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MARCH 2013

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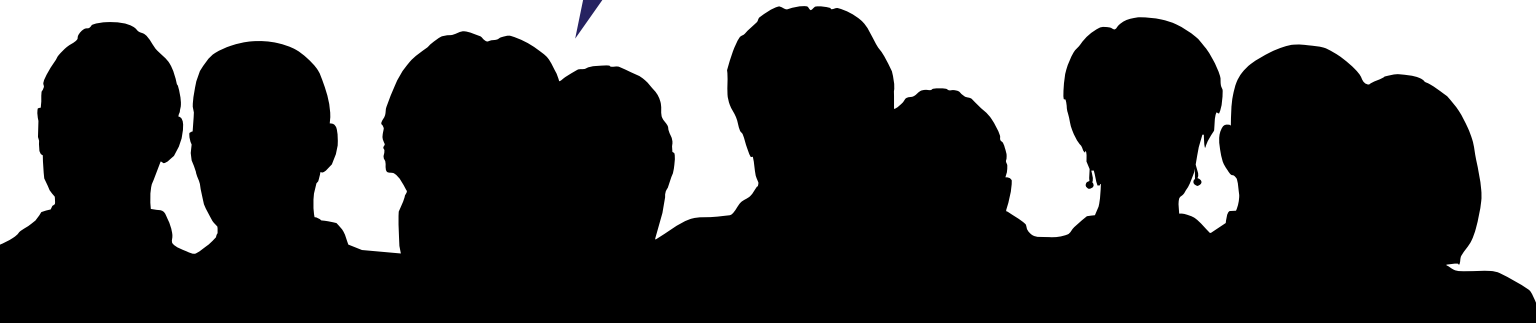
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March 2013 Featured Content

LEGISLATION & ENVIRONMENTAL ISSUES

The March issue of *SMT Magazine* looks at the industry's many environmental issues, including the impact of legislation with a focus on RoHS and REACH compliance and enforcement, ITAR compliance, conflict minerals, and corporate social responsibility. Also included is our exclusive IPC APEX EXPO 2013 post-show coverage. Our veteran team of guest editors and staff bring you the latest from the show floor, including new technologies and products, a review of key panel discussions, and, of course, our in-depth Real Time with... video interviews.

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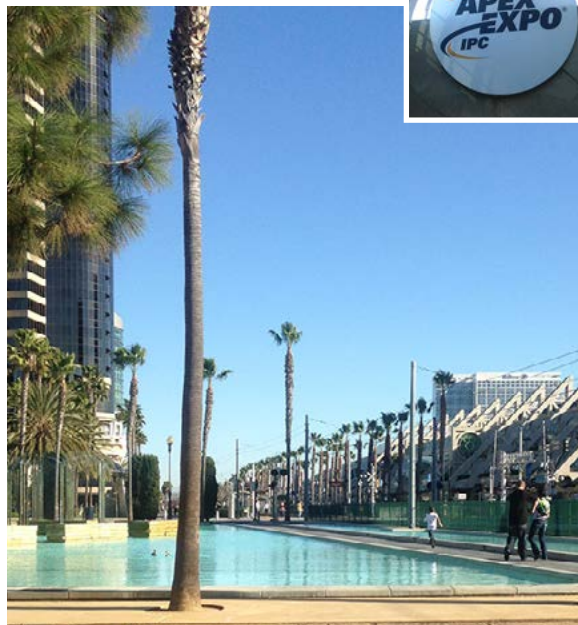
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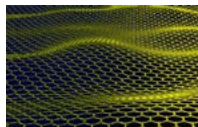
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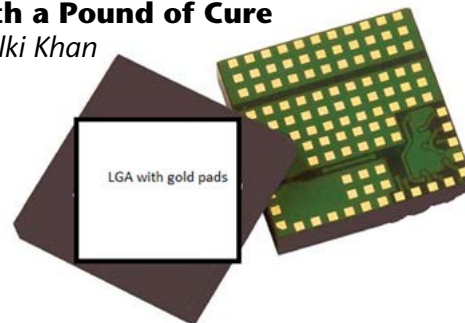


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The Silicon Valley Effect

by Ray Rasmussen

I-CONNECT007

SUMMARY: *The attendance at a show like DesignCon is a great indicator of what's going on in the Valley. And the Valley is a good indicator for the rest of us.*

In late January, I spent a day at DesignCon 2013. Located in Santa Clara, California, the show is in the heart of Silicon Valley. It's typically a good show, focused on the systems needed to design and manufacture electronic products. Here's the official description from their website:

Created by engineers for engineers, DesignCon enables chip, board and systems designers, software developers, and silicon manufacturers to grow their expertise on the latest theoretical design techniques, methodologies, and applications, learn about emerging design tools, and network with peers and industry experts.

It's important to include that here, so that you know what kinds of folks I'll be talking about in this column.

In any case, the halls were packed (with those folks mentioned above) as attendees looked for the latest and greatest design tech-

niques, materials, and components for their upcoming gadgets. I was quite impressed by the number of attendees. It almost looked like the kind of throngs you'd see at a show in China. Lots of engineers and designers filled the sessions and the show floor. All of the exhibitors I talked with were happy with the quality and quantity of the visitors to their booths. As usual, we brought our team of editors and videographers to capture some of the relevant content for our readers. (You can watch our coverage of DesignCon [here](#).)

Silicon Valley Heats Up

The attendance at a show like DesignCon is a great indicator of what's going on in the Valley. And, the Valley is a good indicator for the rest of us. Some of the latest market reports correlate pretty well with the activity I saw at the show. As of December, 2012, California's unemployment rate was 9.8%, while Silicon Valley's was 7.6%, down from 8.8% last July. That equates to about 30,000 more people with jobs out of a population of 3 million. In 2011, the Valley added 42,000 new jobs. If the trend continues, Silicon Valley will post some really strong numbers in 2013. The total Valley employment has now surpassed 2007 highs.

If you're interested, here's a report on the [health of Silicon Valley](#).

Some Perspective

In 2002, I drove to Silicon Valley to see some friends. Having lived there for about 20 years,





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THE SILICON VALLEY EFFECT *continues*

I had a good sense of when to arrive and when to leave to avoid the crazy traffic, which is the daily routine of many techies who live and work there. It was about a year since I'd been there last. That day I was traveling at the wrong time, and I expected to hit significant delays; I wasn't in a hurry so it wasn't a big deal. To my surprise, I cruised right down I-680 (coming from Sacramento) without delay, transitioned to Mission Blvd., and onto southbound I-880. Where was the traffic? Of course, we were all feeling the effects of the dotcom bust, but I had no idea it was this bad. Continuing my drive down I-880 and then on to SR 237, I was shocked to see building after building mostly empty. It looked like a ghost town, really. I'm not exaggerating. It was scary.

Just before things started melting down, in 1999, the lease for our building was up. *CircuiTree*, the PCB-focused magazine I owned with Barry Matties, leased office space in Campbell, a small town butting up against San Jose. Since the Valley was booming, the landlord was planning to double our rent, which accelerated our plans to take the company virtual. I tell you this to illustrate the craziness and dramatic swings the Valley can take. Historically, there have been lots of booms and busts. (By the way, that office space sat empty for many years; the good news is that if they'd only incrementally raised the rent, we would have kept the space, which would have been a significant hardship on our business as the market crashed. So, it worked out for us.)

Back to DesignCon 2013. At the show, I had to park at an overflow lot across the street from the new 49ers stadium, which is slated for completion in 2014. On my way home from the show (I live a couple of hours from the Valley in the foothills east of Sacramento), it took me 20 minutes just to get on the freeway at 6:30 p.m. I was looking for an article or a research group that tracks this, but based on my 30+ years working in this industry, 20 of them in the Valley, I think you can make a good case for the economic activity in San Jose and Santa Clara and the rest of those South Bay cities as being a leading indicator for the tech industry at large. If you buy that, then things are about to pop!

More Evidence

A few of the quick-turn PCB companies I ran into at the show were doing very well. Sales were way up. Some of the larger multinational companies, along with their EMS brothers, were suffering declines. You can see what they're reporting in the [earnings section](#) on our websites. But with the proto guys busting at the seams and the production fabs showing weak demand, it sounds like a whole raft of new products are in the pipeline. There's pent-up demand around the globe for the next systems to improve efficiency and offer new capabilities. From what both big and small companies told me, they are buying equipment. They're getting ready to move to new technical capabilities and develop more capacity.

