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A Closer Look at Shipping Costs
IPC Chief Economist Shawn DuBravac breaks down the trends by sea, air, and land. There’s good news on the horizon.

Journey to Validation
John Vaughan of Summit Interconnect explains the important process of validating to IPC-1791.

[men•tor]: A Wise and Trusted Friend
Garry McGuire has been a mentor to Christina Trussell since 2019, when they were introduced at the Newcomers’ networking reception.

Mexico and IPC on the Move
New IPC Mexico Director Lorena Villanueva is making important inroads with aerospace and automotive industries.

A China Skills Competition
IPC China staff acted as judges for a competition highlighting important technical skills at Wistron.
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I was recently asked what I like about traveling to IPC member locations around the world. My reply was, “How much time do you have?” As IPC president and CEO, I have so many stories to share about the people I’ve met, the new and exciting things I’ve learned, and the electronics manufacturing community I see flourishing everywhere I go.

On a visit to Japan last fall, I met with staffers at CMK, a PCB company with a specialization in the automotive industry. As part of my visit, I hoped to teach CMK more about the benefits of a connection with IPC. I was pleasantly surprised to learn that one
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of CMK’s vice presidents was already participating in IPC standards development. Not only that, but this gentleman had spent part of his career in Georgia, the state that I call home. He was not aware of all that IPC has to offer in workforce education, so I talked to him about how his staff members could benefit from our educational opportunities, and he shared his opinions on IPC standards with me. After that visit, I realized that I can’t fly fast enough or long enough to outpace IPC’s reach. That was a great feeling.

A week and a half after the visit to Japan, I attended electronica in Munich, Germany, and that same vice president had a booth not 50 feet from the IPC booth. Here was yet another chance to connect and build community. An additional upside to all this travel? Friends worldwide!

I visit with IPC members on my travels, and I am reminded that while global electronics manufacturing can seem large and unwieldy, it is a tight-knit, vibrant community of electronics enthusiasts like me. Whether I am in the IPC India, IPC Asia, IPC North America, or IPC Europe areas, my fellow electronics manufacturing colleagues share the same sense of wonder about our industry. The common ground we find is ripe for discussion and connection about how things work, what the next new trend is, and how to solve the issues we face in this ever-evolving industry.

My bags are always packed and ready for my next trip.

Fun Fact
What does the travel schedule look like for a CEO of a global organization? In just October and November 2022, John Mitchell logged 88,896 miles in the air! He visited Germany, Japan, Hawaii, Utah, Oregon and Washington, D.C.
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Home of Arc-Tronics
Arc-Tronics: Quality Runs in the Family

By Linda Stepanich

Arc-Tronics is an EMS company in Elk Grove Village, Illinois, providing electronics manufacturing services for customers in the industrial, medical, aerospace, space, and defense industries. IPC Community talked to the company president, Michael Goeringer, about the founding of Arc-Tronics and its membership in IPC.

Please share with us a little history of the company.

My father, Conrad (Connie) Goeringer, founded Arc-Tronics in 1972 in a basement kitty-corner from Wrigley Field in Chicago, naming it after the three siblings in his family, including himself, his sister Arlene, and brother Ronnie. Later, he moved to a 6,000-square-foot facility in Elk Grove Village, then into a 30,000 square foot facility. In 2000, we added 20,000 square feet. My father wanted a family business, and he got one.

He raised capital from four investors—approximately $12,000—to start the company and he just had the feeling that he could make the business work. He was doing cable and harness, power supply, and box build assembly, as at that time there was obviously no surface mount technology. I now own the business with my sister and brother, Marla and Matthew. We have 200 employees, and we’re on the path to $50 million in sales this year. In fact, we’ve seen tremendous growth in the past several years.

How has IPC contributed to your growth?

We participate in IPC’s monthly EMS market surveys and quarterly North American EMS business performance surveys for information like sales and orders, material costs, and labor costs. Quite often in the past, customers have tried to tell us our operating expenses or our markups are too high, but I have all the facts from the surveys. Because it’s hard to find financials for smaller businesses like ours, the IPC surveys are hugely beneficial. I like the way the results are categorized by company size. It’s reassuring to know, “Hey, we’re headed in the right direction,” or, “We need to take a look at this; our numbers are not in line with IPC’s survey for the sales sector in the industry.”

I have attended IPC APEX EXPO for at least 25 years and the EMS Leadership Summit has been so beneficial to me. The networking is vital, and I’ve formed a good group I can rely on. For example, one EMS provider I’ve met at the summit just recently let me know he had some extra parts he didn’t need because some of his orders were canceled. In this group, we help each other out. We ask how it’s going and what each other is dealing with.
During the pandemic, it was so reassuring to talk to other companies about what they were and weren’t doing and to hear their ideas. When you have multiple companies and people, you always get better ideas.

Obviously, IPC standards are so important, and the certification adds to the quality of our team. All our employees are trained to J-STD-001 standards. In addition, our employees are trained, and all assemblies are built to IPC-A-610 or IPC/WHMA-A-620 Class 2 or Class 3 standards, depending on customer requirements. If repairs are needed, certain employees are trained to IPC-7711/7721.

Please tell us about a recent challenge and how you addressed it.

The ongoing labor shortage is a huge problem for us. If I could find staff for a second shift, I would hire 40 employees tomorrow; we have that much work coming in. Recently, we needed testers for our second shift and asked the son of an employee if he would come over after school and test boards for four hours. After he agreed, we asked if he had friends to bring with him; now a whole carload of high school kids test for four hours at night, three or four nights a week. It’s good money for the kids and a real help to Arc-Tronics. We are having some success as we set up internships through local high schools and colleges. We hope it might lead to an engineering career for many of them.

We do a lot of promoting within, but we also need outside experience. We rely on the IPC Wage and Salary Survey to ensure we are paying a competitive wage and in line to attract outside talent.

How has the industry changed in the past 30 years?

For many years, I was uncomfortable when customers often treated us like suppliers and not partners. Luckily, that has changed. For example, Philips is a large customer that wanted to help us improve our service and reduce costs, so they sent a half-dozen consultants to our facilities for two years. They were instrumental in helping us cut costs, and we, of course, shared those savings with them. We thought we couldn’t afford to add more manufacturing engineers, and they told us we couldn’t afford not to. They showed us how the manufacturing engineers would pay for themselves in less than six months, and we now have six more manufacturing engineers.

Automation is a big change, of course. The pick-and-place machine suppliers are making major advances in speed, accuracy, and feedback to other machines. It helps us remain...
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**Why did you join the EMS Management Council Steering Committee?**

I was invited many years ago, probably initially to help with the golf outings. But through the meetings, I have learned so much, especially from the Technical Marketing Research Committee, which is now dissolved, but I am still in touch today with members of that committee.

It’s been so valuable to be on the EMS Management Council Steering Committee, to talk with owners of EMS companies about our industry, and to become friends with them. A couple of us met before IPC APEX EXPO this year to go wine tasting. We’re competitors, you know, but we are also sharing ideas and getting together because we became friends.

**What are you most proud of about Arc-Tronics?**

I am most proud of things that involve the whole company. We celebrated our 50th anniversary in July 2022. Last year, our longest-serving employee retired. He worked for us for 47 years. We give out service awards on a semi-annual basis and having more than 200 employees with an average tenure of over 10 years at Arc-Tronics is something I am really proud of.

---

**Arc-Tronics Giving Back**

Giving back to the community is an important part of the work experience at Arc-Tronics. In November, employees contributed Thanksgiving baskets for food-insecure families in the Elk Grove community. The company also hosted a blood drive last September. Their goal was to have 14 donors, and they had 18 registered donors, donating 14 total units of blood.

The potential number of patients who could be helped from the donations is 42. Arc-Tronics also runs for charity. Last summer, the company was a platinum sponsor for the Superhero 5K Run/Walk, which benefitted the Road Home, a nonprofit agency that provides shelter, social services, and housing to the homeless.
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For some electronics manufacturing companies, lower freight costs are likely to be their most significant cost savings this year. Decreased demand and improving supply chain dynamics are pulling freight costs down, a trend that should continue throughout this year. Downward cyclical pressures will curtail volume, which should keep prices in check.

**SEA FREIGHT**

Global container flows experienced a rapid normalization in the back half of 2022. In the U.S., for example, imports of 20-foot equivalent container units (TEUs) through leading U.S. ports were up 5.6% through the first half of 2022, but declined 7.6% in the second half. In fact, December’s import total dropped below 2019’s average monthly total, the first such
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decline since June 2020, in the early shadow of the pandemic.

This drop in container throughput has brought containerized freight costs down significantly. The Shanghai Containerized Freight Index, which measures shipping freight costs from Shanghai, peaked at just under 5100 index points in January 2022, up more than 500% from pre-pandemic levels. The index has since declined to levels last seen in the early months of 2020. Similarly, the Freightos Baltic Index, which measures the price movements of FEUs (a 40-foot equivalent unit) across 12 major maritime lanes, peaked in November 2021 at $10,525. The index is expressed as an average price per FEU. The index fell below $2,000 in February 2023, a decline of over 81% from its peak. The index is back to levels last seen in August 2020.

A.P. Moller - Maersk A/S, one of the world’s largest ocean freight companies, said its earnings could fall nearly 80% this year as a result of weakening demand and declining shipping rates. Spot rates for containerized freight were the first to fall, but longer-term contract rates are also starting to decline. Xeneta data shows that the premium between long-term contracts and the spot market fell from over $5,000 per FEU to under $1,300 through the first two months of this year.

Inventory corrections are adding downward pressure to container volume in the near term, and this will likely continue in the months ahead as companies work through excess inventory. Another force likely to keep shipping rates down is the number of new container ships expected to enter the market this year. A record 2.5 million TEUs of new container ship capacity is expected to be delivered in 2023. Carriers will likely attempt to defer some of this new capacity to 2024, and we could also see an increase in cancelled or blank sailings in order to reduce capacity.

Though long-term contract rates will likely remain above spot market prices in 2022, many companies will still look to enter renegotiated longer-term contracts that provide guaranteed pricing. After two volatile years, many companies are looking for certainty even if it means slightly higher prices.

AIR FREIGHT

Global air freight demand fell 8% in 2022 and was down 1.6% from pre-pandemic (2019) levels. Capacity for the year was up 3% com-
pared to 2021, though capacity remains 8.2% below 2019 levels. Air freight accounts for less than 1% of total global trade by volume, but accounts for roughly 35% of global trade by value. It is an important transportation network for high value goods, many of which touch the electronics industry.

Air freight rates are down significantly from their peak levels at the end of 2021. The Baltic Exchange Air Freight Index, which measures air freight rates per kilogram, reports rates on the Hong Kong/North America route are down over 100% from $12.72 in December 2021. Air freight rates on the Hong Kong/Europe route are down 61% from peak, and transatlantic rates are down roughly 56%.

Air freight rates are down significantly over the last nine to 12 months but remain significantly higher than pre-pandemic levels. Transatlantic air cargo rates are still up 80% from pre-pandemic levels, while air cargo rates between Asia and both North America and Europe remain up about 75%. Rates should continue to drop in 2023, but high freighter fleet utilization and elevated fuel costs could keep prices above 2019 levels.

Oil prices surged in the aftermath of Russia’s invasion of Ukraine. The prices peaked around $115 a barrel during the summer of 2022, the first-time oil prices broke $100 per barrel since 2014, then declined after that in line with a broad macroeconomic slowdown. While oil prices have edged slightly higher with the reopening of China, I expect prices to decline modestly this year. Though prices will not return to pre-pandemic levels in 2023, prices will be down sharply from last year.

Gas prices rose in tandem with higher oil prices in 2022 and strong economic activity, especially in the first half of the year. In the U.S., gas prices peaked in May 2022 at a record-setting level, surpassing $5 per gallon. Gas prices are down about 33% from the peak and are off 3% over the last year.

Jet fuel prices were also up in 2022, reaching their highest levels in 14 years. However, jet fuel prices remained high at the start of 2023, the result of tight supply and strong demand. Jet fuel prices rose to levels never recorded in January as China lifted its COVID-19 travel restrictions and air travel picked up swiftly. Moreover, refinery outages and other capacity constraints have kept jet fuel supply in check. U.S. jet fuel inventories ended 2022 at 34 million barrels, the lowest since 1990. The European Union’s ban on Rus-
sian oil products began Feb. 5, 2023, which will further disrupt global jet fuel supply. Jet fuel typically represents 20–25% of total costs, so higher jet fuel will likely keep air freight costs up.

Strong demand for air travel will likely increase air freight capacity in 2023. About half of air freight capacity is in the belly cargo hold of commercial airlines. The reopening of China will increase commercial air travel, which will, in turn, increase air freight capacity. This should drive air cargo prices lower, especially on China routes. Prior to China’s reopening in January, Asia and Oceania air travel had only recovered 57% of 2019 levels, according to IATA, while global air travel had recovered 75% of 2019 levels and North America had recovered 92% of 2019 levels.

