability practices.

Latest I-007eBook from GEN3 Focuses on Process Control

The Printed Circuit Assembler's Guide to...™ Process Control, brought to you by GEN3 Systems and I-007eBooks, tackles critical aspects related to process control and the role of the SEC test in maintaining and providing objective evidence.



Koh Young Southeast Asia Unveils Expanded Offices in Penang, Malaysia

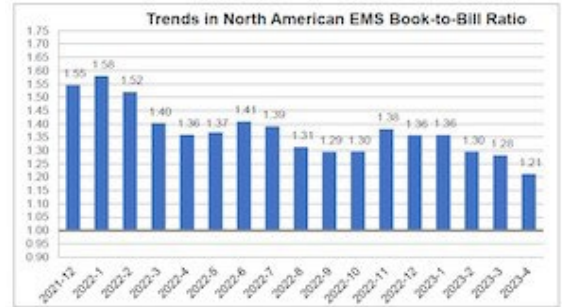
Koh Young announced it proudly revealed its expanded facility in Penang, Malaysia to further cement its market-leading position by offering more space to experience its many different award-winning inspection machines and smart factory solutions available.

Watch ‘Smarter Manufacturing Through Inspection,’ Final Episode of Smarter Manufacturing Micro Webinar Series

Episode 12, “Smarter Manufacturing through Inspection,” from Koh Young’s new micro webinar series ‘Smarter Manufacturing Enabled with Inspection Data’ is available now.

North American EMS Industry Up 14.3% in April

IPC announced the April 2023 findings from its North American Electronics Manufacturing Services (EMS) Statistical Program. The book-to-bill ratio stands at 1.21.



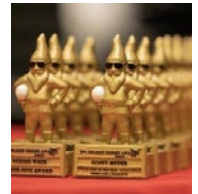
Why Does Sustainability Matter?



In a recent conversation with Kelly Scanlon, IPC lead sustainability strategist, we dove deep into the topic of sustainability, asking what it is and how we achieve it. Because this is such a broad topic, we’ve excerpted just a portion of the conversation here, but what is clear is that we’ve only scratched the surface on sustainability.

IPC Rolls Out Red Carpet for Standards A-Team Volunteers at Annual Golden Gnome Awards Ceremony at IPC SummerCom

The third annual Golden Gnome Awards ceremony was held on May 16, 2023, at IPC SummerCom. The awards recognize the outstanding and creative work of IPC A-Teams, dedicated groups of volunteers within IPC standards working groups who take on a significant amount of work on behalf of their groups.



Maggie Benson’s Journey: The Tale of the Cost-Estimate Problem

Dr. Ron Lasky continues this series of columns about Maggie Benson. In this episode, Sue and Andy get to visit an SMT provider and offer help with the owner’s cost-estimate problem. Are they up for the challenge?



Susan K. Barnes, Mythili Sankaran Join Sanmina’s Board of Directors

Sanmina Corporation, a leading integrated manufacturing solutions company, announced the appointment of Susan K. Barnes and Mythili Sankaran to the company’s Board of Directors effective June 12, 2023.

For the latest news and information, visit [SMT007.com](https://www.smt007.com)

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Career Opportunities



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Sales Engineer SMT North Mexico

Rehm Thermal Systems, a leading German manufacturer of reflow soldering systems with convection or condensation and drying and coating systems, has produced energy-efficient manufacturing equipment for the electronics and photovoltaics industry since 1990. We also offer tailor-made applications related to the soldering, coating and hardening of modules.

Responsibilities:

- This position is responsible for expanding our customer network and maintaining existing customer relationships in the Northeast Mexico region. The Sales Engineer would work closely with the German headquarters and the General Manager Rehm Mexico to implement the sales strategy.
- A candidate's proximity to Monterrey, Mexico, is a plus.

Qualifications:

- An Engineering degree or comparable qualification with a strong technical background is required.
- Sales-oriented attitude, good communication skills and willingness to travel frequently within Mexico is essential.

We offer innovative products, a great dynamic work environment and exciting training opportunities in our German headquarters.