The Bigger Picture

When you look at the forecasts, most markets are predicting solid growth. In a report from Databeans, located in our [Market News](#) section, semiconductors were flat in 2012, but they expect to see 7% growth in 2013. Not bad. Another report says global IT will grow at 3%. Smartphones grew 38% in 2012, and I would expect to see a similar rate in 2013. Automation and robotics are expected to grow 8% in 2013. The personal computer market is expected to stagnate in 2013 as consumers move to more mobile platforms like smartphones and tablets. As a result, 145 million tablets are expected to be sold worldwide in 2013. I know mil/aero has been down the last six months, but check out the contracts being placed with OEMs on our mil/aero website, [Milaero007.com](#).

With Silicon Valley picking up steam and a recovering global economy, we're likely in for a good 2013. If trends hold up, 2014 and '15 could be good years for the tech industries, as well. I'm looking forward to it! **SMT**



Ray Rasmussen is the publisher and chief editor for I-Connect007 publications. He has worked in the industry since 1978 and is the former publisher and chief editor of *CircuiTree Magazine*. Contact Rasmussen [here](#).



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SMT PERSPECTIVES AND PROSPECTS

Conflict Minerals: A Snapshot

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

SUMMARY: *As the supply chain becomes increasingly complex and global, with an ever-increasing number of suppliers, full traceability of conflict minerals throughout the global supply chain is a daunting task. To comply with the SEC's reporting and disclosure requirement, a company must formulate a comprehensive program to achieving traceability and transparency.*

For the last decade, regulations, new or pending, have been the focus of discussions, debates, and reviews. Existing and potential regulations are exerting and will exert significant impact on our industry and our personal lives. Regulations closely affecting our industry include: Sarbanes-Oxley Act (the Public Company Accounting Reform and Investor Protection Act), enacted on July 30, 2002, which regulates accounting principles and procedures and has changed the regulation of financial practice and corporate governance; the RoHS directive, which took effect July 1, 2006, and restricts the use of specified hazardous substances and revamps the use of electronic materials; and REACH (the European Community's Registration, Evaluation, Authorization and Restriction of Chemical Substances) entered into force on June 1, 2007, and calls for awareness and labeling of potential hazardous chemicals and regulates the substances and their safe use. On January 1, 2013, Conflict Minerals came into force, which deals with specific sources of mining ores.

A wide range of regulations change the way we do business and affect corporate behavior, amplifying corporate social responsibility. This month, I'd like to provide a snapshot of the newly-enacted regulation on conflict minerals.

Questioned Minerals

Currently, four minerals are deemed to be "conflict minerals." These mineral ores produce four essential elements (tantalum, tin, tungsten, and gold) which are key to a variety of end-use applications for diverse industries ranging from electronics to industrial to consumer to military sectors. The four minerals are:

- **Columbite-tantalite** - An important source of tantalum; the metal ore from which the element tantalum is extracted. Tantalum is used in electronics, military, and other sectors.
- **Cassiterite** - An important source of tin; tin is widely used in plating, solder, and making specialty alloys and organo-tin compounds that offer various applications in battery and chemical reactions.
- **Wolframite** - An important source of tungsten; tungsten is a highly-dense metal and is frequently used for this property to produce high-density, wear-resistant alloys for a wide array of applications from tools to turbine blades.
- **Gold** - Offering diverse uses from medicine field to electronics. It is also present in some chemical compounds used in various manufacturing processes.



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CONFLICT MINERALS: A SNAPSHOT *continues*

The new regulation covers the above four important elements at the present time, but it should be noted that additional minerals may be added in the future.

The Conflict

Internationally, increased attention has been given to the violence and gross human rights violations occurring during the mining of certain minerals, most often situated in the eastern portion of the Democratic Republic of the Congo (DRC) and surrounding countries. Minerals are mined in conditions of armed conflict and severe human rights abuses. Armed militia groups appear to be intent on exploiting the area's natural resources. This pervasive exploitation in conflict-affected and high-risk areas has caused grave concern in the international community and the region is now deemed a "conflict region."

Companies directly or indirectly sourcing from, or directly operating in, this region face the risk of contributing to the conflict.

Combating the Problem

To combat illegal exploitation of natural resources in conflict-affected and high-risk areas, and to initiate a proactive process through which companies can ensure they respect human rights and do not contribute further to the conflict, Senator Sam Brownback (R-KS) introduced the Congo Conflict Minerals Act of 2009 (S.819) which requires electronics companies to verify and disclose their sources of cassiterite, wolframite, and tantalum. This legislation lost its pulse in committee. However, similar language was later added as Section 1502 of the Dodd-Frank Wall Street Reform and Consumer Protection Act.

Section 1502 of the Dodd-Frank Reform Act requires companies to verify and disclose

their sources of conflict minerals. The goal is to eliminate the link between mining and conflict and to help prevent company complicity in a vicious cycle of mineral-fuelled conflict in the region.

The Dodd-Frank Act passed the U.S. Congress and was signed into law by President Barack Obama July 21, 2010. The U.S. Securities and Exchange Commission (SEC) proposed and published the draft regulations to implement the Conflict Mineral Law in December 2010. During its review and comment period, more than 700 comment letters were submitted to SEC on the proposal.

In August 2012, SEC adopted a rule mandated by the Dodd-Frank Wall Street Reform and Consumer Protection Act to require companies to publicly disclose use of conflict minerals which originated in the DRC or an adjoining country.

Current U.S. Regulation

The regulatory reform law directed the SEC to issue rules requiring certain companies to disclose their use of conflict minerals that include tantalum, tin, tungsten, or gold if those minerals are "necessary to the functionality or production of a product" manufactured by those companies. Companies are required to provide this disclosure on a new form (Form SD) to be filed with the SEC. The provision came into force January 1, 2013.

Before the SEC rule, the California Legislature, on September 16, 2011, passed a law (SB 861) requiring public companies to comply with the Dodd-Frank provision on conflict minerals if they want to do business with the state of California.

As stated in my [January column](#), "2013 will be the first calendar year that the SEC rule requires supply chain due diligence and special-

Minerals are mined in conditions of armed conflict and severe human rights abuses. Armed militia groups appear to be intent on exploiting the area's natural resources. This pervasive exploitation in conflict-affected and high-risk areas has caused grave concern in the international community and the region is now deemed a "conflict region."

CONFLICT MINERALS: A SNAPSHOT *continues*

ized reporting by companies that manufacture or contract to manufacture products that contain these four minerals originating from the Democratic Republic of the Congo and adjoining countries. And the first required report must be filed by May 31, 2014.”

Who's Targeted?

An estimated 6,000 public companies under the jurisdiction of the SEC will need to be transparent about the source of conflict minerals used in their products and manufacturing processes. However, with the complexity of global supply chain, chances are that even the SEC regulation does not directly apply to a company (private companies); the company may need to provide information on the presence of conflict minerals in its products to customers. Attention and efforts by all manufacturers are warranted.

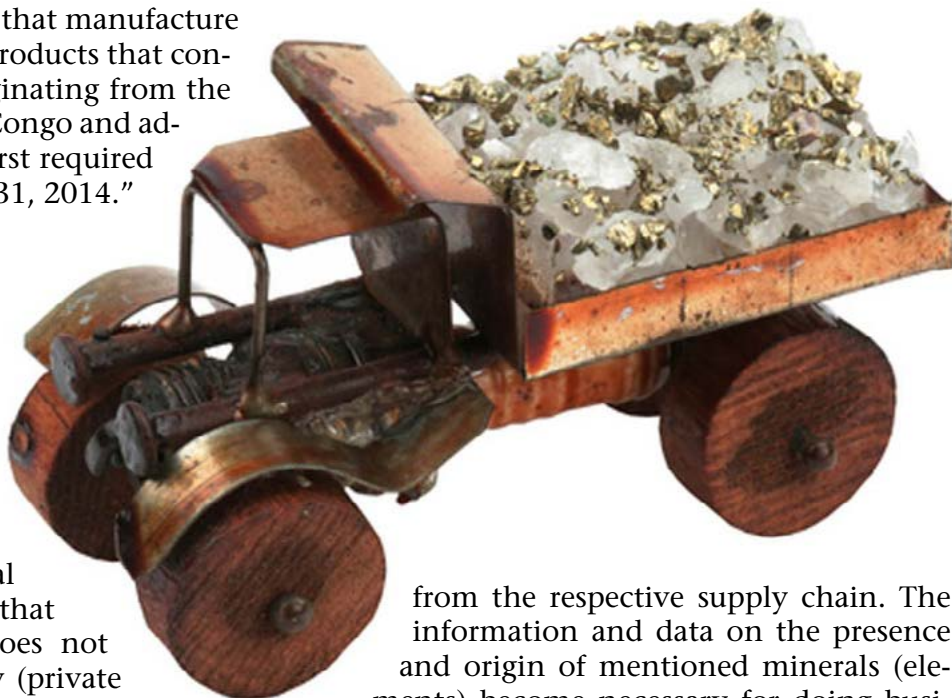
Tracing Origins

Companies must disclose the determination and describe the due diligence on Form SD. According to the SEC:

...companies that contract out the manufacturing of products (or components) that contain conflict minerals can circumvent the required disclosure if it is deemed that the company holds no influence over the item being contracted. A company does not qualify as having influence over the manufacturing of a product if it is simply stamping its brand on the product or if it merely services a product manufactured by a third party, according to the companies that have determined that conflict minerals sourced from countries...the company must make a reasonable inquiry into the country of origin of the conflict mineral...