**LAND FREIGHT**

Trucking freight rates also declined in 2022. Spot prices this year were down 25% over last year while contract rates were off 6% by February. However, prices have remained higher than pre-pandemic levels. Spot prices are about 25% higher than pre-pandemic levels and contract rates remain about 36% higher. Prices should decline modestly in 2023 on weaker demand but are not likely to fully return to 2019 levels, a year wherein rates were extremely low. Spot rates will likely find a floor in the first half of this year. Contract rates, which are negotiated over a longer time horizon, will normalize later in the year as shippers are likely to wait for prices to bottom before renegotiating. This means contract prices should drop more than spot prices—which have already experienced a notable decline—through much of the year. The difference between spot and contract rates means downward pressure on contract prices will continue. Contract rates are likely to drop another 5–10% in 2023.

The trucking market continues to soften as consumers move away from goods consumption and shift toward spending on services like travel and entertainment. Moreover, higher interest rates mean the demand for large-ticket, interest-rate-sensitive goods—like household appliances or autos—are likely to be weak. The U.S. Bank Freight Payment Index reports freight shipments declined 7.1% in the fourth quarter of 2022 over 2021.
A few factors are keeping freight prices from dropping more quickly. First, fuel costs are up. Moreover, diesel fuel costs are roughly 50 cents per gallon higher than what they should be, given the current price of oil. Second, industry capacity is likely shrinking. Small carriers are probably exiting the market because of cost pressures and weak spot market volumes and rates. This is one factor that will keep spot prices from significantly falling further. A big drop in rates would cause small carriers to exit the market and cut available capacity. Finally, carrier costs are up, creating a floor as to how far prices can fall.

**CONCLUSION**

Prices across all freight transportation modes should soften in 2023; however, many electronics manufacturers expect prices to continue drifting higher. Survey results from an IPC report\(^1\) show that the industry expects freight costs to rise 7.2% on average in 2023. Companies operating primarily in Europe expect prices to rise 9.1%; companies operating primarily in Asia-Pacific (APAC) expect freight costs to be up 10.3%; and companies operating primarily in North America expect costs to be up 6.3%.

**REFERENCES**


For additional IPC industry intelligence and data, please contact me at ShawnDubravac@ipc.org or visit IPC’s industry intelligence website.
The Journey to IPC-1791 Validation

How does a company protect its most valuable electronics manufacturing information? How can designs and processes be kept safe? IPC-1791 is an industry-driven and industry-written standard that focuses on protecting two things: controlled unclassified information (CUI) and controlled technical information (CTI)—the information that would be devastating for a company to lose.

IPC Validation Services plays a critical role in ensuring that you can keep your information safe. This is the team that performs the Qualified Manufacturer List (QML) audits, validating the manufacturing process to the four pillars: quality, supply chain risk management, security, and chain of custody.

To learn more about how IPC members participate in the process, we spoke with John Vaughan, vice president of strategic markets at Summit Interconnect, who provides insight into his company’s IPC Validation Services journey. If you’re working with defense primes, he says, this certification is vital.

By Linda Stepanich
John, please tell us a little about Summit Interconnect.

Summit is the largest privately-held printed circuit board manufacturer in North America, featuring eight highly integrated facilities, over one-half million square feet of advanced technology processing capability, and approximately 1,300 employees.

Why did Summit Interconnect decide to certify to IPC-1791?

We operate in very compliance- and certification-driven markets, and we support a heavily DoD and military prime customer set. Our customers have very high expectations in terms of Summit protecting controlled unclassified information (CUI), supply chain risk management (SCRM), chain of custody (CHoC), quality systems (AS 9100), ITAR/EAR, and compliance to NIST 800-171. The IPC-1791 audit and standard is focused on compliance to all these and our position on the IPC-1791 Qualified Manufacturers List (QML) as a Trusted Fabricator gives our customers third-party assurance through the IPC Validation Services that Summit meets specific criteria that are important to them.

What is significant about the IPC-1791 standard?

IPC-1791 is gaining widespread acceptance across the DoD as the de facto standard for Trusted Electronics Design, Fabricator and Assembler requirements. This is evidenced by:

- The 2021 PrCB Executive Agent Report on DoD Access that states in part, “IPC-1791 addresses quantifiable assurance for printed circuit boards and should be mandated in defense acquisition policy.”
- The FY2020 National Defense Authorization Act (NDAA) Section 224 “requires defense microelectronics products and services meet trusted supply chain and operational security standards.”
- The FY2021 NDAA Section 841 “applies Section 224 of the FY2020 NDAA to covered printed circuit boards” and, in continuum, the most recent FY2022 NDAA Section 851 “applies NDAA FY2020 section 224 to covered printed circuit boards and assemblies.”
- The PrCB Executive Agent Congressional Response Summary that states, “IPC-1791 Trusted Electronics Designer, Fabricator and Assembler Requirements addresses all considerations required in Section 224 for printed boards and assemblies.”

How does this certification differentiate Summit from other companies?

In simplest terms, I believe it demonstrates to our customers that Summit “walks the walk” when it comes to certifying our operations to meet the most stringent requirements for the products that we manufacture in support of our nation’s warfighters.

Please describe the experience of working with IPC’s Validation Services department. Why would you recommend it to others?

If you are in this industry long enough, you meet most of the key people across our industry. I would say, without reservation, that the IPC-1791 leadership team led by Randy Cherry
is exceptional. The engagement almost feels like a concierge service expertly guiding you through the process, the gap analysis, the improvement process, and the qualification. I highly recommend this IPC team.

Do you think other companies will follow Summit’s example? What is the benefit to them?

I just reviewed the QML for IPC-1791 online and 34 companies are now qualification, so adoption of the qualification across the industry is happening. If you take a closer look at the company names on that list, you will find the industry leaders across both the EMS and PCB landscape, with a sprinkling of military primes that also have become certified as they have captive operations that design, build, and assemble PCBs that are part of the DoD systems. If your market is the DoD, I believe it is a very instructive QML for you to analyze. Smart companies make smart decisions and plan for the future of their market.

You’ve looked at Validation Services from two market segments: an EMS company and a PCB fabricator. Why is it in the best interest of each segment to participate in Validation Services?

If you are a U.S.-based PCB fabricator or EMS provider, your core market may be in support of the DoD and military primes. In the very near future, it is my expectation that the DoD will underscore the importance of trust...
IPC-1791:
Qualified Manufacturers List

- APCT Inc., Anaheim and Placentia, California
- Calumet Electronics Corporation, Calumet, Michigan
- FTG Circuits Fredericksburg Inc., Fredericksburg, Virginia
- Hughes Circuits, Inc., San Marcos, California
- IMI Inc., Haverhill, Massachusetts
- L3 Technologies Communication Systems, Salt Lake City, Utah
- Lockwood Industries, LLC, dba Fralock, Valencia, California
- Mercury Systems Edge, Chantilly, Virginia
- Mercury Systems Embedded Hudson, Hudson, New Hampshire
- Mercury Systems Microwave Hudson, Hudson, New Hampshire
- Mercury Systems, Inc., USMO, Phoenix, Arizona
- Science Applications International Corporation, Indianapolis, Indiana
- SEAKR Engineering, Centennial, Colorado
- STI Electronics, Inc., Madison, Alabama
- Summit Interconnect, Anaheim, Orange, and Santa Clara, California; Toronto, Ontario, Canada
- Teledyne Advanced Electronic Solutions, Lewisburg, Tennessee
- TTM Technologies, Anaheim, California; Chippewa Falls, Wisconsin; Littleton, Colorado; Syracuse, New York; Forest Grove, Oregon; Logan, Utah; Jackson, Ohio; Santa Ana and Santa Clara, California; Stafford and Stafford Springs, Connecticut; Sterling, Virginia
- Zentech Manufacturing, Inc., Baltimore, Maryland; Richardson, Texas
underpinned by IPC-1791 certification. A very large portion of our work at Summit is DoD-related through the military primes, so we have made a commensurate commitment to IPC-1791 with four of our facilities—Santa Clara, Orange, Anaheim (California), and Toronto (Ontario)—certified to IPC-1791.

**How long did the process take? What advice would you give other members preparing for an audit?**

As with any audit, your timeline to certification will be directly relative to the commitment you have already made to having your business in good order. For those already building IPC Class 3 products, are AS 9100 certified, adhere to ITAR/EAR, are in line with NIST 800-171 compliance, and have strong processes relative to supply chain and chain of custody, certification to IPC-1791 will be a very efficient process.

My advice to those companies is to get on the audit schedule now with the goal of being qualified. If the conditions described above do not portray your company’s current qualification set and you support our military or other trusted sector work, you should absolutely turn to the IPC-1791 team to audit for gaps and get on the pathway to IPC-1791 qualification. The feedback from the IPC Validation Services audit team will be very prescriptive with the actions required to qualification clearly identified and this can become your company’s roadmap to overall compliance.
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Realizing the Promise of IPC-1791

By Chris Mitchell
IPC Vice President
Global Government Relations

IPC-1791, *Trusted Electronic Designer, Fabricator and Assembler Requirements*, is an electronics standard developed in collaboration with the U.S. Department of Defense (DoD) and industry to address some of today’s greatest risks to a trusted supply chain. The standard provides traceability and helps protect against counterfeits. In fact, IPC-1791 was specifically cited in the U.S. Department of Commerce response to Executive Order 14017-Securing America’s Supply Chains.

But to be as effective as possible, the standard needs greater support from the DoD. While it has been adopted by the DoD, it has not yet been mandated. IPC-1791 holds the promise to introduce much greater security to U.S. defense electronics, and support the goals of the U.S. Defense Industrial Base.

IPC developed this standard as it does all its standards—with all relevant stakeholders in the room. For IPC-1791, this group included the DoD, defense primes, PCB fabricators and designers, and electronics assemblers. The
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Houston
Meticulously prints the legends on circuit boards that identify vital information.

Steven
Maximizes production panel assembly yields with precise routing and scoring.

Natasha
Carefully applies solder mask coatings using direct image machines.

Aaron
Assembles and laminates layers of circuitry into multilayer PCBs.

Charles
Carefully applies solder mask coatings using direct image machines.

Emilee
Rigorously tests every electrical circuit path.

Calumet Electronics Corporation

calumetelectronics.com
standard was first published in 2018 and the latest release, Revision B, was approved for publication in January 2023. Because this is an industry standard, electronics manufacturers continue to work with the DoD to maintain it and to address emerging security concerns.

Since its release, the DoD has adopted IPC-1791 as a standard available for use by program managers and procurement officers. But what does it mean to be adopted? It means that a standard has been vetted by DoD offices and is suitable for meeting DoD requirements. Adoption gives the standard visibility through its inclusion on the DoD online ASSIST database, which is a repository for all standards approved or adopted under the Defense Standardization Program.

DoD adoption of IPC-1791 was a significant step, but adoption does not place a mandate on its use. Today, IPC-1791 is not a requirement in the sourcing of defense electronics, which is likely to change in the future.

The encouraging news is that in Section 841 of the fiscal year 2021 National Defense Authorization Act, Congress mandated the development and implementation of trusted supply chain standards for PCBs just as the DoD had been tasked with regarding microelectronics. Developing supply chain standards for microelectronics has been a daunting challenge marked with more than one reset, but the opportunity to move quickly on PCB and PCBA standards is ripe. After all, the DoD has already adopted IPC-1791; the only remaining challenge is promoting use of the standard across the DoD.

While the DoD has not yet begun requiring IPC-1791 certification in its acquisition, many companies are already leveraging certification as a competitive advantage to win both defense and commercial business.

This year, IPC is stepping up its advocacy on IPC-1791 in concert with our members and peer organizations. Our advocacy will seek to generate greater industry support for IPC-1791 and to leverage this support as part of our direct engagement with Congress and executive branch leaders.

While IPC-1791 can be viewed narrowly as a standard and validation program, IPC regards it as critical in the development of a community that constitutes the U.S. Defense Industrial Base for trusted PCBs and PCBA. Once this community is defined, DoD is in a much better position to measure this community’s health and to steer support so that U.S. defense capability and capacity needs can be met by manufacturers.

IPC-1791, in short, holds the promise to introduce much greater security to U.S. defense electronics, while also supporting U.S. industrial base goals. The hard work has been done, but realization of the IPC-1791 promise requires greater support from the DoD.

To get more involved, contact Chris Mitchell, IPC Vice President Global Government Relations, at: ChrisMitchell@ipc.org.
Validating to IPC-1791

Become a part of a global network that the industry looks to when evaluating business partners.

IPC-1791: Building a community of trusted suppliers
A new engineer walks into a reception at IPC APEX EXPO... in other words, there are many ways to connect with one another in the electronics manufacturing community. Here’s the true story of how a mentor and a mentee met, discussed IPC standards, chaired a committee together, and won top IPC awards.

Christina Trussell of Blue Origin was new to her career and eager to learn. Garry McGuire of NASA Marshall Space Flight Center was an established contributor to dozens of IPC standards.