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Please send resumes to: Mr. Luis Garcia at luis.garcia@rehm-group.com.

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Europe Technical Sales Engineer

Taiyo is the world leader in solder mask products and inkjet technology, offering specialty dielectric inks and via filling inks for use with microvia and build-up technologies, as well as thermal-cure and UV-cure solder masks and inkjet and packaging inks.

PRIMARY FUNCTION:

1. To promote, demonstrate, sell, and service Taiyo's products
2. Assist colleagues with quotes for new customers from a technical perspective
3. Serve as primary technical point of contact to customers providing both pre- and post-sales advice
4. Interact regularly with other Taiyo team members, such as: Product design, development, production, purchasing, quality, and senior company managers from Taiyo group of companies

ESSENTIAL DUTIES:

1. Maintain existing business and pursue new business to meet the sales goals
2. Build strong relationships with existing and new customers
3. Troubleshoot customer problems
4. Provide consultative sales solutions to customer's technical issues
5. Write monthly reports
6. Conduct technical audits
7. Conduct product evaluations

QUALIFICATIONS / SKILLS:

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

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

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Career Opportunities



BLACKFOX

Premier Training & Certification

IPC Instructor Longmont, CO

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

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

Salary: Starting at \$30 per hour depending on experience

Benefits:

- 401k and 401k matching
- Dental and Vision Insurance
- Employee Assistance Program
- Flexible Spending Account
- Health Insurance
- Health Savings Account
- Life Insurance
- Paid Time Off

Schedule: Monday thru Friday, 8–5

Experience: Electronics Manufacturing: 5+ years (Required)

License/Certification: IPC Certification—Preferred, Not Required

Willingness to travel: 25% (Required)

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**Prototron
Circuits**

Sales Representatives

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

Reasons you should work with Prototron:

- Solid reputation for on-time delivery (98+% on-time)
- Capacity for growth
- Excellent quality
- Production quality quick-turn services in as little as 24 hours
- 5-day standard lead time
- RF/microwave and special materials
- AS9100D
- MIL-PRF- 31032
- ITAR
- Global sourcing option (Taiwan)
- Engineering consultation, impedance modeling
- Completely customer focused team

Interested? Please contact Russ Adams at (206) 351-0281 or russa@prototron.com.

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Career Opportunities



Regional Manager West Region — Two Positions

General Summary: Manages sales of the company's products and services, Electronics and Industrial, within the Pacific Northwest or Southwest Region. Reports directly to Americas Manager. Collaborates with the Americas Manager to ensure consistent, profitable growth in sales revenues through positive planning, deployment and management of sales reps. Identifies objectives, strategies and action plans to improve short- and long-term sales and earnings for all product lines.

DETAILS OF FUNCTION:

- Develops and maintains strategic partner relationships
- Manages and develops sales reps:
 - Reviews progress of sales performance
 - Provides quarterly results assessments of sales reps' performance
 - Works with sales reps to identify and contact decision-makers
 - Setting growth targets for sales reps
 - Educates sales reps by conducting programs/ seminars in the needed areas of knowledge
- Collects customer feedback and market research (products and competitors)
- Coordinates with other company departments to provide superior customer service

QUALIFICATIONS:

- 5-7+ years of related experience in the manufacturing sector or equivalent combination of formal education and experience
- Excellent oral and written communication skills
- Business-to-business sales experience a plus
- Good working knowledge of Microsoft Office Suite and common smart phone apps
- Valid driver's license
- 75-80% regional travel required

To apply, please submit a COVER LETTER and RESUME to: Fernando Rueda, Americas Manager

fernando_rueda@kyzen.com

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Technical Marketing Engineer

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

Requirements:

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

EMA Design Automation is a small, family-owned company that fosters a flexible, collaborative environment and promotes professional growth.

Send Resumes to: resumes@ema-eda.com

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Career Opportunities



MACHINES FOR PRINTED CIRCUIT BOARDS

Field Service Engineer

Location: West Coast, Midwest

Pluritec North America, Ltd., an innovative leader in drilling, routing, and automated inspection in the printed circuit board industry, is seeking a full-time field service engineer.