The “influence” is to be determined and the traceability is the name of the game.

To trace the origin of conflict minerals in products, the entire hierarchy of suppliers must be engaged, obtaining data and information



from the respective supply chain. The information and data on the presence and origin of mentioned minerals (elements) become necessary for doing business. A third-party audit and due diligence measures are mandatory.

The identification of conflict-free smelters and refiners is quite helpful for manufacturing companies. The Electronic Industry Citizenship Coalition (EICC) and Global e-Sustainability Initiative (GeSI) can help.

Due Diligence Guideline

On the international front, the Organization for Economic Cooperation and Development (OECD), and its member countries, has made a concerted effort on this front. The organization set its objectives to combat illegal exploitation of natural resources in conflict-affected and high-risk areas in order to avoid contributing to conflict; to promote principles and standards for responsible business conduct; and to successfully contribute to sustainable, equitable, and effective development. Last November, OECD published Due Diligence Guidance for Responsible Supply Chains of Minerals from Conflict-Affected and High-Risk Areas, Second edition.

The SEC stipulates: “...Reporting companies have to perform due diligence that must conform to a nationally or internationally recognized due diligence framework, such as the due diligence guidance approved by OECD.”

CONFLICT MINERALS: A SNAPSHOT *continues*

The OECD Guidance sets out a five-step framework for risk-based due diligence in the mineral supply chain:

1. Establish strong company management systems.
2. Identify and assess risk in the supply chain.
3. Design and implement a strategy to respond to identified risks.
4. Carry out an independent third-party audit of supply chain due diligence at identified points in the supply chain.
5. Report on supply chain due diligence.

Going Forward

Basically, the U.S. conflict minerals law contains two requirements: Independent third-party supply chain traceability audits and reporting of audit information to the public and the SEC.

Dodd-Frank 1502 is a disclosure requirement and places no ban or penalty on the use of conflict minerals. However, a company is required to assess whether any conflict mineral was “necessary to the functionality or production” of a product manufactured or contracted for manufacture by the company. To comply with SEC regulation, whether or not the company that contracts out production holds the influence over the item being contracted is also to be assessed and determined.

Although it is not illegal to use conflict minerals, corporate social responsibility is on the line. The ultimate goal is to be conflict-free. Apple released its “2011 Supplier Responsibility Report,” detailing how it traces its supply chain—first to the suppliers that created the subcomponents to their products and then to the smelters that processed the ores. Intel has conducted on-site reviews on smelters as part of a conflict-free smelter program.

As the supply chain becomes increasingly complex and global, with an ever-increasing number of suppliers, full traceability throughout the global supply chain is a daunting task. To comply with the SEC’s reporting and disclosure requirement, a company must formulate a comprehensive program to achieving traceability and transparency. Formulating and executing such a program to comply with all regula-

tions and exceed customer requirements should be a top priority.

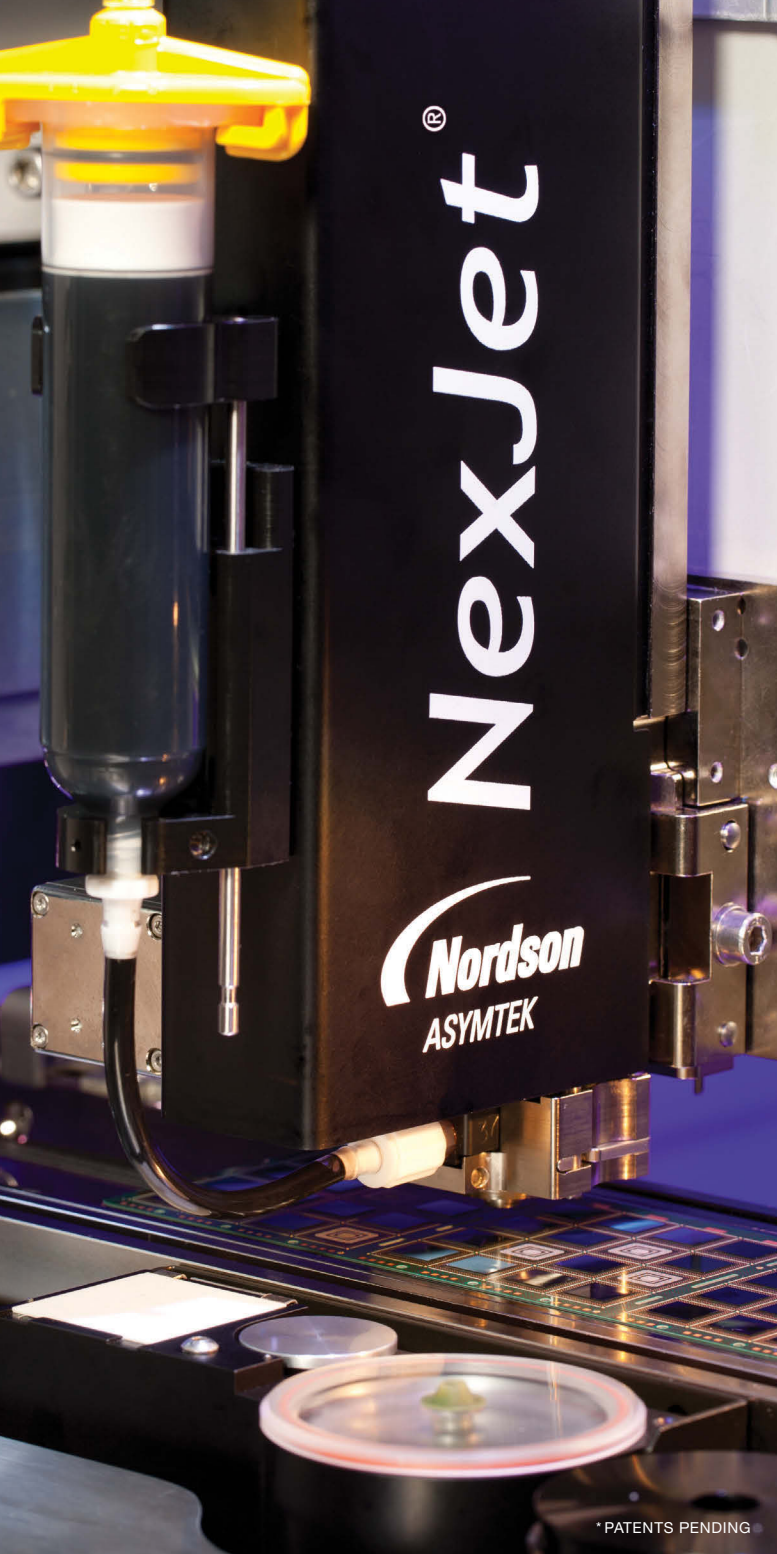
On the business front, a shift in long-term investments in mines or mine-related business may shed new light and warrant further discussions. On the corporate governance front, conflict minerals will become an additional board and management issue to be monitored in enterprise risk management programs.

Overall, conflict minerals will have a real impact on the entire supply chain in all industries, with electronics on the front line. **SMT**



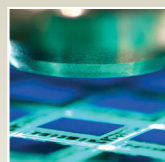
Dr. Hwang will present three lectures related to electronics manufacturing at the annual System Integration in Micro-Electronics Conference April 16-17, 2013, in Nuremberg, Germany, and four lectures in Penang, Malaysia, March 4 -7, 2013.