By Linda Stepanich

After they met at an IPC APEX EXPO Newcomers’ Reception, the two built a strong mentor/mentee relationship. Christina is an Emerging Engineer (EE), and they both have leadership roles on the 7-31FS IPC/WHMA-A-620 Space and Military Electronic Assemblies Addendum Task Group. Coincidentally, they also celebrated two big wins at the IPC annual awards ceremony this year, with Garry taking home IPC’s highest honor, the IPC Raymond E. Pritchard Hall of Fame Award, and Christina emerging as a Rising Star.

Christina Trussell and Garry McGuire
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**Let’s start with your first meeting. How did that go and what was your expectation?**

*Christina:* The first time I attended IPC APEX EXPO, I went to the Newcomers’ Reception. While I was there, I had a question regarding the IPC/WHMA-A-620S and I had no idea who to talk about it. I saw John Mitchell, president and CEO of IPC, greeting everyone and I decided that talking to him would be the best way to find an answer to my question. I was able to speak with John about my question, and he directed me to Teresa Rowe, who eventually introduced me to Garry. When I met Garry, he gave me such a great answer to my question that I asked him if he would be my mentor.

*Garry:* Teresa Rowe approached me and said she knew an engineer who would be a great candidate for me to work with in the Emerging Engineer program. Christina and I met shortly thereafter. The COVID shutdown affected our ability to conduct face-to-face activities, but we did make it to several IPC meetings, and we had many more virtual meetings.

**There is much to gain from being part of a mentorship program. What were your expectations, and how did you establish the types of meetings and projects you would work on?**

*Christina:* My expectations were to have someone show me the ropes in the IPC standards committee world. Outside of that, Garry has proven to be a valuable resource for one-off technical harnessing-type questions that have stumped me over the years. Aside from being a co-vice-chair on the IPC/WHMA-A-620S with Garry, we haven’t taken on any special projects together. The A-620 space addendum has kept us busy enough that we have maintained virtual communication throughout those COVID years.

*Garry:* I didn’t know what to expect. Christina was in the first or second class of the EE program, so there wasn’t much history to base our plans on, but in the generic definition of “mentor,” I knew it would be my responsibility to guide her through how the meetings work: how to lead them, and to obtain insight into the intent of many requirements in our standards. As someone who is nearing retirement, my primary goal has been to do what I can to help the next generation of engineers take the technology to its next level of evolution.

**Christina, what have you learned from Garry and how do you intend to use that information as you continue your career?**

*Christina:* Garry has taught me everything that I know about how IPC works, from submitting comments and dispositioning them, to navigating passionate committee members. When I first met Garry, I was a lead harnessing technician. He has helped guide me in the industry from a technical IPC mentorship perspective so that I have had the confidence and knowledge to succeed as a harness design engineer in the aerospace industry.

**Garry, would you give us some insight into the sorts of projects you worked on with Christina?**

*Garry:* Developing successive revisions of the working draft of our standard is probably the only thing we could call a project. We discussed how comments should be submitted, how to address them in meetings, and to ensure the commentator’s interests were not ignored during committee meetings. Working with Christina has been an excellent experience. Our shop in Alabama has even procured tooling that Christina brought to my attention from her visits to the exhibition hall vendors.
Garry, why are you a mentor? What do you enjoy about the experience, and how do you see the profession changing?

Garry: In my career, I have witnessed the loss of tribal knowledge through two cycles. It’s frustrating when we have to address something we thought we fixed 20 years ago. In addition, I was an instructor in a previous life, and I like sharing my experiences because they can help navigate through the gray area that will always exist between acceptable and rejectable conditions in our standards.

Now that you’ve received the Hall of Fame Award, you can probably ride your motorcycle off into the sunset. Will you retire from IPC now or will you continue to participate?

Garry: It’s still a small handful of years before retirement, so I’m here for a while yet. When I finally do retire, it’s hard to predict what will come next. I take great pride in ownership of the standards I’ve supported, but it’s important to know when to cut the umbilical cord and let the next generation take over. Keeping up with the rapid pace of evolution in this industry is almost impossible to do part-time, but walking away from relationships that we developed back in the ‘90s is something that’s hard to imagine. I’m probably going to leave this question conveniently vague.

I’ve seen the value that effective standards add to the industry—for the manufacturer and the consumer. Conversely, I’ve seen how standards that are poorly written or disorganized can add costs, delay schedules, or deliver inconsistent products.

Christina, what do you enjoy about the Emerging Engineer program? How has it benefited your career?

Christina: I have greatly enjoyed the Emerging Engineer program. It has pushed me to attend technical development courses that I likely wouldn’t have attended otherwise, and I’ve stepped up to volunteer on committees that have proven so valuable over the years. The other most amazing part of the Emerging Engineer program is the STEM outreach that takes place at every IPC APEX EXPO. Not only has IPC been beneficial to me, but it has fostered an environment of inspiration for future generations of the electronics industry. Getting a chance to be a part of that is so fulfilling.

Garry, what about your involvement in the Emerging Engineer program? How has it benefited you?

Garry: It’s becoming an unexpected but welcome facet to this phase of my career. I’m pleased Christina and I were brought together for this, and I hope she’s enjoyed the journey as much as I have.
There’s a saying that highly successful people have three things in common: motivation, ability, and opportunity. The same can be said for electronics manufacturing and assembly in Mexico: We have the motivation, the ability, and the unique opportunity to take this industry to the next level.

For many years, Mexican companies have reliably produced various products for global markets, and together with more recent investments in homegrown talent, have positioned Mexican manufacturing to take advantage of recent shifts in global supply chains and consumer markets.

Similarly, IPC has a long history with Mexican companies, providing standards and certification to a largely labor-based workforce. There are nearly 140 IPC member companies with facilities in Mexico.

A Growing Need

As the electronics industry grew in Mexico, IPC recognized it must train and certify not only labor-intensive roles, but the more technical roles, such as inspection, design, and engineering. In early 2020, immediately prior to the global COVID pandemic, IPC personnel traveled to Mexico and met with numerous companies in our industry. Their goal was to learn how best to serve this growing need for training and certification. While the pandemic restricted further in-person investigation for a time, IPC continued its conversations virtually to guide the development of training programs with Mexico.

In 2022, once pandemic restrictions were manageable and newly developed training products had been made available in both English and Spanish, IPC’s Education Team once again set its sights on face-to-face engagement in Mexico. It wasn’t enough, however, for IPC just to create Spanish-language products for this vital market and to serve the electronics industry from afar. That’s where I come in.
The ArchFX Production Insights Suite uses core Assembly, Quality, and Test Analytics modules to understand exactly where problems are in the manufacturing processes and how to solve them - empowering manufacturers to reclaim millions of dollars in quality, performance, and utilization losses.
Putting Boots on the Ground

I am based in Mexico City and my experience in various professional roles with global brands has positioned me to accelerate IPC’s strategy development and understanding of Mexico’s electronics manufacturing needs—both Mexico’s common goals in a global market, as well as its unique challenges. We have found there’s a lot of work to be done on “re-educating” the local industry on the difference between certification and training and seeing workforce training as an investment rather than just an expense.

With its strong foundation based on IPC standards and certification, the IPC Education Team began months of intense relationship building as well as market research and analysis. The results were immediate. Through our in-person, social media, and marketing activities, we were flooded with messages from companies and individuals interested in knowing more about IPC Mexico, learning about our specialized training courses, and understanding our certification programs and industry standards.

We launched several pilot programs with key members and nonmembers of IPC, such as Benchmark and Continental. Our objective was for them to achieve better quality, lower costs, and improve productivity through training—something obvious, but not so popular. We met with the leadership teams, human resources, and training leaders; walked with their operations, quality, and engineering teams; and had coffee and cookies with the operators. We walked the floor and listened to people, hoping to understand their needs and what they were looking for.

There are nearly 140 IPC member companies with facilities in Mexico.
how they are carrying out their daily manufacturing activities.

For one pilot program, the team visited plants in Guadalajara and Tijuana, implementing two training courses—*Electronics Assembly for Operators* (in Spanish) for 44 operators, and *Electronics Assembly for Engineers* (in English) for 25 engineers. Our IPC team implemented two more pilots, the first with a German auto parts manufacturing company with operations in Guadalajara and Guanajuato, and the second with a Swiss company specializing in the manufacture of automotive components, with plants in northern Mexico’s Coahuila and Tamaulipas. Both pilots involved more than 30 operators from various locations for the *Electronics Assembly for Operators* training course in Spanish.

The results of the three major pilots were gratifying: The electronics industry is incredibly eager to excel on the world stage and to take market share from other locations. These companies are aware that this will only be achieved through quality standardization (IPC standards), excellence (IPC certifications), and knowledge and steady updating of skills and tools (IPC trainings).

We wanted to capture the voice of the customer and they were eager to share their feedback and comments on the training programs they had completed. One quality engineer in Tijuana said, “The content of the course was great. Recommend it for all engineers getting into electronics because this is something you don’t learn in school.”

These companies learned firsthand the opinions of the operators when it comes to their supervisors’ knowledge, which otherwise would’ve been difficult to learn. An operator from Guadalajara said, “This course should be given to engineers, quality leaders, and management.” Another commented, “You learn about the decision-making process of when to ‘pass’ a board or when to reject it. That’s still a confusion with line leaders. They should take it too.”

Over these past several months, my deep-rooted pride and long-standing passion for Mexico and its people has quickly found new energy. Mexico-based electronics manufacturing is on the rise and IPC, as a not-for-profit association, plays a key role in
the continued growth of the country’s electronics manufacturing industry.

**The Voice of IPC**

IPC participates in various industry forums and events to learn more about the profile of visitors and exhibitors. Having a physical presence at these events allows us to share this powerful message: IPC is the voice and the champion of the electronics industry and has positioned itself here to support companies in increasing their quality, performance, and growth.

We have learned a lot through these interviews, pilots, and forums; we intend to intensify the face-to-face interactions with what I consider the three key pillars of the electronics manufacturing industry in Mexico: the local governments, academic and training institutions, and the enterprise. Along these lines, the IPC Mexico team has been meeting with industrial clusters in different regions in Mexico. The industrial clusters are concentrations of related industries grouped by region (or by state) and they are diverse, key actors in the development of industry in these regions. They are comprised of local governments, academies, or institutions in charge of education, training and technical support, vendors, and service providers.

IPC is working with an important aerospace cluster in the State of Queretaro, with plans to sign a collaborative agreement at the Mexico Aerospace Fair (FAMEX), April 26–29, in Mexico City. This event is organized by the Ministry of National Defense through the Mexican Air Force. We are enthusiastic about this opportunity and will keep you updated on its progress.

The plans that IPC has for Mexico are very exciting and I feel deeply privileged to spearhead these efforts and put the capabilities and excellence of our country’s electronics industry at the forefront of the race in this market. There is certainly a lot of work to be done but the region and the industry can always count on my commitment to work tirelessly, providing all IPC member companies with the tools to achieve and exceed their business objectives. We want Mexico and the world to know that IPC makes things happen for the global electronics manufacturing industry. We are here to help them all build electronics better.

**DID YOU KNOW?**

$1.150 trillion

Expected GDP of Mexico in 2023

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**Want to chat with Lorena?**

Your feedback on Lorena’s efforts or a direction she might look at will help expand her message and strengthen the industry in Mexico. Reach out to Lorena at LorenaVillanueva@ipc.org.
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Man-made chemicals known as PFAS have regulators busy trying to address previous releases and prevent future releases of this chemical into the environment from widespread uses in manufacturing processes and products used across the globe. PFAS chemicals tend to be persistent in the environment and they have been used long enough and in enough applications that their unwanted presence in the environment has public health policymakers concerned.

PFAS are per- and polyfluoroalkyl substances, a family of chemicals generally defined by the presence of a carbon-fluorine bond. PFAS resist chemicals, water, and oils, and perform many different functions in products useful in our daily lives.

PFAS released to the environment can remain in the environment—they are persistent chemicals. There are thousands of PFAS chemicals composing the family of PFAS. Some, depending on the complexity of the molecule, perform differently, have a different lifetime, and have different potential for adverse health effects in exposed populations.

We are advocating on behalf of the electronics industry globally and sounding the alarm within the electronics manufacturing industry: Now more than ever it is imperative to understand the chemicals used in your products and the processes used to make those products, and if you’re not taking action to learn more, you may find your ability to purchase or use a critical chemical has been restricted. If you’re not aware of the chemical makeup of your products, and if and where PFAS chemicals exist, it’s time to really start looking into this. We recognize more and more that companies will need to either be prepared to disclose PFAS in their products, or the government will impose a requirement.
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What Role Does Advocacy Play in PFAS?
In my experience as an environmental attorney, and as IPC’s environmental regulatory affairs manager, I recognize that there is often a lack of data to back up community-based environmental cases. There’s a disconnect between the science and what is happening to people (or what we’re concerned could be happening), and it’s hard to make that connection. It happens all the time with environmental laws and regulations. While government works diligently to protect public health and the environment, the laws are often broad and rather lofty. The importance of advocacy and understanding the implications of a law are critical. Providing the government with data to support a policy ensures thoughtful and sustainable regulations that can be effectively enforced. With input from stakeholders, it is often found that it is more useful to protect public health when you have a narrower regulatory scope that is more realistically achievable.