This individual will support service for North America in printed circuit board drill/routing and x-ray inspection equipment.

Duties included: Installation, training, maintenance, and repair. Must be able to troubleshoot electrical and mechanical issues in the field as well as calibrate products, perform modifications and retrofits. Diagnose effectively with customer via telephone support. Assist in optimization of machine operations.

A technical degree is preferred, along with strong verbal and written communication skills. Read and interpret schematics, collect data, write technical reports.

Valid driver's license is required, as well as a passport, and major credit card for travel.

Must be able to travel extensively.

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Technical Service & Applications Engineer

Full-Time – Flexible Location

Koh Young Technology, founded in 2002 in Seoul, South Korea, is the world leader in 3D measurement-based inspection technology for electronics manufacturing. Located in Duluth, GA, Koh Young America has been serving its partners since 2010 and is expanding the team with an Applications Engineer to provide helpdesk support by delivering guidance on operation, maintenance, and programming remotely or on-site.

Responsibilities

- Provide support, preventive and corrective maintenance, process audits, and related services
- Train users on proper operation, maintenance, programming, and best practices
- Recommend and oversee operational, process, or other performance improvements
- Effectively troubleshoot and resolve machine, system, and process issues

Skills and Qualifications

- Bachelor's in a technical discipline, relevant Associate's, or equivalent vocational or military training
- Knowledge of electronics manufacturing, robotics, PCB assembly, and/or AI; 2-4 years of experience
- SPI/AOI programming, operation, and maintenance experience preferred
- 75% domestic and international travel (valid U.S. or Canadian passport, required)
- Able to work effectively and independently with minimal supervision
- Able to readily understand and interpret detailed documents, drawings, and specifications

Benefits

- Health/Dental/Vision/Life Insurance with no employee premium (including dependent coverage)
- 401K retirement plan
- Generous PTO and paid holidays

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Career Opportunities



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

- Engineering
- Quality
- Various Manufacturing

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

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

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

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

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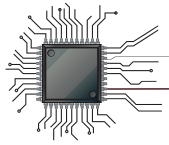
Are You Our Next Superstar?!

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

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

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Career Opportunities



MivaTek

Global

Field Service Technician

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

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

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

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

More About Us

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

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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



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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APCT

Passion | Commitment | Trust

APCT, Printed Circuit Board Solutions: Opportunities Await

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

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

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

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

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ON DEMAND: Free 12-part Webinar Series

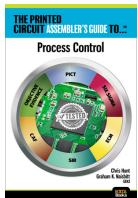
Smarter Manufacturing Enabled with Inspection Data

with expert Ivan Aduna

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



I-007eBooks The Printed Circuit Assembler's Guide to...



NEW! Process Control

by Chris Hunt and Graham K. Naisbitt, Gen3

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



SMT Inspection: Today, Tomorrow, and Beyond

by Brent Fischthal, Koh Young America

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



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

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



Solder Defects

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

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



NEW PODCAST! On the Line with...

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

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

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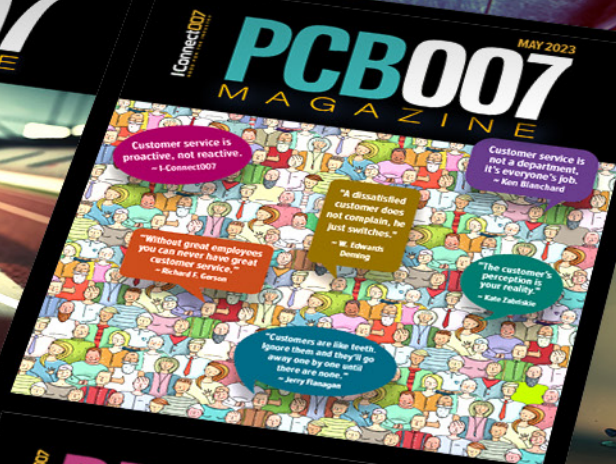
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