Dr. Hwang, a pioneer and longstanding contributor to SMT manufacturing since its inception as well as to the lead-free development, has helped improve production yield and solved challenging reliability issues. Among her many awards and honors, she has been inducted into the WIT International Hall of Fame, elected to the National Academy of Engineering and named an R&D Stars to Watch. Having held senior executive positions with Lockheed Martin Corporation, Sherwin Williams Co., SCM Corporation and IEM Corporation, she is currently CEO of H-Technologies Group providing business, technology and manufacturing solutions. She is a member of the U.S. Commerce Department’s Export Council, and serves on the board of Fortune 500 NYSE companies and civic and university boards. She is the author of 350+ publications and several textbooks and an international speaker and author on trade, business, education and social issues. Her formal education includes four academic degrees, as well as the Harvard Business School Executive Program and Columbia University Corporate Governance Program. Contact her at (216) 577-3284; e-mail jennieHwang@aol.com.



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Legislative & Regulatory Product-Related Environmental Policy Developments to Watch in 2013



by Holly Evans
STRATEGIC COUNSEL LLC

SUMMARY: *The many international, federal, and state environmental requirements placed on the electronics industry can make compliance no easy task. Designed to provide a status report of these requirements, former IPC Director of Government Relations Holly Evans details what every manufacturer should know.*

As 2013 begins, one thing is certain: The electronics industry will have significant international, federal, and state environmental policy developments to track, assess, and manage for the remainder of the year. The electronics industry is at the forefront of a trend toward product-focused environmental policies that seek to reduce the environmental impacts of

products during their key life cycle stages: Design, manufacture, use, and disposal.

This trend has triggered the growth of legislation and regulations that aim to restrict the use of toxic chemicals in electronic products, curb the energy consumption of consumer electronics, and hold electronic producers financially responsible for managing discarded products at end-of-life. This trend, which has been evolving and expanding for more than a decade, has produced a complicated “patchwork quilt” of international, federal, and state environmental requirements.

This trend is not expected to diminish and the complexities associated with tracking, managing and meeting these requirements will continue to grow. This article is designed to provide a status report of these requirements—both those in effect, as well as those on the immediate horizon. It will largely cover U.S. devel-

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ENVIRONMENTAL POLICY DEVELOPMENTS TO WATCH IN 2013 *continues*

opments although international developments will be briefly addressed.

Chemical Regulation

California Safer Consumer Product Regulations

Chemicals regulations that may impact the electronics industry are expected to increase in 2013. The California Department of Toxic Substances Control (DTSC) formally released its [Revised Proposed Safer Consumer Product Regulations](#) January 29, 2013. The rules are mandated by [AB 1879](#), a bill enacted in 2008 that requires the DTSC to adopt regulations to establish a process by which chemicals or chemical ingredients in consumer products are classified as “chemicals of concern” and a process by which those “chemicals of concern” (and their potential alternatives) are evaluated to determine whether regulations are warranted to limit consumer exposure to such chemicals. Possible restrictions may include labeling, limiting potential exposures, end-of-life management requirements, or prohibitions on the continued use of such chemicals in consumer products sold in California.

Once final, the rules, also known as the California “Green Chemistry” rules, will require producers of “priority products” to conduct alternative assessments for “chemicals of concern” present in certain products and possibly phase-out the use of those substances. The DTSC is expected to issue a final rule in early 2013. Although the electronics are unlikely to be identified as initial “priority products,” the electronics industry is actively watching and commenting on these rules as they will likely establish regulatory precedent that will be followed by other states and possibly the federal government.

TSCA Reform

The [Toxic Substances Control Act](#) (TSCA) is the federal law that regulates the manufacture, import, processing, or distribution of chemical substances in the United States. Originally passed in 1976, TSCA provides the U.S. Environmental Protection Agency (EPA) with the authority to review and regulate chemicals in commerce. For the last several years, bills have been introduced in the United States Congress to reauthorize and reform TSCA. Last July, the Senate Environment and Public Works Committee approved a bill ([S.847](#)) that would have required chemical producers to bear the burden of proving that chemical substances are safe before they enter the marketplace. The

final vote was decided on party lines with ten Democrats voting in support of the bill and eight Republicans voting in opposition. Due to the political stalemate in the 112th Congress, the bill failed to advance.

The 113th Congress, which convened in January, remains divided with a Democratic-controlled Senate and a Republican-controlled House of Representatives. Any TSCA reform and reauthorization bill, therefore, will need to attract bipartisan support to advance. Both the chemical industry and environmental/public health advocates agree that TSCA reform is needed; however, both groups differ on the means to that end. As a result, it is unclear whether viable bipartisan TSCA reform legislation will emerge in 2013.

One thing is clear, however. Recognizing that federal chemical regulatory reform may not be viable, environmental and public health advocates will continue to lobby for aggressive chemical reform bills at the state level. These advocates may develop model state chemical reform legislation and lobby for its enactment on a state-by-state basis. Such legislation would likely follow the California Green

“**Both the chemical industry and environmental/public health advocates agree that TSCA reform is needed; however, both groups differ on the means to that end. As a result, it is unclear whether viable bipartisan TSCA reform legislation will emerge in 2013.**”

Chemistry model and impose greater testing, assessment, and data disclosure requirements on chemical producers and chemical users.

Chemical Specific Regulation

The chemicals that are specifically used in electronic products have come under regulatory scrutiny since 2006 largely due to the European Union's [Restriction of the Use of Certain Hazardous Substances \(RoHS\) Directive \(as amended by recast\)](#). The RoHS Directive restricts the use of lead, mercury, cadmium, hexavalent chromium and polybrominated biphenyls (PBBs), and certain polybrominated diphenyl ethers (PBDEs) in virtually all electrical and electronic equipment placed on the European market. The RoHS Directive, although an EU law, has triggered worldwide substitution away from the regulated heavy metals and brominated flame retardants and toward alternative materials and substances. Despite this trend, legislation proposals to restrict these substances in electronic products may be introduced in the U.S. at both the federal and state levels.

The electronics industry will need to continue to watch federal and state legislative and regulatory developments that seek to restrict certain substances—namely cadmium, flame retardants, and phthalates, in children's products. Although the electronics industry supports efforts to protect children from exposure to heavy metals and potential endocrine disruptors, the definition of "children's product" is often broad and could inadvertently cover consumer electronics, such as mobile phones, computers, and handheld devices.

Energy Efficiency Mandates

Federal Energy Conservation Standards

The U.S. Department of Energy (DOE) has the authority to establish federal energy conservation standards for certain appliances and



equipment, including consumer products that are listed in Section 6292 of the United States Code, Title 42, Chapter 77, Subchapter III, [Part A—Energy Conservation Program for Consumer Products Other Than Automobiles](#). That Section lists "television sets" and "any other type of consumer products which the Secretary classifies as a covered product." The U.S. Congress added battery chargers and external power supplies to the list of potentially covered products when it enacted the [Energy Policy Act of 2005](#). Congress enacted the [Energy Independence and Security Act](#) in 2007 that set energy efficiency limits for Class A external power supplies. Those limits went into effect for Class A EPSs manufactured after July 1, 2008.

The DOE has been slow to implement its authority to establish energy conservation standards for potentially covered electronic devices. The DOE issued a [notice](#) of proposed rulemaking for a federal television test procedure (the first step in an energy conservation rulemaking) January 19, 2012; however, since then, there has been no recent update. The DOE issued a [notice](#) of proposed rulemaking regarding energy conservation standards for battery chargers and external power supplies March 27, 2013; however, the final rules have not been published. Finally, the DOE issued a [Request for Information](#) regarding possible energy conservation standards for set top boxes and networking equip-

ENVIRONMENTAL POLICY DEVELOPMENTS TO WATCH IN 2013 *continues*

ment on December 16, 2011, signaling DOE's interest in adding set top boxes and networking equipment to its list of covered products. DOE published a [notice](#) of proposed rulemaking for a test procedure for set-top boxes January 23, 2013—action that indicates that the DOE may develop energy conservation standards for these devices.

DOE's slow pace to establish energy conservation standards for electronic devices has frustrated federal and state legislators, state energy agencies, and energy efficiency advocates which view the growth of electronic devices as a significant contributor to global energy demands and a source of increased carbon emissions. Because of DOE's perceived inaction, these legislators, agencies and advocates have been urging DOE to act at the federal level, but also working to establish energy conservation standards at the state level. Although federal energy conservation standards preempt state specific requirements, energy efficiency advocates see value in establishing interim state specific requirements, largely to accrue immediate efficiency benefits but also to influence the development of federal rules.