At IPC, we are working closely with electronics manufacturing companies to help support their understanding of PFAS use and keep them ahead of upcoming policies, both nationally and globally. There’s a lot to keep track of and we want to fully support our members in being as prepared as possible.

PFAS is one of those big issues where scientists, industry, and regulators don’t yet have all the answers. There are so many different variations and uses of PFAS it’s hard to make a regulation that will be effective and achievable. In the policy world, having evidence and data to support achievable regulations is so important.

How Are PFAS Chemicals Being Regulated?
In the policy space, mainly in Europe and North America, we’re seeing a push to regulate the entire class of PFAS chemicals—not just any one specific PFAS, like PFOA or PFOS, but the entire family. But are they all bad actors to public health? This is difficult to determine. It is impractical and tedious to test the thousands of chemical chains categorized as PFAS and understand the environmental and human health impacts. Rather, it is more protective and practical to push for an alternative to the carbon-fluorine bond. However, we need to consider if that is technologically and economically feasible for the array of uses.

We learned from ozone-depleting substances, chlorinated

There are possibly more than 10,000 PFAS chemistries included in the OECD definition of PFAS.
solvents, phthalates, flame retardants, and others, that a one-off approach to regulating chemicals often leads to substitution regret for alternatives that aren’t much better than the original chemical. Yet, regulating the entire class of chemicals poses difficulties for the electronics industry because they are used across the supply chain and viable alternatives are often not available. If regulators universally restricted or banned all PFAS, it would not address the challenges of remediating legacy sites. It also doesn’t address how to replace so many chemicals at one time—so many chemicals that have provided critical utility without which there may be negative consequences to health and well-being.

**What Regulations Are on the Horizon?**

At IPC, we are focused on tracking two major policies:

**REACH Annex XV Restriction Dossier on PFAS**

A REACH restriction is an EU policy mechanism implemented by the European Chemicals Agency (ECHA) to protect human health and the environment from risks posed by chemicals. Restrictions generally limit or ban the manufacture, placement on the market, or use of a substance. An EU member state, or ECHA, at the request of the European Commission, can initiate the restriction procedure if they are concerned that a certain substance poses a risk.

Recently, the national authorities of Denmark, Germany, the Netherlands, Norway, and Sweden submitted a proposal to ECHA to restrict PFAS under REACH. These nations first announced their intention to create the restriction, which will be one of the broadest in the EU’s history, in December 2019 and began collecting evidence in May 2020. On Feb. 7, 2023, the pre-publication for the restriction proposal was released and, in turn, many stakeholders are getting to work trying to address the broadest universal ban on PFAS.

A future restriction on PFAS in the EU can have significant ripple effects across the globe and on the electronics supply chain. Once again, the big question is where and how PFAS are used and whether viable alternatives exist.

**TSCA Section 8(a)(7) Reporting and Record-keeping Requirements for PFAS**

The U.S. Environmental Protection Agency (EPA) has proposed a reporting and record-keeping requirement for PFAS under TSCA. Following amendments to TSCA implemented by the FY 2020 National Defense Authorization Act (NDAA), the EPA proposed that persons who manufacture (including import) PFAS since Jan. 1, 2011, must report information on their PFAS uses, production volumes, disposal methods, potential exposures, and hazards. For the purposes of the proposed rule, articles containing PFAS, including imported articles containing PFAS (such as articles containing PFAS as part of surface coatings), are included in the scope of reportable chemical substances. Providing data on PFAS from over a decade ago can potentially pose significant

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**Where are PFAS found in electronics?**

- Wires and cables
- Printed circuit boards
- High temperature film capacitors
- Liquid crystal displays
- Semiconductors

Fluoropolymers, a group of polymers within the family of PFAS, are used in electronics applications in high stress or harsh environments. Polytetrafluoroethylene (PTFE) for example, is a fluoropolymer used in insulation on wires and cables where high-volume data transmission is required.
difficulties on businesses. The final rule was expected to be published within the first half of 2023.

The Impact on the Electronics Industry
IPC’s current plan includes compiling readily available resources on PFAS uses in electronics to prompt, prepare, and motivate the industry to act:

• Look into what you make, how you make it, and who you sell it to. This enables your customers, and their suppliers they buy it from, to prepare for regulatory action.
• If you don’t know what you’re using and why it’s critical to the functionality of your product or your process, you may face unexpected supply chain changes or product changes.

We see IPC’s role as enabling information exchange on a very complicated subject matter. IPC has provided webinars and briefings, and we continue that message of looking ahead and preparing. You have a responsibility, and the sooner you look, the better. We know this is difficult. We recognize at times it may feel and seem impossible. It may require new resources. But the sooner you can embrace the challenges, the better. Because guess what? We’re trying to help you advocate for continued uses, if needed, but also enable safer alternatives when feasible. We want to enable you to do the best you can. It will be tough but doing something is better than nothing. Please do something.

As much as we would love to prepare everyone by handing out fact sheets and exactly what needs to be done, it’s not there. There’s a lot of learning and moving as we go. That’s where we’re at.

Suhani Chitalia is environmental regulatory affairs manager at IPC. Kelly Scanlon, lead sustainability strategist, also contributed to this article.

Common consumer and commercial products that may contain PFAS

• Cleaning products
• Water-resistant fabrics, such as rain jackets, umbrellas, and tents
• Grease-resistant paper (think of parchment paper you use for baking)
• Nonstick cookware
• Shampoo, dental floss, nail polish, eye makeup
• Stain-resistant coating on carpet, upholstery, and other fabrics
• Microwave popcorn bags

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#BUILD ELECTRONICS BETTER
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, deeper, 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. These are just some examples of Carol’s lifelong work in materials engineering, involvement with governing bodies, and a forward-thinking approach to electronics manufacturing that has spanned more than three decades.

Her latest participation is an appointment to the Industrial Advisory Committee, an extension of the National Institute of Standards and Technology (NIST), where she joins 23 other members in advising the U.S. Department of Commerce on the science and technology needs of the nation’s domestic microelectronics industry.

Carol currently serves as the Reinhardt Schuhmann Jr. Professor of Materials Engineering, Environmental and Ecological Engineering at Purdue University. She formerly worked at NIST, where she became chief of the Metallurgy Division. She is well-known for her research on determining the best options for
solder that connect electronic components to circuit boards, focusing on almost any physical condition that a circuit board could encounter.

Her current research is part of the U.S. Partnership for Assured Electronics (USPAE) and is backed by a $40 million U.S. Department of Defense contract. (Click here to learn more about her research.)

But the NIST appointment is something altogether different. Her work on the committee, alongside three other representatives from academia, is to provide guidance to the federal government in relation to the recently passed CHIPS and Science Act, which has appropriated $52 billion toward bolstering the semiconductor industry in the United States.

“It’s an incredible opportunity to be appointed to this committee because of my perspective, both from having been a lead in advanced packaging at NIST, seeing and believing in the mission of NIST, and knowing the strengths that can be brought to the table when academia, companies, and government work together,” she says. “As a result, I have some strong views about priorities for the program.”

The committee, which also includes IPC Board Member and packaging leader Meredith LaBeau of Calumet Electronics, has begun the discussions about how to best advise the Department of Commerce and what must be advised upon.

Committee members, representing companies ranging from Intel and Microsoft to Ford Motor Company, Qualcomm, and the Potomac Institute for Policy, will provide assessments of research and development (R&D) programs and activities authorized under Section 9906 of the CHIPS Act.

“My impression is that this is an incredibly knowledgeable, insightful, and powerful group,” Carol says. “They are taking on these roles for the good of the country.”

It’s an important point to make, she says, that each comes to the committee not as an individual, but as one representing a specific sector or organization. “They were very clear when they sent the invitation that we’re not supposed to leave our day jobs behind. We must bring those insights to bear on the committee.”

As Carol and the others begin the perhaps daunting task of advising this national body, she hopes to impress upon the others the criticality of advanced packaging and heterogenous integration both for this generation of semiconductors and the next. “This is also about economic prosperity in the United States,” she says. “We have a long road ahead regarding reshoring packaging, assembly, and test.”

Current statistics suggest that just 2–3% of the global packaging of semiconductors happens in the United States, first as a result of offshoring and now continuing because of labor costs for manufacturing and investment incentives from other countries.

“Our task isn’t just about building more fabs and making more chips, but being able to package them in the United States with the most cutting-edge technologies,” Carol says. “We need powerful, creative strategies that allow us to create new technologies and create them for manufacturing in the United States.”
Contagious: Why Things Catch On, by Jonah Berger. This book explores why some new products and ideas gain widespread popularity while others don’t. Berger believes the key is “word of mouth,” and that things catch on when people talk about them.

What she likes about it: “It helps me understand more clearly who I’m trying to communicate with,” Carol says. “Knowing who you want to communicate with and why is really important going forward with the NIST committee.”

It’s also key to addressing the global crisis surrounding educational workforce development and students interested in STEM fields. “So, how do we communicate the excitement and opportunities, and give them encouragement to work in these areas?” she asks. “We’re trying to lower the barriers to entry so that in the end, they have the skills they need, but we don’t scare them away at the beginning. We need to be able to ‘sell’ semiconductors in a meaningful way.”

Elinor Ostrom: An Intellectual Biography, by Vlad Tarko. Elinor Ostrom was the first woman to win the Nobel Prize in economics, and chiefly recognized for her work on the theory of “natural commons.”

Why she likes it: “Her area of expertise determined how people self-organize to manage things,” Carol says, “for the betterment of society. Elinor also did a lot of work in game theory. I’m interested in the way that groups organize themselves, or how they interact with other groups to see if they can really come close to the optimal in terms of meeting those national level goals.”

How it relates to the Industrial Advisory Committee: “What I’m trying to do is introduce to others the underlying science about organizational performance theory, to let them know what else is out there that can help them achieve their goals. I like to facilitate interactions.”
government relations at IPC, and Christopher Peters, executive director of USPAE, but she has been involved in more than 18 standards committees with IPC during the past 30 years.

“They had me at ‘Hello,’” she says, referring to her long-term interest in volunteering with IPC committees (and the 1996 movie “Jerry Maguire”). “When I was at NIST, I started working on IPC standards committees. Even in the transition to lead-free, I helped Dave Bergman develop the roadmap for the lead-free transition within IPC. I also worked on the DoD Lead-Free Manhattan Project.”

Her admiration for IPC’s advocacy efforts regarding lead-free solder, and now with advanced packaging (particularly concerning the development of new substrates), runs deep. “I think that the leadership at IPC is doing a great job at engaging with some of the representatives of Congress to make sure they understand what the membership needs are,” she says. “They are encouraging IPC members to also reach out to their own members of Congress, to have public, substantive discussions about what some of the issues, barriers, and challenges are to strengthening microelectronics in the U.S., and how to overcome them.”

First Funding Opportunity Launched

As part of the bipartisan CHIPS and Science Act, the U.S. Department of Commerce is overseeing $50 billion to revitalize the U.S. semiconductor industry, including $39 billion in semiconductor incentives. The first funding opportunity seeks applications for projects to construct, expand, or modernize commercial facilities for the production of leading-edge, current-generation, and mature-node semiconductors. This includes both front-end wafer fabrication and back-end packaging. The Department will also be releasing a funding opportunity for semiconductor materials and equipment facilities in the late spring, and one for research and development facilities in the fall.

The CHIPS and Science Act is part of an economic plan to invest in America, stimulating private sector investment, creating good-paying jobs, making more in the United States, and revitalizing communities left behind.

To read more, visit commerce.gov.

“They had me at ‘Hello.’”
—Carol Handwerker
Lead, educate, and connect were resounding themes throughout the 2023 WHMA 30th Annual Wire Harness Conference at the Sandia Resort & Casino, Feb. 14–16, in Albuquerque, New Mexico. The exhibition was supported by nearly three dozen exhibitors and sponsors who showcased their products and services; 175 company owners, executive staff, and key leaders came to renew friendships, do business, and discover new approaches to many aspects of the wire harness industry.

This year’s event featured several timely presentations and roundtable presentations on topics important to attendees: current events and their impact upon manufacturing, forces fueling the wire harness and cable assembly industry, effective leadership skills, organizational success, work/life alignment, non-verbal communications, body language cues, and more.

Opening keynote presenter Dan Thurmon, peak performance coach and work/life balance expert, presented “Off Balance on Purpose:
Improving Work-Life Alignment.” His goal was to help attendees embrace lifelong learning and leverage their past experience into present action and future success.

“I continue to be impressed with the evolution of the IPC/WHMA partnership,” said Jeff Barth, president, JWB Manufacturing, LLC.

Last year [2022] was my first year attending the WHMA conference. My expectations were blown away on what I got out of the event—the speakers, networking, and just the intimacy of the event. I enjoyed my experience so much that I decided to sponsor the First Timers reception for 2023. As a business owner and
leader, I look for others who can relate to my experiences and together we can share insights that help us all move our businesses forward. I can't wait until next year's conference.”

“This year’s event and 30th anniversary celebration was successful thanks to WHMA/IPC staff, our stellar lineup of presenters, and event sponsors and exhibitors,” said Joe DeMan, WHMA board chair. “We’re already planning for the 2024 Global Leadership Summit, which will take place Feb. 13-15 in Myrtle Beach, South Carolina.”

For more information on the 2024 event, visit www.annualconference.whma.org.
In recognition and acknowledgment of their extraordinary contributions to the Wiring Harness Manufacturer’s Association (WHMA) and the cable and wire harness industry, two longtime WHMA members were presented with coveted WHMA awards. A WHMA Hall of Fame and a WHMA Volunteer Excellence Award were presented at WHMA’s 30th Annual Wire Harness Conference on Feb. 16, 2023.

This WHMA Hall of Fame Award recognizes extraordinary contributions with broad significance to the cable and wire harness industry and distinguished service to WHMA. Award recipients support the advancement of the industry, consistent with the goals and mission of WHMA. This is the highest level of recognition WHMA can give to a member and is based on exceptional merit over the long term.

This year’s inductee was Donnie Hill, Precision Mfg. Co. He was recognized for his long-term service and strategic and passionate leadership to WHMA as a board member, six years as WHMA board vice chair, key architect in the IPC/WHMA affiliation, as well as his many years promoting WHMA and its programs, and his contributions to WHMA’s mission to lead, educate, and connect members globally.

“WHMA Hall of Fame recipients represent the best of the best—strategic, visionary, and committed. Donnie has demonstrated passion, dedication, and a continued commitment to propel the harness, cable and interconnect industry forward,” said Joe DeMan, WHMA board chair. “WHMA is honored to acknowledge Donnie’s hard work. He is truly a champion of our industry.”

The WHMA Volunteer Excellence Award honors individuals from WHMA-member companies who have demonstrated ongoing leadership in WHMA activities and have contributed significant time and talent to the association and the cable and wire harness industry.

This year’s recipient was Micah Durham of Schleuniger. He was recognized for his contributions to the wiring harness industry through service on the WHMA Board of Directors, significant contributions to the WHMA annual meeting, and Electrical Wire Processing Technology Expo (EWPTE) program planning.

“The leadership shown by Micah has made a significant impact on WHMA and will do so for years to come,” said DeMan. “We are privileged that Micah has chosen to share his knowledge and expertise with WHMA and with the entire global wire harness manufacturing industry.”

WHMA award winner Micah Durham.
Toward a European Chips Act

By Alison James, IPC Senior Director, European Government Relations
While the U.S. government has begun to implement its Chips and Science Act, the European Union is deliberatively moving to issue its own legislation. Rising geopolitical tensions and the supply chain vulnerabilities exposed during the heights of the COVID pandemic, followed by the Russian invasion of Ukraine, accelerated a move in the European Union now happening throughout all global regions—taking stock of strategic assets and vulnerabilities.

Electronics and data, it seems, are the “oil” of the 21st century, and the high strategic importance of both elements focuses efforts to secure supply by building regional bases for high value-added activities and intensifying cooperation with strategic trading partners.

The European Union’s proposal for legislation regarding semiconductors was issued in February 2022 against the backdrop of global chip shortages, a global “subsidy race” in the world’s main producing regions, and a renewed EU industrial policy aiming to deliver on the bloc’s ambitious digital and green transition. It is part of the region’s evolving “strategic autonomy” agenda: reducing the continent’s vulnerability to supply chain disruptions and geopolitical risks. At this time, the proposed legislation is in the final months of negotiation in the inter-institutional process under which European legislation is formed.

With announcements of confirmed and rumored investments by well-known chip companies, it’s clear that a leading intention behind the European Chips Act is to attract high-end semiconductor manufacturing to produce the most advanced chips. From the start, IPC has made strong arguments that advanced packaging plays an increasingly important role in chip performance and supply chain resiliency. We continue to be a leading voice in the negotiations to argue that the Chips Act framework must enable the growth of regional capacities and capabilities in this field and every effort must be made to leverage investments that will deliver benefits across the entire electronics manufacturing value chain. In other words, it is about the electronics ecosystem, and every link in the value chain is important.

It is worth stepping back and looking at the European Chips Act in more detail. What does it involve? With a complex set of challenges, the proposal is intended to provide responses in the short, medium, and long term. Its purpose is to create a state-of-the-art European chip ecosystem that includes increased production and resilience in semiconductor technologies and applications.

To fulfill this vision, the European chips strategy is formed around a series of objectives which include:

- Strengthening the region’s research and technology leadership
- Reinforcing its capacity to innovate in the design, manufacturing, and packaging of advanced chips
• Setting up a framework to substantially increase production capacity by 2030
• Developing an in-depth understanding of global semiconductor supply chains
• Addressing skills

**A Three-pillar Structure**

This is all based on a three-pillar structure to strengthen, secure, and monitor the EU’s position, funding, and progress:

1. Strengthen the EU’s position in the pre-production phase of semiconductor technologies. Provide both research and innovation funding and seek to strengthen the industrial ecosystem.

2. Improve the EU’s security of supply. This pillar introduces guiding rules for investment and lays down criteria for state aid approval for so-called “first-of-a-kind facilities.”

3. Provide measures to monitor semiconductor supply chains and anticipate shortages. This includes measures to facilitate a crisis coordination mechanism between European Union member states and proposes strong European Commission powers during times of crisis.

Each of the pillars and objectives has not been without controversy during the institutional process. The intent of the European Commission to better understand electronics supply chains, to put in place mechanisms to avert future crises, and to ensure supply for end industries can be a worthy objective, but those mechanisms should not become obstacles for companies. The complexity of those supply chains, and the range of chips needed by European end industries, make this no easy task.

Throughout the process there has been a continual effort toward broadening the scope of what is, in reality, a legal framework. This framework will provide the direction for implementation activities and industry opportunities in the coming years. What is seen as important and strategic lays the basis for future deployment of activities.

**How IPC Makes a Difference**

IPC’s government relations activities have been focused on working with political leaders and decision-makers of the EU institutions during the different stages of the legislative process. We want to better articulate the role and importance of a legal framework which empowers the region to build out capacity and capabilities in packaging, PCB fabrication, and final package assembly and testing. For a resilient European manufacturing ecosystem, Europe needs chips for current and future markets, access to inputs, and a legislative and regulatory environment that bolsters the industry from silicon to system. This is our continual stance.

In this process, we have seen leading European politicians hear IPC’s arguments and then take action that includes suggested language on packaging, broader references to the value chain around semiconductors, and the need to ensure that benefits from the European Chips Act are spread through the member states.

The importance of extending the scope of the legal framework of the European Chips Act for the future of the electronics industry should not be underestimated.
The European Chips Act must be seen as a first step in building and re-building Europe’s electronics manufacturing base. With a Chips Act proposed budget under strain and already inadequate for the purpose, the EU is also conscious of the more investment-friendly climate for manufacturers supported in other regions which have less stringent conditions. Those regions have enabled state aid and are not hit by skyrocketing energy prices from the war in Ukraine.

For IPC, the first—albeit difficult—step of getting an extended legal framework within the European Chips Act has been taken and continues in the coming months as we reach the final stages in institutional negotiations. The next step will concern the implementation of the European Chips Act. The legal framework will allow the EU member states to act. Continued voices will be needed to ensure that these actions build a resilient, future-facing European electronics manufacturing ecosystem.

**Member Milestones**

Congratulations to members who celebrated milestone (25-year+) anniversaries in the first quarter. Thank you for your continued support and contributions!

### IPC Anniversaries in Q1 2023

- **45 YEARS**
  - All Flex Solutions
    - Minneapolis, Minnesota
  - Amphenol Printed Circuits Inc.
    - Nashua, New Hampshire
- **35 YEARS**
  - Eltos S.p.A.
    - Arezzo, Italy
- **30 YEARS**
  - ACDI—American Computer Development Inc.
    - Frederick, Maryland
  - Circuit Works Corporation
    - Waukegan, Illinois
  - DLA Land and Maritime
    - Columbus, Ohio
  - Quality Circuits Inc.
    - Fergus Falls, Minnesota
- **25 YEARS**
  - Cadence Design Systems Inc.
    - Burlington, Massachusetts
  - Cal-Comp San Diego
    - Carlsbad, California
  - Cubic Corporation—Defense Applications Inc.
    - San Diego, California
  - Innovative Circuits
    - Alpharetta, Georgia
  - KB Electronics Inc.
    - Coral Springs, Florida
  - Minco Products Inc.
    - Minneapolis, Minnesota
  - Minnetronix Inc.
    - St. Paul, Minnesota
  - Pioneer Circuits Inc.
    - Santa Ana, California
  - TT Electronics—IMS
    - Perry, Ohio
  - Verion Training Systems, LLC
    - Dallas, Texas
It’s fair to say that cables connect everything, from our phones and toasters to electric cars and the rockets that launch satellites into space. It’s also a technology that evolves rapidly. Standards, such as IPC/WHMA-A-620, were developed to provide structure and best practices to that technology, but it requires constant review and revisions. Revision E, which refines both text and figures, was released recently and sets the stage for an even bigger revision in two years.

“The A-620 standard acts as a neutral third party,” says Cathy Hanlin, an employee of Precision Mfg. Co., and co-chair of the 7-31F IPC/WHMA-A-620 Task Group. “It’s not me or my company saying what is right on a harness. It’s a third party—with no vested interest—saying what a good crimp is, what a good solder is, or what length should be looked at. It’s just an industry standard for best practices.”

Once a standard or its revision has been released to industry, there are opportunities for comments to be made about the standard.

“We receive hundreds of comments around the world from users, customers, manufacturers, and others, and revisions are based on those comments,” says Teresa Rowe, IPC senior director, assembly and standards technology. “The committee considers every comment.”

While some comments may not be accepted, or they may be modified, Teresa says the committee will always provide feedback about the comment.

“We find that data helps us a lot,” she says. “We have several small teams that worked on specific areas of the document to make sure that the criteria and the content were ultimately accepted by industry through a consensus ballot, which is IPC’s process for releasing a new standard.”

In fact, this particular A-Team, affectionally known as Wire Nutz, met to review and make decisions about every comment Revision D received.

“I feel our A-Team is very effective because there are very few comments that come up during discussion with the entire committee that we probably have not already touched on during an A-Team meeting,” Cathy says. “It speeds up the process with the committee when the A-Team has already heard the arguments, and we have either researched the question(s) or know who we can direct it to for an answer.”

Fun fact: Wire Nutz won a Golden Gnome Award in 2022 for best team name.
IPC/WHMA-A-620 is on a three-year revision cycle, although Revision E was published in just 35 months, and Teresa expects to see the next revision within a similar period.

“There is a lot of technological change that can happen very quickly in wire harness manufacturing,” Cathy says. “There are ways of doing things that changed quite a bit for Revision E. We took out a chapter on wire wrap, and that’s not common in the industry anymore. In this revision, we will be focusing on some changes to Section 7—ultrasonic welding—which is coming to the forefront more often in making wire harnesses.”

Ultrasonic welding is frequently used in electric vehicles, so it was an important section to be reviewed, in order to bring the best and latest information to it.

“Electric vehicles are bringing in new technologies that will need to be addressed eventually,” Cathy continues. “When we were at Gnomeapalooza last October, we were talking about electric vehicles where there is a battery cable that is much beefier and has drain wires and overall shielding. That’s completely different than how battery cables are typically constructed, so I can see that we will be addressing how to manufacture using these different styles of cables and the materials that we will be using to manufacture them.”

While A-620E already has a space addendum, it’s possible an automotive addendum could be included as well. “One portion of the group is working on a high voltage cable addendum, so instead of saying that we’ll do an automotive addendum, the group felt this was the best way to approach it,” Teresa says. “But they are just getting started.”

High-mix, High-volume Representation

To form such a committee requires a range of expertise; both Cathy and Teresa feel the committee of about 100 members is well represented.

“Everybody on the committee represents some function in wire harness making, from start to finish,” Cathy says. “My professional focus is the actual manufacturing of the wire harness. I work on things from when we quote it to when the routing sheets get out on the floor, and it first gets made. We also have engineers, technicians, suppliers—it’s really a wide range of anybody who has anything to do with making a wire harness, from designing it on a piece of paper to physically putting it together with their own hands.”

She acknowledges she would like to see even more representation on the committee, particularly those outside of aerospace.

“We make wire harnesses for every industry possible, from fire protection and medical, to landscape equipment, and so forth,” Cathy says. “Typically, if I’m around WHMA folks, I’m trying to get them to send people to this committee.”