California Energy Commission Appliance Efficiency Regulations

This strategy has been successfully implemented in the State of California where the California Energy Commission (CEC) originally established energy conservation standards for external power supplies in 2005. The CEC largely acted because of DOE's failure to establish federal standards (CEC standards for Class A EPSs were later preempted by the federal Class A EPS standards that were established by EISA). Since then, the CEC has effectively led the development of energy conservation standards in the U.S. The CEC's [2012 Appliance Efficiency](#)

[Regulations](#) currently include efficiency requirements for televisions, compact audio products, DVD players and recorders, and battery chargers as well as other appliances. In March 2012,

the CEC held a [scoping workshop](#) to hear feedback regarding possible energy conservation standards for displays, game consoles, computers, set top boxes, servers, and imaging equipment.

The impact of these state-specific energy efficiency mandates must not be overlooked. Although the CEC standards only apply to products that are sold in California, producers often redesign their entire U.S. product line to meet CEC requirements, recognizing that California-only sales are impossible to manage. Furthermore, certain states such as Washington, Oregon, and New York often follow the lead of the CEC and enact legislation that establishes identical efficiency standards on covered products that are sold in their states. These state requirements pose compliance challenges for covered producers and often prompt

them to request the DOE to establish federal energy conservation standards to preempt all state requirements for covered products.

Recycling Obligations

U.S. State Recycling Laws

Twenty-five U.S. states and one U.S. territory, Puerto Rico, have enacted laws that require producers of certain electronic products to participate in programs to recover and recycle used electronics. The vast majority of these laws require producers to fund the collection, transportation, and recycling of covered devices either through manufacturer-led programs or through state-run plans. The products covered by each law differ although most laws cover computers, televisions, and increasingly printers. The mechanics of each law also differ greatly with some

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programs requiring only registration and the payment of a fee while other laws require the establishment of “convenient” collection locations, the achievement of aggressive recycling rates, and the payment of penalties if recycling targets are not met.

As 2013 began, numerous bills had already been pre-filed in various state legislatures, indicating that 2013 will likely to be a busy year for the consideration and possible enactment of new state electronics recycling laws. States where electronics recycling legislation may be considered include Arizona, Colorado, Hawaii, Iowa, Missouri, Nebraska, Oklahoma, Wyoming, and Mississippi.

U.S. Federal Recycling Bills

A comprehensive federal electronics recycling law has never been proposed in the U.S. Congress. Although bills have been introduced to establish federal programs to encourage and promote electronics recycling, no effort has been made to attempt to establish a federal framework to address electronics recycling. This is largely due to the fact that solid waste management is a matter of state jurisdiction in the U.S. and the federal government lacks significant authority to manage municipal solid waste.

There is recognition that the federal government could play a role in helping facilitate the movement of electronic waste across state boundaries and also help curb the illegal export

of waste electronics; however, beyond those incremental improvements, federal solutions have been slow to emerge. As a result, compliance is largely driven by state requirements. Producers must meet state-specific e-waste obligations that pose registration, payment, and recordkeeping challenges given differing deadlines, program years, and program requirements.

International Issues to Watch

Although these U.S. federal and state chemical initiatives, energy efficiency mandates, and producer recycling obligations combine to form a very complex “patchwork quilt” of compliance obligations, they are not the only issues to watch. Governments around the globe are simultaneously proposing and enacting legislation and regulatory requirements that add to this confusing legal and regulatory maze.

Canada

Most Canadian Provinces have electronics recycling programs in place that cover a broad segment of electrical and electronic equipment. In 2013, a New Brunswick program may come on line. Canada is also considering the establishment of energy conservation for battery charger. The country is waiting for the U.S. DOE to finalize its rule before it proceeds with Canadian rulemaking. British Columbia is assessing whether or not energy efficiency standards for set top boxes are warranted.

Europe

In Europe, chemical regulation will continue to develop via the European Chemical Agency’s ([ECHA](#)) implementation of the REACH regulation. Energy efficiency mandates will also continue to cover more electronic and electrical products through expansion of the Ecodesign Directive and its Implementing Measures. The European Commission’s [2012-2014 Work Plan](#) identified enterprise servers, data storage and ancillary equipment as potential priority products for further evaluation. Also, the recast



ENVIRONMENTAL POLICY DEVELOPMENTS TO WATCH IN 2013 *continues*

of the RoHS Directive, which brings new electrical and electronic products into scope of the law's substance restriction and new CE marking requirements, will present new challenges for producers that want to sell their products in the European Union.

China and India

Policy developments in Asian countries will emerge to address electronics recycling, substance restrictions, and energy efficiency mandates. China will continue to be a country to watch as it establishes rules for the recycling of electronic products and it makes revisions to its RoHS law. China is expected to issue new energy efficiency standards for electronic products, including the implementation of labeling mandates for computers. India will develop electronics recycling rules as well as a RoHS-type program for covered electrical and electronic equipment. Korea will continue its work to develop energy efficiency standards for server products.

Latin America

Over the last several years, we have seen several Latin American countries establish programs to address electronics recycling and consumer product energy consumption. This trend is expected to continue in 2013. Mexico recently approved a regulation that will require producers of electronic products to submit and implement waste management plans. Mexico has also proposed standby power limits for certain products sold in the country. We also may see expansion of existing energy efficiency programs in Brazil and Chile to cover new consumer electronic products. E-waste initiatives, at the federal, state, and city levels, are likely to continue in Argentina, Brazil, Chile, Costa Rica, and Peru.

Green Procurement and Marketing Initiatives

Finally, it is important to recognize that legal product-related environmental requirements are not the only developments for electronic producers to watch. There are new market-based initiatives, such as the [Electronic Product Environmental Assessment Tool](#), [UL Environment Sustainability Standards](#), and the [Sustainability Consortium](#), that producers must

track to ensure that they remain competitive in government procurement and retail markets. These market-based initiatives often go beyond legal requirements in terms of eco-design, energy efficiency, end-of-life management, and corporate performance and often have registration, certification, and other costs that must be considered.

Conclusion

For electronic producers, there are many product-related environmental policy developments and initiatives at the U.S. and international level to watch, monitor, assess, and meet. This may appear to be an overwhelming and impossible task to manage; however, many tools, strategies, and resources are available to help address this challenge. As an environmental lawyer and consultant who has worked for and with the key trade associations engaged in the development of these initiatives and the large and small companies that are facing the challenges of these developments, my best advice is to take a "big picture" systematic approach. Know your products, assess your markets, evaluate your exposure, identify any possible competitive advantages, and understand your supply chain. Once an accounting of these key factors has taken place you will be in the best shape possible to address your relevant compliance obligations and possible market opportunities. **SMT**



Holly Evans is the president and founder of Strategic Counsel, LLC, a full service environmental law and policy firm located in Washington, D.C. Holly has more than 15 years' experience, representing members of the global electronics industry on environmental, health, and safety issues. Evans previously served as deputy general counsel and director of environmental programs for the Electronic Industries Alliance (EIA). She also served as director of government relations for the IPC and a congressional fellow for Senator Joseph Lieberman (I-CT). She can be reached at hevans@strategiccounsel.org.

U.S. to Ease Restrictions on PCB Exports and Related Technology

by **Corey L. Norton**
KELLER AND HECKMAN LLP

SUMMARY: *With changes coming to restrictions on exports in the industry, Corey Norton, an international trade attorney, outlines updates to ITAR, EAR, the U.S. Munitions List, and more. The goal of these revisions is to create a control list of specific items with real inherent military significance.*

The United States prohibits the export of numerous types of PCBs and related electronics and technology if the exporter does not first obtain a U.S. government license. These restrictions also impose a prohibition on sharing technology with partners overseas and even sharing with foreign national employees without a license. Failure to obtain a required license can result in penalties of \$250,000 per violation, or more, and even the loss of export privileges. New rules, however, are about to go into effect that would remove the most burdensome restrictions on PCB exports and make it easier for companies to comply with the remaining restrictions.

The Issue

U.S. export controls [1] generally cover a very broad range of products and technologies



used in military products or that are of a sufficient sophistication to cause the U.S. government concerns about their proliferation. The types of export transactions the government can prohibit without a license also vary quite widely. They range from actual exports of products and technologies to customers or sister companies, exports of products manufactured abroad with U.S.-origin items, and to sharing technology with non-U.S. engineers and other personnel (this sharing is deemed to be an export to the individual's home country). The U.S. government has placed a high priority on enforcing these rules and can impose the substantial fines noted above for even the most innocent violations.

Electronics and semiconductor manufacturers must be aware of, and implement measures to comply with, two particular regulatory schemes governing these exports: 1) the very restrictive International Traffic in Arms Regulations (ITAR) [2], which actually cover many commercial products rather than just "arms" and 2) the somewhat more permissive Export Administration Regulations (EAR) [3]. The State Department [4] administers the ITAR, whereas

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U.S. TO EASE RESTRICTIONS ON PCB EXPORTS AND RELATED TECHNOLOGY *continues*

the Commerce Department [5] administers the EAR.

The ITAR generally restrict products, including small parts, with some military significance, whereas the EAR control just about all other sophisticated electronics. Both schemes also address related equipment and technology. The primary mechanism is the same for both the EAR and ITAR—if an item to be exported appears on a designated list of controlled products set out in the respective set of regulations, export restrictions could apply [6]. The ITAR list is called the U.S. Munitions List (USML) [7], whereas the Commerce Control List (CCL) [8] is published under the EAR.

A product on the USML generally cannot be exported without a license regardless of the intended destination, and the licensing requirements can be very onerous. In contrast, the EAR do not impose a license requirement for all destinations—notes on particular CCL entries indicate which countries would be controlled. The USML has historically covered far more electronics and related parts than just those that are truly “arms.” For example, the main category on the USML that controls electronics (Category XI) currently covers broad categories of electronics, as well as “[c]omponents, parts, accessories, attachments, and associated equipment specifically designed or modified for use with” (emphasis supplied) designated electronics. The law does not define what “specifically designed or modified” means, and this lack of definition has forced electronics companies to tread very cautiously. Electronic parts and products can also currently be caught under the ITAR if they were specifically designed or modified for use with various other types of equipment that are controlled under the ITAR, such as military aircraft and vehicles.

As a result, the ITAR’s very strict prohibitions and broad applicability have imposed significant compliance burdens even on exporters of arguably benign electronic components and products. To ensure

compliance with ITAR, these companies must expend a significant amount of resources to navigate the very dense and confusing USML and associated license requirements and licensing procedures. Even then, as various enforcement actions have shown, there is no guarantee they will get it right. Indeed, even the U.S. government has at times found its own restrictions hamper efforts to transfer needed equipment or supplies to its allies [9]. For this reason, the U.S. government set out in early 2010 to substantially reform the ITAR and EAR. Following a couple of years of considering and proposing reforms, they appear to become a reality soon. Significant benefits could, therefore, await the electronics industry in the not-too-distant future.

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Change is Finally (Almost) Here

As noted, the ITAR are so restrictive that any tweak to the form, fit, or function of a part for use in a military application could embroil a company with the ITAR even if the company typically served only civil applications. For example, the ITAR potentially apply to almost any PCB whose pathways were laid out just for a military application, even if the particular layout has no military significance. The export control reforms currently underway seek to revise the overly broad descriptions that have pulled so many items and products into the ITAR’s orbit. The goal is to create a control list of specific items with real inherent military significance.

U.S. TO EASE RESTRICTIONS ON PCB EXPORTS AND RELATED TECHNOLOGY *continues*

To that end, the U.S. government this past November proposed a revision to the ITAR electronics category on the USML [10]. The following examples of items that would remain subject to the ITAR show that the remaining list of controlled items would be much more specific:

- “Application specific integrated circuits (ASIC) for which the functionality is ‘specially designed’” for identified military equipment;
- “Printed circuit boards or patterned multichip modules for which the layout is ‘specially designed’” for identified military equipment;
- “Transmit/receive modules or transmit modules that have any two perpendicular sides, with either length d (in cm) equal to or less than 15 divided by the lowest operating frequency in GHz [$d \leq 15 \text{ cm} \cdot \text{GHz} / \text{fGHz}$], that incorporate a MMIC or discrete RF power transistor and a phase shifter or phasers;” and
- Certain “[h]igh-energy storage capacitors with a repetition rate of six discharges or more per minute.”

Critically, State has proposed a new definition of the term “specially designed,” which will be key to determining whether an item is or is not subject to the ITAR. The definition itself is, unfortunately, fairly complicated, but once exporters get used to it, the definition should be workable. Unlike the current term “specifically designed,” which is not defined, the definition of “specially designed” will identify specific categories of items that are covered and will expressly carve out those items without real military significance. For example, under the proposed definition, items will not be considered specially designed if they were “developed with a reasonable expectation of use in or with defense articles enumerated on the [USML] and commodities not on the [USML] [11].” It will be important, however, to maintain thorough and clear files documenting a particular part or product’s history of development to demonstrate compliance.

The many parts and products that will no longer be subject to the ITAR following the

control list revisions will become subject to the EAR. Many will even be classified as EAR99. This essentially means that they can be exported to most places in the world without a license provided the country is not embargoed and no prohibited end-users or end-uses are involved. In addition, the CCL will likely set out in objective terms the types of PCBs and related electronics and technologies that will become subject to the EAR and their less stringent licensing requirements. Examples of likely interest to circuit board manufacturers include:

- “Microelectronic devices or printed circuit boards not otherwise controlled on the USML that are certified to be a ‘trusted device’ from a defense microelectronics activity (DMEA) accredited supplier”—being “trusted,” of course, has a long definition, but is generally defined through an affiliation with an accredited defense microelectronics activity (DMEA);
- “Microwave ‘monolithic integrated circuits’ (MMIC) power amplifiers” having specified technical characteristics; and
- Discrete microwave transistors having specific technical characteristics.

Certain production equipment and technology associated with these types of items would also be subject to the EAR.

The main advantages of the shift to the EAR are that: 1) fewer export licenses will likely be required and additional license exceptions will become available; 2) fewer foreign-made items containing U.S.-origin parts will be subject to U.S. export license requirements; and 3) when a license is required, the procedures will be far more simple, particularly with respect to the sharing of technology and particular types of technical assistance.

Circuit board and semiconductor manufacturers should keep an eye on the rulemaking to ensure that the State and Commerce Departments carry through with these burden reduction initiatives. The comment period for the proposed rules noted above has closed, and the U.S. government is now reviewing the numerous comments it received and has posted

U.S. TO EASE RESTRICTIONS ON PCB EXPORTS AND RELATED TECHNOLOGY *continues*

online [12]. The news from the Commerce Department is that the government will soon be undergoing the intra-government reviews required to make the rules final (including a statutorily required notification to Congress). The final rules on military electronics noted above should be published soon thereafter. Exactly when all this will occur is, of course, uncertain, but it is clear that the reform effort has a good head of steam and will likely become reality, perhaps this year. **SMT**

References

1. This article addresses restrictions under U.S. law, but other countries also impose similar restrictions.
2. 22 C.F.R. Parts 120-130.
3. 15 C.F.R. Parts 730-774.
4. www.pmddtc.state.gov.
5. www.bis.doc.gov.
6. Additional restrictions could also arise if the recipient of an export is on a government watch list, a prohibited use would be involved (such as development of certain rocket systems), or an embargoed country would be involved.

7. 22 C.F.R. § 121.1.

8. 15 C.F.R. Part 774, Supp. 1.

9. See, e.g., Remarks Delivered by Secretary of Defense Robert M. Gates to the Business Executives for National Security Export Control Forum (April 20, 2010), available [here](#).

10. 77 Fed. Reg. 70,958 (November 28, 2012) (State Department rule); 77 Fed. Reg. 70,945 (Nov. 28, 2012) (Commerce Department rule).

11. 77 Fed. Reg. 36,428, 36,432.

12. See [comments](#) on proposed Commerce rule and [comments](#) on proposed State rule.



Corey L. Norton, an international trade attorney with Keller and Heckman LLP in Washington, D.C., counsels companies on compliance with U.S. and foreign export controls, economic sanctions, import requirements, anti-bribery laws, and anti-boycott laws. Contact him at (202) 434-4303 or norton@khlaw.com.

FDA Approves First Bionic Eye for the Blind

The U.S. Department of Energy (DoE) approved the first bionic eye for use in the U.S. The creation of this retinal prosthesis stems, in part, from DOE support for a decade of revolutionary research with Argonne National Laboratory and several other national labs, universities and companies.

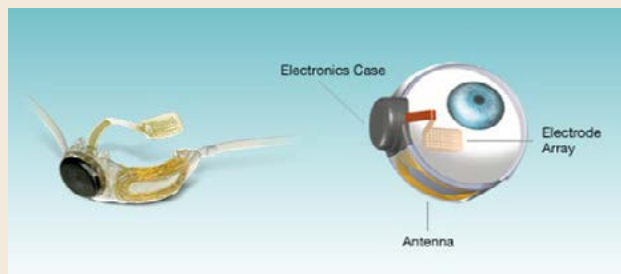
"The development of the artificial retina is just one more example of the unique value of our National Laboratories and research universities," said Energy Secretary Steven Chu. "While no one can predict a breakthrough before it happens, the investments we're making in research pay enormous dividends for our economy and improve our lives."