“The number of members also varies,” Teresa chimes in, “as people come in and out of the group. You know, they’re all volunteers, so at times they’re assigned other areas of work, or they have competing company interests. You also come in and out of the group because you want to work on a specific chapter and it’s your area of expertise.”
“We need more toaster manufacturers,” Cathy says, laughing. “An aerospace person can only make a decision for the toaster manufacturer because they’re a user of the product.”

What Exactly Changed in Revision E?

Teresa says A-620E was one of refinement, “cleaning up things that were hanging out there, where the industry saw differences, or things they didn’t understand at first because Revision D was such a huge change.”

Target conditions were removed from Revision D, and Revision E introduced new sections. “With Revision E, we took the time to address areas where industry said, ‘Well, you took the target out, but what did that do here or there?’” Teresa says. “We wanted to make some statements more understandable. Target condition is like parking your car at the front spot of Walmart on a Saturday afternoon perfectly centered in the lines.

“Maybe you can do it on a rare occasion, but for the most part, if you can even get in the parking lot on a day like that, you’re doing good,” she continues. “If you take that spot at the front door, or you aren’t perfectly aligned in the blocks, now what? People say, ‘What am I supposed to do here?’ In fact, the acceptable may have been worded slightly different, and it left people confused.”

Because the document is translated into several other languages, some revisions meant looking at the wording and how it would translate. Much of the work done in this revision sets the committee up for a bigger revision in the next cycle.

“A lot of people were wondering what the standard would become once we took out the target, but target is perfection and not obtainable 100% of the time,” Cathy says. “I feel we have a much better document without the target because there are people who will rework something, trying to obtain the target condition, and actually end up making things worse than what they were before. This takes away the temptation.”

“Additionally, some figures were adjusted so that some wording in the requirements is better understood,” Teresa says. “We have a lot of international users, and they use the figures to help them understand what the words say. We had requests to make things better, to change a figure, to swap it out because it wasn’t clear enough or it didn’t pick up the criteria well enough.”

Cake and Comments

Celebratory cake parties are becoming increasingly popular at IPC APEX EXPO, especially when a committee has published a standard or one of its revisions. The 2023 meeting was no exception, and along with the giant sugar rush, the IPC/WHMA-A-620 committee also met to review comments that had been deferred until they could meet in person.

“Now that the new revision is out, we already have requests to make changes or add content based on the changes, so we worked on some leftover stuff from the Revision D deferrals all the way through the new content,” Teresa says. “It was a busy meeting.”
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Standards Update

Newly Published Standards/Revisions

**IPC-1792**
*Standard for the Management and Mitigation of Cybersecurity Incidents in the Manufacturing Industry Supply Chain*

IPC-1792 establishes requirements for companies to provide assurance that their products have been manufactured in cybersecurity environments, ensuring that there has been no risk of impact to the product due to any cybersecurity incident. IPC-1792 requirements specify actions that need to be taken if a cybersecurity incident is detected, identifying all possible affected products.

**IPC-7091A**
*Design and Assembly Process Implementation of 3D Components*

IPC-7091A describes the design and assembly challenges and ways to address those challenges for implementing 3D component technology. Recognizing the effects of combining multiple uncased semiconductor die elements in a single-package format can impact individual component characteristics and can dictate suitable assembly methodology. The information contained in this standard focuses on achieving optimum...
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functionality, process assessment, end-product reliability and repair issues associated with 3D semiconductor package assembly and processing.

**IPC-7092A**

**Design and Assembly Process Implementation for Embedded Circuitry**

IPC-7092A describes the design, materials, and assembly challenges associated with implementing embedded circuitry into a printed board. IPC-7092A covers various aspects of embedded circuitry related with the design, selection, processing and testing to achieve a completed multilayered structure that is ready for surface mount and/or through-hole component attachment.

**IPC-8952**

**Design Standard for Printed Electronics on Coated or Treated Textiles and E-Textiles**

IPC-8952 establishes specific requirements for the design of printed electronic applications and their forms of component mounting and interconnecting structures on coated or treated textile substrates. Textile substrate, as pertains to IPC-8952 standard, could be a bare textile or an integrated e-textile (e.g., woven or knitted e-textile). Coated or treated textile substrates, as pertains to IPC-8952 standard, are textile substrates which have or will have a coating or treatment localized or across the full substrate.

**IPC-8971**

**Requirements for Electrical Testing of Printed Electronics E-Textiles**

IPC-8971 is intended to assist in selecting the test equipment, test parameters, test data and fixturing required to perform electrical test(s) on printed electronics on e-textiles. Printed electronics on e-textiles is printed electronics on coated or treated textile substrates. Coatings and treatments may be applied for printability of the textile substrate and/or for performance of the textile substrate or finished printed electronics e-textile (e.g., hydrophobic, water retardance, flame retardance, surface energy). Coatings or treatments may be applied using printing, lamination, or other processes.

**IPC-J-STD-003D**

**Solderability Tests for Printed Boards**

IPC J-STD-003D describes solderability determinations that are made to verify that the printed board fabrication processes and subsequent storage have had no adverse effect on the solderability of those portions of the printed board intended to be soldered. Solderability is determined by evaluation of a test specimen which has been processed as part of a panel of boards and subsequently removed for testing per the method selected. IPC J-STD-003D provides solderability test methods to determine the acceptance of printed board surface conductors, attachment lands, and plated through-holes to wet easily with solder, and to withstand the rigors of the printed board assembly processes.

To view a complete list of newly published standards and standards revisions, translations, proposed standards for ballot, final drafts for industry review, working drafts, and project approvals, visit www.ipc.org/status.
The IPC Education team is working hard to create and update workforce training and certification programs that allow participants to learn, apply, and validate the job-specific knowledge and skills they need to meet and exceed organizational goals. But, we need your help!

Share Your Knowledge and Expertise with the Industry.

• Review education program outlines, storyboards, and completed courses for accuracy and relevance.
• Provide real-life scenarios, best practices, and lessons learned that can be used to create practice activities, assessments, and job aids.
• Write test questions for IPC certification programs.

If you can lend your expertise in these areas, all you need to do is scan QR code to complete a form and indicate your areas of expertise. The next generations will thank you!

For more information, send an e-mail to Julia Gumminger, IPC Professional Development and Events Manager at JuliaGumminger@ipc.org.
Wistron Corporation, founded in 2001 and headquartered in Taiwan, is a major global supplier of information and communication technology products. Since joining IPC in 2013, Wistron has committed to promoting IPC standards within its companies and the whole industry. It includes IPC standards in its employee training system and uses skills competitions as a key part of that training.

Global FAE Skills Competition started in 2019 and has been hosted by a different Wistron factory each year. IPC China was honored to be invited as the chief judge and to provide onsite technical support, helping companies recognize their excellent technical talents. This year, the competition took place Feb. 15-16 in Wistron Chengdu. Seven delegations from the group’s domestic and Southeast Asian factories competed both onsite and online. Standards referenced in the competition included the latest revisions of IPC-A-610, IPC J-STD-001, IPC-7711/21, and IPC-7095.

This year’s competition had four events: DIY soldering, IPC standard knowledge, BGA rework, and circuit diagram troubleshooting competition winner: Ye Zhang

Championship team: Wistron InfoComm (Zhongshan) Co. Ltd. Plant 1

• Championship team: Wistron InfoComm (Zhongshan) Co. Ltd. Plant 1
• DIY soldering competition winner: Mak Yang
• IPC standard knowledge competition winner: Karen Shi
• BGA rework competition and circuit diagram troubleshooting competition winner: Ye Zhang

A China Skills Competition

By Sydney Xiao, President, IPC Asia Operations
ing. Kang Laihui (MIT), IPC China training and certification manager, served as the chief judge. He advised contestants on the competition rules and criteria, and provided a systematic and comprehensive training to the judges, so as to present a professional and fair competition.

IPC China hopes that contestants can better understand IPC standards through such a competition because it combines theory with practice, seeks to improve their skills, and helps companies further their competitive advantages. After two days of competition, and thanks to the impartial and rigorous judging, the top three individuals and team were finally announced.

Jayme Lai, director of the Wistron FAE and customer service support division, expressed his heartfelt thanks to IPC. He said, “Customers and the overseas markets are expecting higher product quality, but it turns out that there is a lack of understanding in the electronics industry standards, as well as the application of the standards. IPC standards are applied in our daily work, and we need a thorough understanding of them. Therefore, our company chose the official training courses provided by IPC China.”

IPC offers professional training on IPC standards, such as IPC-7711/7721 and IPC-A-610, and Lai says that Master IPC Trainers (MITs) presented detailed explanations on some real cases. “These courses have effectively improved our understanding of IPC standards, and when it comes to a disagreement with customers or suppliers regarding the quality issues in electronics assembly, we can better settle the differences.”

At the same time, with the industry standards, he continued, “We can have better control on product quality and manufacturing technique. Our product quality is improved, and the differences between customers and suppliers on product quality are reduced. Gradually, we will develop a stronger influence in the electronics manufacturing industry.”

Even more important, Lai said, is that IPC standards training gives Wistron employees more opportunities to meet their counterparts in this industry. “We can communicate with and learn from each other in future work, and we also maintain communication with the IPC trainers. If we have any questions, we can ask them for advice. Thank you, IPC, for creating this communication platform.”

Successful companies embrace today’s pace of change and gain competitive advantage by proactively investing in the professional development of new and existing employees. IPC China appreciates the great efforts that Wistron Group has put into developing high-quality and high-end technical talent. We encourage and support more companies to carry out talent training programs, and together we can foster high-quality development of the electronics manufacturing industry.
How are you participating in lifelong learning?

What skills do you need to enhance your career? IPC helps you take stock of your professional goals and the skills you need to achieve them.

For example, you may want to:

- Build your knowledge and expand your influence
- Stay current on the most relevant electronics industry topics
- Empower yourself to operate in your role effectively
- Further your skill-based education

IPC works with industry experts to provide the most relevant skill-based educational programs available. The IPC online instructor-led curriculum currently includes a fabrication troubleshooting class, a Certified Electronics Project Management program, and a whole suite of PCB design and manufacturability courses. These include PCB Design I and II, PCB Design for Rigid-flex Boards, PCB Design for Military & Aerospace Applications, and Design for Manufacturability. You can find more detailed explanations in our Winter 2023 issue of IPC Community.

Taught by experts with over 25 years of industry and instructional experience, these popular programs introduce the concepts and skills needed to create real-world IPC-compliant designs, meet the most challenging customer requirements, and guide the development of the next generation of PCB designers.

New Courses in Production Yield and High-reliability Products

Starting this spring, IPC APEX EXPO presenter Dr. Jennie Hwang will share decades of academic and industry experience in three new courses designed to help participants deal with the most challenging issues in production yield and high reliability products:

BTC and PoP Packaging and Assembling: Materials, Processes, and Reliability
Participants will learn to optimize production yield and product reliability for bottom termination component (BTC), and package-on-package (PoP) packaging and downstream manufacturing assembly.

Top Lead-free Production Issues and Defects: Causes, Remedies, and Prevention
Participants will learn to identify and mitigate the occurrence of common production floor issues that decrease yield, increase cost, and jeopardize reliability.

Lead-free Reliability for Harsh Environment Electronics
A must for solder suppliers and users who supply, select, and qualify material. This course dissects what it takes to perform in a harsh environment and what is required to assess solder joint reliability and assembly integrity.

Visit training.ipc.org to see the full catalog of IPC’s self-paced and online instructor-led courses.

Interested in becoming an IPC online instructor? Tell us about your expertise at go.ipc.org/sme.
WHAT THE WORLD LOOKED LIKE THE YEAR IPC WAS FOUNDED

June 1957

- IBM phases out vacuum tubes in favor of transistors
- The #1 song was *All Shook Up* by Elvis Presley
- Founding meeting of IPC. Seated (L-R): Al Hughes, Electralab; Robert Swiggett, Photocircuits; William McGinley, Methode. Standing (L-R): Dick Zens, Printed Electronics Corporation; and Carl Clayton, Tingstol.
- ‘57 Nomad: $5,269
- Whopper: 37 cents
IPC’s instructor-led courses provide a personalized learning experience for highly technical material focused on PCB design and electronics manufacturing. Our instructors are active members of the industry community and have years of hands-on experience developing and manufacturing electronic products.

Since IPC introduced instructor-led courses, hundreds of engineers have benefited from in-depth discussions with our instructors and their colleagues also taking the course. Our instructors go above and beyond to ensure an understanding

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<td>June 5 – July 12</td>
<td>M/W</td>
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<tr>
<td>PCB Design for Military, Aerospace &amp; Other Extreme Applications</td>
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of the material by providing technical guides and meeting with students during office hours in addition to the virtual classes. Plus, all lectures are recorded for review.

Visit my.ipcedge.org to secure your spot and start learning in 2023. If you’re interested in teaching a course, contact KellyAllen@ipc.org or tell us about your expertise at go.ipc.org/sme.

<table>
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<tr>
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The IPC Education Foundation is proud of its IPC Student Chapter Program, which started in 2019 at Auburn University and has expanded to more than 50 schools. Our goal is to enhance collaboration among students at their university or college. The chapters are student driven, which provides an opportunity for them to develop their leadership, as well as professional and personal skills. For only a $40 membership fee, students realize several benefits of joining a student chapter, including scholarships and awards, select sets of industry courses, access to IPC standards, and regular connections with industry professionals.

We want to share just a few comments we’ve received from our student chapter leaders. The knowledge and experience they’ve gained is so great that it’s hard to measure. We are grateful to the industry for their participation, especially because we know these types of activities help keep students engaged and moving forward.

Gaird Brock
Michigan Tech University

Gaird Brock, president of the IPC Student Chapter at Michigan Tech University, says, “The goals of the student network on campus are embedded in education, industry connections, and projects, which demonstrate theoretical concepts in a lab setting. Both the scholarships being offered and the leadership experience are big benefits to being a chapter member.” His chapter has engaged with the industry through hands-on workshops, facility/plant tours, and training on different soldering techniques.

If you are a member of industry wanting to participate in a local chapter, a student wanting to join or start a student chapter, please send an email to WendyGaston@ipc.org.
Henry Crandall
University of Utah

Henry Crandall, a PhD student at the University of Utah, who now serves as the IPC Student Board Member, will act as the voice of his peers. He says, “It is my responsibility to share with the board the perspectives of college students, graduate students, entry level professionals, and the next generation of engineers who are hoping to make an impact in the industry and the wider engineering field.”

Henry is a columnist for I-Connect007. His column appears bi-monthly in PCB007 Magazine under the title, “The Doctor’s In.” In his column, he will be writing about all things health engineering, graduate school, and wearable health monitors. You can read his column here.

Padmanava Choudhury
Auburn University

Padmanava Choudhury serves as president of the IPC Student Chapter at Auburn University. He says, “Our chapter serves as a bridge between the students and the electronics industry. We participate in conferences, organize guest speaker events, and provide IPC chapter members with potential internship and full-time job opportunities. We have had many students from our chapter win scholarships at Auburn. One great event we hosted was ‘Flexible Electronics and the Future of Devices.’ Another successful event in February was a webinar titled ‘Wire Harness Application in Space Industry.’ The speaker was Jacklyn Perry, harness engineer and supervisor from the Johns Hopkins University Applied Physics Laboratory.”

Charlene Gunter du Plessis is senior director of the IPC Education Foundation. Wendy Gaston is business development manager for the IPC Education Foundation.
Overheard

One of the hallmarks of the STEM Outreach Event at IPC APEX EXPO is the opportunity for high school students to rub shoulders with industry professionals. Many of these companies help sponsor the event financially, but representatives also enjoy the time to visit with students. Here’s what some participating IPC member companies had to say about their time at the outreach event.

“I was impressed with the quality of the questions and the interest and energy emanating from the students.”
Tom Edman, TTM Technologies Inc.

“STEM education plays a crucial role in achieving a better and more sustainable future and improving the lives of people around the world.”
Andrea Schafer, CAES

“We’re glad to support the students of the STEM program with our products, so that they are prepared for their future workplaces.”
Philippe Buidin, Weller Tools

“Altium believes a sustainable future depends on the creativity and vision of the next generation of innovators.”
Rea Callendar, Altium Education

“The IPC STEM event allows us to connect with and provide early work experiences with elite students that showcase their intellect and creativity.”
Tracey Hogan, Heller Industries
On Demand:
Free 12-part Webinar Series

Smarter Manufacturing Enabled with Inspection Data
with expert Ivan Aduna

In this micro webinar series, viewers will learn about secure data collection, AI-powered solutions to manage and analyze data, and much more. Each segment can be viewed in 5 minutes or less.
FROM IPC HQ:
Meet the Membership and Customer Service Teams

The membership and customer service teams enable IPC members and customers to achieve maximum value for their membership and provide customer service and administrative support. The department is comprised of two main parts: membership operations and customer/member service. Membership operations process new memberships and renewals, member communications, and other systems support related directly to membership offerings. Customer service is the first point of contact related to IPC. Customer service representatives answer questions, provide support, and assist and process product orders. As a team, we evaluate, consider, and design new ways to engage and support our members and customers to continually improve their experience with IPC.

THE TEAM LEADERS

Brian Knier
Vice President, Marketing Membership and Sales

Clay Ervine
Senior Director, Member Success

Marianna Garbuzova
Operations Manager and Analyst

Susie Wood
Customer Service and Member Success Manager
Customer and Member Operations

Marianna Garbuzova and Ravin Figueroa support members and customers by providing proactive error detection and correction, membership validation, processing, and reconciliation as well as ongoing support to distributors and partners. This team oversees monthly membership renewals and manages the set up and maintenance of IPC’s customer database. Additional duties include new member onboarding, process and system improvements, and overseeing strategic projects.

CUSTOMER SERVICE TEAM

Ravin Figueroa
Member Support Coordinator

Cecilia Dominguez
Customer Service Representative

Logan Smith
Member and Customer Support Team Lead

Heather Schieve
Customer Service Representative

Kayla Young
Customer Service Representative
Customer Service and Member Support

This team of five supports members and customers with general inquiries (website, product details, pricing, etc.), manages profile updates in the customer database, assists with membership questions and processes orders.

In addition, we assist with each standard’s digital rights management (DRM) process, provide support to those seeking certification, and handle various data entry projects.

Operations

All email and phone calls to Customer Service generate a “case” within IPC’s customer relationship management platform. Our cases are worked on in a “first in, first out” basis and owned by the same representative until closed.

The goal is to have 90% of “cases” closed within one business day. Our team currently averages a 93% closure rate. Cases that take longer are those that require a clarification or response from the customer before they can be resolved.

We implemented a customer service survey to get feedback on customer experience. We wanted to know if the inquiry was fully answered in a timely manner. The result:

- 45,488 cases in 2022
  (on average, 176 cases per day)
- 9,128 phone calls in 2022
  (on average, 35 calls per day)

Our top case types are: order processing, certification questions, data entry requests, membership, and finance.

We have also launched a customer dashboard for “self-service” types of activities: updating contact information and tracking activities.

Do you have a question for the membership or customer service teams? Send an email to Contact.Us@ipc.org.

“I called to get a quick shipment out at the last minute that was extremely important to us. Logan Smith handled the call with great professionalism and understood our need and the importance of it. She was able to help us get the order in and shipped the same day as needed with only minutes left in the workday to do it! We are very grateful to the IPC Customer Service team!” — Radiall USA
IPC’s High Reliability Forum Technical Conference focuses on Class 3 electronics for mil-aero, automotive, and long-life applications that are subjected to harsh use environments. Subject matter experts will facilitate true problem solving and cooperation to share best practices across applications focused on exceptional reliability requirements.

For more information visit: ipc.org/event/high-reliability-forum
What Does Sustainability Mean for Electronics Manufacturers?

By Kelly Scanlon, IPC Lead Sustainability Strategist

In our previous article, “Sustainability: IPC Leading the Way,” we asked, “Which sustainability issues are most likely to impact the operating performance of electronics companies?” While there are a multitude of sustainability topics, not all are material or relevant to electronics manufacturing. The answer, though, can enable companies to manage resources that help them meet regulatory obligations and to identify more sustainable business and manufacturing practices with the most beneficial outcomes for the resources invested.

Here’s how we have addressed this question and looked for an answer:

IPC completed an exploratory materiality assessment in Q4 2022 to evaluate the reporting and disclosure drivers causing industry to report and disclose company-specific data and information on various sustainability topics and targets, and the material they have prioritized. The purpose of the exploratory study was to provide a foundation for future industry-specific, sustainability-related studies. However, we were surprised by how useful the results of the study were.

The exploratory study included the following steps:

1. Identify sustainability reports from electronics manufacturing companies.
2. Analyze the results to support consistent review and compilation of data on several parameters.
3. Report to ensure comparability across companies and produce meaningful results.
We analyzed 61 sustainability reports published since 2020 by industry leaders (based on 2021 revenue estimates) using a custom Materiality Framework Tool to support both the consistent review of the reports and the compilation of data. PCB, EMS, and wire/cable companies, as well as OEMs, all from Asia, Europe, and North America, were represented in the study. We recorded data from each report, including:

- **Reporting frameworks and standards:**
  The disclosure frameworks and standards reported on in the sustainability report included Global Reporting Initiative (GRI), Sustainability Accounting Standards Board (SASB), Task Force on Climate-Related Financial Disclosures (TCFD), and the Carbon Disclosure Project (CDP).

- **Stakeholders and stakeholder engagement tactics and methodology:**
  The companies, organizations, or communities identified as relevant to the company’s financial and nonfinancial success and the approach taken to survey or otherwise engage with those stakeholders.

- **Sustainability goals:** Qualitative, quantitative, or time-bound targets established by the company.

- **Material topics and topic boundaries:**
  The sustainability topics presented in the company’s sustainability report and the terminology used to define or describe that topic.

We found that there was consistent use of the four frameworks and standards (GRI, SASB, TCFD, CDP) across the four industry segments (PCB, EMS, wire/cable, OEM) and across the three regions (Asia, Europe, and North America). GRI was strongly preferred and most used. Only 8% of companies evaluated did not reference any of the frameworks/standards. Six stakeholder categories were most represented in the sustainability reports:

- Customers (75% of companies in this survey mention this stakeholder category)
- Investors and providers of capital (75%)
- Policymakers (69%)
- Employees (64%)
- Suppliers (54%)
- Communities (48%)

We did find some consistency across sustainability reports, however. Investors were mentioned more frequently by PCB companies and EMS companies; customers were mentioned more frequently by wire/cable companies; and policymakers were mentioned more frequently by OEM companies.

Most companies evaluated in this exploratory study set sustainability targets: 54 of 61 companies published their goals in their sustainability reports, yet only 33 of those 54 companies set qualitative, quantitative, and time-bound targets—an indicator of maturity in corporate responsibility and due
Koh Young is delivering solutions to increase production efficiency with measurement-based inspection for boards with a mix of component types. The Zenith and KY-P3 product offerings provide automated back-end solutions that combine advanced optics and innovative AI-powered vision algorithms for through-hole leads and pins, as well as traditional surface mount components on the same assembly.

Typically, manufacturers required two separate machines for surface mount and through-hole inspection, but the updates to our best-in-class Zenith and KY-P3 machines afford mixed technology capabilities that reduces capital investments by delivering machines capable of both surface mount components and through-hole leads and pins.

The traditional surface mount components and through-hole leads and pins are inspected with our multi-projection Moiré interferometry system. With proprietary, AI-powered algorithms for blow or pin holes, solder volume, bridging, insufficient, excessive, solder balls, and solder fillet, missing or offset pin, pin height, polarity, plus foreign material, the machines are more powerful than ever. When considering pin inspection challenges, the KY-P3 addresses single, array, press-fit, and fork arrangements, as well as pins within a connector shroud, inner and outer wall distances, fork pin separation, and paste height measurement to help manufacturers increase yields.

Incorporating the world’s first True3D™ quad-projection probe, the systems deliver shadow-free measurement with low false calls. Additionally, the “Stop-and-Go” probe movement allows it to capture 3D measurement data without system vibration, image stitching, or data interpolation. The machines deliver True3D™ measurement capabilities for automotive electronic control units (ECMs), industrial products, and computer boards, as well as backplane and connector assemblies. Its quantitative True3D™ measurement-based approach delivers best-in-class accuracy and repeatability for electronics manufacturers.

- Algorithms for Blow or Pin Holes, Bridging, Insufficient, Excessive, Volume, Solder Balls, and Solder Fillet, Missing or Offset Pin, Pin Height, Volume, Polarity, plus Foreign Material and Debris
- Suitable for Pin in Paste, wave, and selective
- Dual Side Inspection with Integrated Flipper
- 70mm extended clearance
- Versatile substrate and carrier handling systems
- Automated back-end THT inspection solution
diligence. Target-setting occurred evenly across industry segments and evenly across revenue groups.

Companies reported material or relevant sustainability topics representing approximately 30 topic areas. The descriptions and definitions for these topic areas include more than 600 different terms. For example, anti-corruption and business ethics had the highest average number of mentions. This topic area includes measures for compliance, corporate social responsibility, financial integrity, honest operations, and risk management.

Emissions had the second-highest average number of mentions and includes measures for carbon footprints, greenhouse gas emissions, climate change, resilience, decarbonization, energy management, and use of low-carbon products.

There was a tie for the third-highest average number of mentions: diversity and equal opportunity, and occupational health and safety. Diversity and equal opportunity includes measures for staff distribution and diversity, employee rights, human rights, racial equity, and justice. Occupational health and safety includes measures for well-being, pandemic prevention and management, and workplace health and safety standards.