The artificial retina, dubbed the Argus II Retinal Prosthesis System may prove to be an aid to those blinded by the disease retinitis pigmentosa, which can run in families and is estimated by the National Institutes of Health to affect about 1 in 4,000

people in the U.S. Over the 10-year lifetime of the project, the Department provided \$75.2 million for the development of technologies aimed at advancing artificial retinas like the Argus II, which was based on work by a consortium of scientists using advanced technologies developed by several of the Department's National Laboratories.

The Argus II can partially restore the sight of blind individuals after surgical implantation. Clinical trials demonstrated that totally blind individuals could safely use the device to successfully identify the position and approximate size of objects and detect movement of nearby objects and people.

For more information, click [here](#).



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Top Ten Market News Highlights



How Apple, Blackberry Plan to Battle Android, Windows Phone 8

The race is on and competition is heating up as Apple Inc. and Research In Motion Limited look to defend their positions in the marketplace. Apple's primary focus remains on the consumer, with enterprise and government market share gains growing as a result of RIM's aging platform. RIM is looking to reverse this trend and build new momentum with the launch of BB10, BlackBerry's first major revamp since the dawn of the iPhone circa 2007.

Graphene Market to Hit \$126 Million in 2020

Graphene, touted as the next wunderkind material because of its extraordinary properties, will grow to a \$126 million market in 2020, from its \$9 million base in 2012, according to Lux Research. While an impressive debut for a new material, this growth is less than some of the hype may suggest.

Global Semiconductor Industry: Flat Market in 2012

The global semiconductor market witnessed another flat market for the year 2012 with sluggish demand across all market segments resulting from lingering uncertainties in the global economic situation, particularly in major regional markets such as the U.S., EU, and China, all of which saw poorer than expected results for the year.

ASEAN Positioned for Greater Growth

The growing maturity of ASEAN's higher education institutions, accompanied by higher R&D spending, make them attractive partners to drive indigenous innovation to serve local needs. Research originating from the region covers a wide range, from blue-sky to regionally focused clinical and product relevant solutions. The region also offers unique capabilities.

Apple Leads U.S. Mobile Phone Market in Q4

According to the latest research from Strategy Analytics, mobile phone shipments grew 4% annually to reach 52 million units in the United States during the fourth quarter of 2012. Apple became the number one mobile phone vendor for the first time ever, capturing a record 34% market share.

Semiconductor Leaders See Massive Industry Transformation

The semiconductor industry is undergoing massive transformation as the rise in mobile computing, changes to the fabless-foundry model, uncertainties in technical innovation, and global macroeconomic trends become the dominant forces in 2013 and beyond, according to industry leaders speaking at the SEMI Industry Strategy Symposium (ISS), which opened in Half Moon Bay, California.

PC Market at Tipping Point; Growth to Slow in 2013

As IDC looks at the future of computing, the advancement of the technology no longer begins and ends with the personal computer. Since the first smart phone appeared in 2000, and the introduction of the Tablet a decade later, we have witnessed an explosion of mobile form factors and a breakneck rate of innovation in hardware and software. These form factors are now extensions of personal computing.

Global Market to See Modest Growth

Global growth will strengthen gradually in 2013, says the IMF in an update to its World Economic Outlook (WEO), as the constraints on economic activity start to ease this year. But the recovery is slow and the report stressed that policies must address downside risks to bolster growth.

Global PC Shipments Down 4.9% in 4Q12

Worldwide PC shipments totalled 90.3 million units in the fourth quarter of 2012, a 4.9% decline from the fourth quarter of 2011, according to preliminary results by Gartner, Inc. "Tablets have dramatically changed the device landscape for PCs, not so much by 'cannibalizing' PC sales, but by causing PC users to shift consumption to tablets rather than replacing older PCs," said Mikako Kitagawa, principal analyst.

Global IT Industry to See 3% Growth Rate in 2013

Strong customer demand for innovative technology solutions, such as cloud computing, big data, and mobility, are countered by concerns about economic uncertainties, pricing pressures, and substitution effects in the IT Industry Outlook 2013 released by CompTIA, the non-profit association for the industry.



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Embracing Transparency: How Flextronics Addresses Social and Environmental Responsibility

by Seb Nardecchia and Matt Perrone
FLEXTRONICS CORPORATE SUSTAINABILITY

SUMMARY: *Innovation in today's industry continues to be the driving force behind most successful companies. By taking this concept and applying it to corporate social and environmental responsibility, the company has established a foundation for a more sustainable business model.*

Conflict minerals, chemical substance management, and sustainability metrics are all inextricably linked to increased levels of transparency in the electronics industry, and success in all three disciplines will have a significant benefit on society and the environment. The proliferation of new social and environmental requirements serves as more evidence of an effort by governments, non-governmental organizations, and citizens alike to force the industry to take accountability for their actions.

There has never been a better time to adopt a sustainability strategy. The challenge begins with adopting the habit of continually learning and growing from past experiences and constantly reaffirming a commitment to serve

people and the environment and at the highest levels of good corporate citizenship. As companies better understand their social and environmental performance, sustainable business strategies will be more effective and their impact to create change will be more impactful. Flextronics continues to place a significant emphasis on embracing these new transparency requirements in our industry today, not only because increased levels of corporate transparency is a cost of doing business today, but because sustainability is the mega-trend that will shape the competitive business landscape over the next decade.

Innovation in today's electronics industry continues to be the driving force behind most successful companies. By taking this concept and applying it to corporate social and environmental responsibility (CSER), Flextronics established the foundation for a more sustainable business model. As the cost of labor and natural resources continues to put pressure on profit margins, all companies must search for ways to make their business more efficient and achieve greater productivity. That is the basis of the management system concept of continuous

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EMBRACING TRANSPARENCY *continues*

improvement. But what does it mean to continually improve your company's CSER performance, and how does one go about measuring its success in that regard?

The answer lies in the ability to understand where the electronics industry is headed, while still appreciating its roots. Recognizing the global landscape and the critical industry drivers are vital, but understanding why those drivers exist enables any company to achieve true sustainability and stewardship. Company executives around the world have begun to recognize the importance of a robust CSER program and the direct impact proactive initiatives have on the bottom line. However, the future goal is to take these increasingly complex regulatory reporting requirements and turn them into value that increases customer competitiveness.

While the term corporate social responsibility (CSR) dates back to the late 1960s, the concept has experienced exponential growth in recent years resulting in a much more significant business driver. The definition of CSER is continually evolving to reflect the challenges and opportunities facing industry and society today. A strategic-thinking organization would have recognized the direction regulatory agencies were taking in driving chemical substance management a number of years ago, and devised solutions to address the core issues in a sustainable fashion.

Since the introduction of the European Union's groundbreaking Restriction of Hazardous Substances Directive (RoHS EC 2005), an onslaught of new legislation bans or restricts the use of chemical substances in nearly every jurisdiction worldwide. By taking a moment to think about the ultimate goal of these environmental directives (such as RoHS, REACH, etc.), a logical solution to the problem becomes quite

clear. A primary objective is to continuously remove more and more chemical substances from use in products and manufacturing processes. Companies should view these new regulatory requirements as an opportunity to improve internal compliance processes and create value for customers. Providing full material and chemical content collection and analysis allows producers placing product on the market (customers) to recognize all chemical substances in the bill of materials (BOM)

for products they design. This enables them to conduct an assessment and verify compliance against any regulation that limits or restricts the use of certain chemical substances. The assessment guarantees customers' products are delivered to their markets in line with their overall business strategy, saving a significant amount of time, resources, energy, and manpower. This translates into significant cost savings and an undeniable competitive advantage. In addition, companies are able to fulfill what many deem as a moral obligation to provide transparent information to relevant stakeholders around the world.

Flextronics sees great value in constantly reinventing compliance processes that ultimately enable customers' success. The company has been continually working to redefine materials environmental data management processes since instituting the RoHS declaration systems almost a decade ago. Last year, we deployed a new environmental data management solution to leverage a centralized data collection process for a much more streamlined compliance assessment and verification process for all direct and indirect materials used in the product and manufacturing processes. This new solution allows design centers and manufacturing sites around the world to determine if products and

A primary objective is to continuously remove more and more chemical substances from use in products and manufacturing processes. Companies should view these new regulatory requirements as an opportunity to improve internal compliance processes and create value for customers.

EMBRACING TRANSPARENCY *continues*

processes are compliant to all applicable chemical substance management regulations (and customers' specifications) in an efficient and standardized manner.