The study offers a snapshot of sustainability themes, targets, and topics based on a refined subset of the electronics manufacturing industry. We intend to evaluate these results to best determine how they apply to the broader industry. For now, we can conclude that there are some consistencies in reporting frameworks and standards, stakeholders, the ability to set targets, and material topics. The extent to which we can use these results will be tested as IPC moves forward with its Sustainability for Electronics Initiative.
### How Many Times Was the Topic Mentioned?

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We Want to Hear From You

If you have insights about sustainability reporting, please let us know. Contact KellyScanlon@ipc.org to learn more about IPC's Sustainability for Electronics Initiative or to share your insights.
How Can Government Help or Hurt You in 2023?

IPC Invites You to Speak Up

As a member of the electronics manufacturing industry, it’s important to stay informed about the government policies that impact your business and your industry. With that in mind, we want to know: Which government policies worry you most? How can government help or hurt your company in the next few years?

To help us better understand your concerns, we’ve created a short, five-question survey. It will only take a few minutes to complete, and your answers will help us shape IPC’s advocacy efforts in 2023.

Here are a few examples of the types of policies that might be worrying you:

Trade policies: Are you concerned about tariffs or other trade barriers that could impact your business?

Regulation: Are you worried about the burden of regulations on your business? Do you feel the rules and standards you have to follow are fair and reasonable?

Environmental issues: Do you worry about the impact of your business on the environment and/or the government’s efforts to address these issues?

Supply chain: IPC expects that volatility and uncertainty will continue to affect the electronics supply chain in the months ahead. Will your business be affected?

Workforce issues: Are you concerned about the government’s labor policies and their impact on your business? Do you worry about issues like workplace safety?

Click here to begin the survey
Hmm… If I have a **conductor width** and isolation distance of 40 µm (1.5 mils), does that mean my **PCB is considered Ultra HDI**?

PCBs are complex products which demand a significant amount of time, knowledge and effort to become reliable. As it should be, because they are used in products that we all rely on in our daily life. And we expect them to work. But how do they become reliable? And what determines reliability? Is it the copper thickness, or the IPC Class that decides?

Every day we get questions like those. And we love it. We have more than 550 PCB experts on 3 continents speaking 19 languages at your service. **Regardless where you are or whenever you have a question**, contact us!

What's your PCB question?

Reliable answers. Reliable PCBs.
North America
By Brian Knier, Vice President, Marketing, Member Success and Sales

The annual IPC APEX EXPO event was held in San Diego, Jan. 22–27. Attendance reached pre-pandemic levels as the industry gathered to share knowledge, network, and celebrate achievements. The premiere industry technical conference held as part of the event reached record levels of participation and attendance. For a full review of IPC APEX EXPO 2023, click here to read Real Time with... Show & Tell Magazine.

The Wire Harness Manufacturing Association (WHMA) held its annual Wire Harness conference in Albuquerque, New Mexico, Feb. 14–17, celebrating 30 years supporting the industry. The event featured workshops, keynote presentations and many opportunities to network with industry peers. Read more about this event on page 50.

Looking ahead, plan to attend the Electrical Wire Processing Technology Expo in Milwaukee, May 16–18. EWPTE is where the industry comes together, with more than 3,000 attendees and nearly 200 exhibitors, to find solutions to challenging wire problems through training and education and for an opportunity to network with industry leaders and subject matter experts. EWPTE is co-located with IPC SummerCom, the forum to support IPC standards committee meetings and the ongoing development of IPC standards.
Asia
By Sydney Xiao,
President of IPC Asia Operations

The COVID pandemic spread rapidly in China and, by December 2022, a large amount of the Chinese population was infected. By February, it seemed that China’s economy was recovering rapidly. We’re happy to learn that our members in Asia are very busy and businesses are accelerating. In Q1, our most important activity was to visit IPC member companies, government agencies, and partners in Asia to understand their priorities in 2023 and seek for areas where IPC can provide support.

Q2 and Q3 are typically the two busiest quarters in the industry, and the IPC Asia team has planned for a wide range of events.

In April, we will hold high-reliability conferences in Thailand and Vietnam to share with member companies how to achieve high-product reliability through IPC standards and the latest industry technology solutions.

In May, the Asia Standards Steering Committee, the Asia Education Steering Committee, and the China Automotive Electronics Advisory Committee will meet in China for annual face-to-face events.

In June, July, and September, we have planned hand-soldering competitions in Thailand, China, and Vietnam, respectively.

In addition, in June and September, we will hold webinars with content that focuses on advanced packaging, Factory of the Future, and automotive electronics.

Europe
By Sanjay Huprikar, President of Europe and South Asia Operations

IPC Electronics Europe GmbH has planned another exciting year of member engagement in 2023 with no fewer than eight trade shows, two technical conferences focused on such hot topics as advanced packaging and e-mobility, and numerous “IPC Day” events targeting the European EMS and PCB industries.

The highlights of Q1 included the Southern Manufacturing and Electronics event in the UK in February, the Global Industrie event in France in early March, and the Innoelectro...
event in Hungary in late March. To continue to shine the spotlight on both workforce development training needs across Europe and the importance of assembly standards in the manufacturing process, one of the top attractions at each event was a hand-soldering competition and the crowning of regional champions, who will all compete in the HSC World Finals at productronica in November.

While IPC will continue participating in multiple trade shows, our core focus areas from April to June will be on advocacy-related events. We will be hosting private summits with European PCB manufacturers in Brussels and UK EMS companies in London; these are executive networking events, which help to unify industry voices around a targeted and unique set of challenges faced by our members.

In addition, the combined forces of our global government relations team, global solutions team, and European regional team will play host to our first European workshop on “silicon to systems.” This event is being developed in response to a direct request by many of our European members—who attended IPC’s Advanced Packaging Symposium in Washington, D.C., last October and the technical conference at IPC APEX EXPO 2023 in January—and walked away with the sentiment that IPC is positioned to do more to “advance the European electronics industry.”

India
By Gaurab Majumdar,
Executive Director of IPC India

In February, IPC organized technical workshops and industry networking in the states of Uttarakhand and Andhra Pradesh, to start standards development activities in India. These workshops were conducted to assist engineers in understanding the design and manufacturing process of IPC products and how to use the latest technologies to improve efficiency. They also provided the opportunity to discuss best practices and troubleshoot any problems they may have encountered.

The cities of Rudrapur and Pantnagar, both in Uttarakhand, one of India’s major auto-
tive hubs, have prominent OEMs and suppliers that house companies in power and consumer electronics. IPC India hosted a networking event on Feb. 9 that provided support for the electronics industry in that region.

A networking event and technical workshop was organized for the electronics industry in Vizagapatam, Andhra Pradesh, by IPC India on Feb. 7. The honorable Rolland Williams, secretary of Vizagapatam Chamber of Commerce and Industry, welcomed the guests, including Dr. Y Sreenivas Rao, director, Naval Sciences Technological Laboratory, DRDO, Ministry of Defence, Government of India.

With many naval and defense organizations in and around Vishakhapatnam, the region is poised for growth in a variety of electronics manufacturing sectors. This highlights the need for local industry to focus on innovation and the importance of the private sector in the growth of the defense industry.

IPC India hosted several standards development activities, Feb. 22–25, conducted by David Bergman, IPC vice president of standards and technology. In Pune, an automotive solutions committee met with prominent members of the Indian automotive industry to hear about their current challenges and opportunities. In Bengaluru, teams met with prominent EMS providers and wire harness organizations to discuss having a global standards/guidelines document that will connect Indian organizations on a common platform. The PCB Design Committee also presented its progress and roadmap for 2023.
IPC has revamped its Thought Leaders Program (TLP), an initiative designed to “mine” key industry experts’ insight and knowledge on issues driving change within the electronics industry.

Five experts have been selected to generate ideas and insights in five areas:

1. Education and workforce
2. Technology and innovation
3. The economy
4. Key markets
5. Environment, health, and safety

The TLP is chaired by Mike Carano, IPC consultant and a member of IPC’s Hall of Fame.

New TLP members are:
- **Peter Bigelow**, President and CEO, IMI Incorporated
- **Matt Holzmann**, President, CGI Americas
- **Stanton Rak**, Principal, SF Rak Company
- **Stephen Sweeney**, Program Manager, Materials and Environmental Management, IBM
- **Hiroyuki Watanabe**, Executive Director, Global Security, NEC Corporation

The Thought Leaders’ responsibilities are to provide publishable material in their subject areas, flagging opportunities for IPC engagement, and participating in quarterly roundtable discussions. Each expert is expected to fulfill at least one 12-month term, during which quarterly contributions will be expected.

“I’m honored to work with such a diverse and august group of experts,” says Mike Carano. “The program is drawing on individuals who are leaders within the electronics manufacturing industry and who have insights into market research, trends, cybersecurity, high-tech production, emerging technologies, sustainability, business management, materials science, and consulting. Our industry rapidly changes, and these experts have been assembled to provide guidance and solutions to lead and influence change toward building electronics better.”

For more information on the Thought Leaders Program, click here.
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IPC member benefits

IPC membership has its advantages and we’ve provided you with a list of special resources that are available to employees at an IPC member-company. We hope you will take some time to review the links below, and more importantly, to put these resources to work for you and your company.

**Technical resources:** Get exclusive access to technical documents presented at IPC conferences.

**Industry Intelligence:** IPC renewed its commitment to serving the industry by expanding the scope and scale of research under a revamped IPC Industry Intelligence program.

**Free ESD and Safety courses:** All member companies have access to training modules covering electrostatic discharge (ESD) and safety in an electronics manufacturing environment. Reduce costs with free access and easily implement common training across all your manufacturing sites.

**Receive free IPC standards:** IPC member companies may download a free single-device IPC document in its original language, within 90 days of publication.

**Sponsor and exhibit at an IPC event at discounted rates:** IPC provides a discount to members for sponsorships and exhibitions at events like IPC APEX EXPO.

**Discounts on education and training courses:** All of IPC’s education courses are offered at a discounted rate.

**All IPC members receive access to WHMA benefits:** Now it’s even easier to connect with wiring harness manufacturers.

**Promote your company to the electronics industry:** Download the IPC logo and create your listing for IPC Global Marketplace.

**Business resources:** IPC partners with NAM Healthcare and Exostar to provide exclusive discounts to our membership.
Distinctly different.

Our books are written by recognized industry experts. At around 8,000 words, they are unique in that they are able to be incredibly focused on a specific slice of technology.

“1-007ebooks are like water in the desert … it’s up to you to drink it in order to survive!”

Stephen V. Chavez
PCEA Chairman, MIT, CID+

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2023 Programs Q2

Stay connected with IPC through some of these regional events in April, May, and June. Visit our online calendar of events for more information.

**APRIL**

April 27
**IPC Hand Soldering Competition and Technical Workshop:** “Standards Help Produce More Reliable Electronics Assemblies and Enhance Product Quality” at Indian Chamber of Commerce, ICC Kolkata, India

May 4
**IPC Day Design France, Designers Council France**
Lyon, France

May 9
**IPC Hand Soldering Competition at Prebin Distribution CC**
Johannesburg, South Africa

May 11
**IPC Hand Soldering & Wire Harness Competition at ELCIA**
Bengaluru, Karnataka, India

May 13–18
**IPC SummerCom**
Milwaukee, Wisconsin

May 16
**IPC Hand Soldering Competition at Mysuru ESDM Cluster, Lahari**
Mysuru, Karnataka, India

May 16–18
**Electrical Wire Processing Technology Expo**
Milwaukee, Wisconsin

May 17–18
**IPC Hand Soldering Competition at FocusOnPCB**
Vincenza, Italy

May 18
**IPC Taiwan CIT Club**
Taiwan Region

**MAY**

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Taiwan Region

**JUNE**

June 2
**IPC Hand Soldering Competition & Technical Workshop:** “Standards Help Produce More Reliable Electronics Assemblies and Enhance Product Quality” at Vadodara Chamber of Commerce Vadodra, Gujarat, India

June 6
**ITI/IPC Critical Environmental Requirements for Electronics Conference 2023**
Virtual

June 6
**Technical Workshop: “Best Practices on Electronics Assembly” at MACCIA**
Nashik, Maharashtra, India

June 7–10
**IPC Hand Soldering Competition at WinEurasia**
Istanbul, Turkey

June 14
**IPC Hand Soldering & Wire Harness Competition at Maratha Chamber of Commerce, Industry and Agriculture (MCCIA)**
Pune, Maharashtra, India

June 15
**IPC Day EMS Europe**
London, England

June 21–24
**IPC Hand Soldering Competition at NEPCON Thailand**
Bangkok, Thailand

June 27
**IPC Hand Soldering Competition & Technical Workshop:** “Standards Help Produce More Reliable Electronics Assemblies and Enhance Product Quality,” Federation of Telangana Chambers of Commerce and Industry (FTCCI) Hyderabad, India
We Invite You... to Subscribe!

How do we celebrate member success? By telling stories—stories of the electronics manufacturing industry and how we are all connected. This publication celebrates member success while sharing the important work being done within the association to better serve its members and the global electronics manufacturing community.

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