In 2013, Flextronics is enhancing the process through the integration of a compliance status mechanism that seamlessly links with enterprise resource planning systems to control all purchasing and materials processes companywide. To bolster the materials data management process, the company entered into a partnership with a globally-renowned laboratory testing agency to formulate a new component material testing capability for all global design and manufacturing sites. In addition, the company has joined with a regulatory database service provider that offers innovative online tools which deliver the most timely and accurate global regulatory intelligence to empower business compliance. By creating cross functional workgroups that span the entire value chain, we can identify synergies that allow us to meet or exceed all customer compliance requests in a sustainable and economically-sensible way.

Much like chemical substance management, the procurement of materials used in electronics manufacturing should be done in a way that fulfills all compliance and moral obligations. Controlling the extraction and production of tin, tantalum, tungsten, and gold (3TG) has enabled Congolese rebel military forces to use the proceeds to torment local citizen populations and commit catastrophic human rights abuses. The electronics industry has been under increased scrutiny, because 3TG minerals are used in almost all electronic

applications, creating an opportunity for manufacturers to have a positive influence over the conditions of mineral and metal production and extraction.

The challenge with the increase of transparency in the electronics industry will be the dichotomy between the need for transparency and confidentiality, as many manufacturers and suppliers refuse to disclose information for competitive reasons. However, companies that see beyond the confines of compliance view these transparency requirements, like the Conflict Minerals Dodd-Frank Act, as an opportunity to improve the conditions of life for people living in conflict regions. By partnering with all members of the value chain to create mutually-beneficial solutions to the conflict minerals issue, electronics manufacturers can ensure legal compliance and more importantly, have a significant impact in improving the quality of life for citizens living in conflict regions.

Industry associations like the Electronics Industry Citizenship Coalition (EICC) are developing programs that ensure the smelters and refiners at the end of the supply chain prop-



EMBRACING TRANSPARENCY *continues*

erly identify the origin of the materials used in the production of electronics equipment. Flextronics, a founding member of the EICC, has complied with the OECD Guidance regarding conflict minerals including publication of a conflict minerals policy, analysis of our material commodities to determine if 3TG are present in products we manufacture, and adoption of the EICC's due diligence tool set including the Conflict Free Smelter (CFS) program as the company standard. We believe that the most effective approach is to create a system that allows us to identify existing and new suppliers that require due diligence, collect their information map the smelter data against the EICC CFS list, and provide to our customers upon request. Collaborating with all members of the value chain to achieve greater levels of transparency is highly beneficial. Conflict minerals reporting is just one of many new requirements driving the electronics industry to become much more transparent, creating an opportunity for companies to demonstrate their commitment to doing the right thing.

Although the importance of sourcing materials in an ethical manor is critical to the future success of all electronic companies, the most widespread transparency requirement in today's electronics industry is the public disclosure of the manufacturing footprint, both operationally and throughout the supply chain. Greenhouse gas emissions, water consumption, and waste generation are just a handful of the 'new era of manufacturing metrics' that OEMs are requesting from their suppliers. An increased number of institutionalized investors are starting to invest in companies based on their environmental performance disclosed in the company's annual SEC filing.

To fulfill these increasing reporting requirements, Flextronics developed a sustainability metrics work group to collect, analyze, validate, monitor, and report accurate and reliable data for our sustainability indicators. The overall strategy of the program is to baseline, define annual objectives and goals, establish targets, monitor performance, and fulfill these requirements in a continuous improvement manner to meet and/or exceed our corporate sustainability objectives. The sustainability metrics

functional work group includes environmental metrics, social metrics, a CSER key operating indicator competition dashboard, and both carbon and water disclosure project participation, sustainability benefits and costs data collection calculation, monitoring sustainability performance, reporting sustainability metrics data to stakeholders, fulfilling of customer sustainability data requirements, and scope of the 3-CO2 emissions preparation.

Through this sustainability metrics tracking and reporting program, manufacturing locations around the world are able to share a comprehensive set of data pertaining to social and environmental performance to all relevant stakeholders in a transparent way that goes beyond compliance. **SMT**

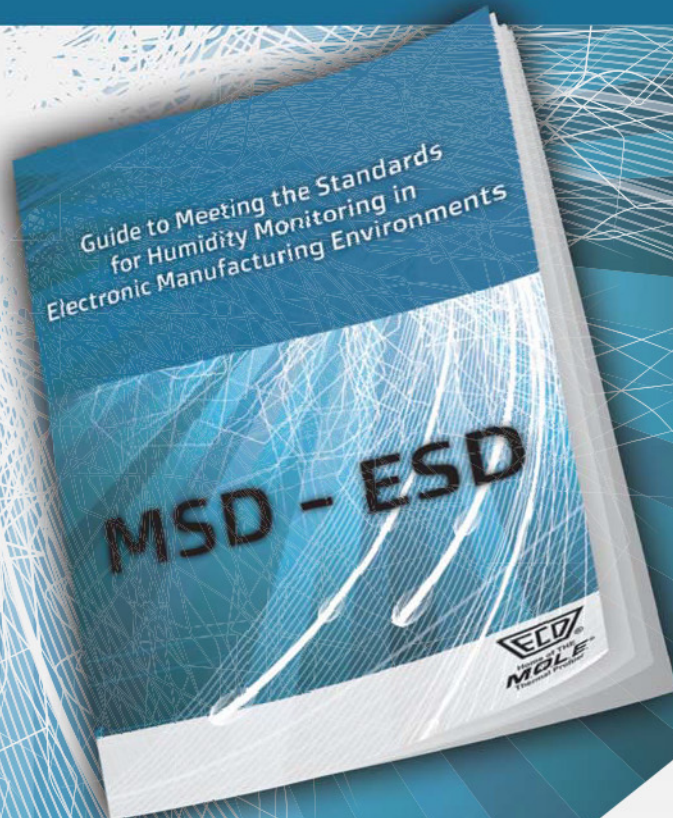


Seb Nardecchia, senior director, corporate sustainability, has held executive level positions in Fortune 100 companies as well as several high-tech startup companies. He currently leads sustainability cross functional teams at Flextronics, ensuring global compliance in the areas of labor/human rights, health and safety, and environmental. He is responsible for building an industry-leading environmental sustainability strategy at the company, as well as a roadmap to environmental stewardship.



Matt Perrone is a project specialist for the Corporate Sustainability group at Flextronics, a \$30 billion, industry-leading, Fortune Global 500 EMS and end-to-end supply chain solutions provider. He drives environmental sustainability, occupational health and safety, and employee engagement best practices in the company's manufacturing operations globally. Since joining the company in 2010, he has been focused on regulations and market intelligence, metrics and communications, and global operations functional workgroups.

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IPC APEX EXPO 2013 Ends on a High Note

by Ray Rasmussen, I-Connect007

The mood of the show was pretty optimistic. All of the fabricators and assemblers I ran into were at the show prospecting for technology, additional capacity, or both. Most exhibitors felt that the show had done its job. They were selling equipment and materials.

One of the last interviews I conducted as part of our Real Time with...IPC program was with Walt Custer, who offered an upbeat [2013 market forecast](#) and even extended industry growth into 2014. Although he was reluctant to look beyond 2014, he basically stated that all market segments, along with most geographical regions, are trending up, which bodes well the industry. Great news!

Lisa Lucke, managing editor of The PCB Magazine, managed our panel sessions this year with 13 in-depth discussions covering the market, onshoring, and hot technical topics. To view, click the "Panel Discussions" tab at [Real Time with...IPC](#).

We're off to Las Vegas in 2014. Not everyone I spoke with was excited about the prospect of moving the show next year. Some felt Vegas distracts the attendees. I agree that it does, but it also attracts a more international crowd. Personally, I like Vegas, although after a long day on the show floor the mile walk back to the hotel room can be a bit taxing. In talking to Dave Torp, vice president of standards

and technology at IPC, he didn't expect the conference attendance to suffer in Vegas. It's more a condition of the market than of the location. If people can afford it, and if the conference is relevant to them, they'll come.

IPC APEX EXPO and beyond! I'm hearing that IPC will be developing additional, major, APEX-like shows in hotspots around the globe, along with a substantial increase in the number of technical conferences as well, to service existing and emerging markets. It looks as though the staff will have their hands full over the next couple of years.

IPC President and CEO John Mitchell has been busy getting all the right people on his IPC bus and placing them in the right seats. It's an interesting transition to watch as the old guard "roadblocks," as some might say, make way for those who'll transform the IPC into an organization for the future. I'm optimistic. Watch Mitchell's interview from the show floor [here](#).

Whether or not you made it to the show, you might want to take a look at a few of the more than [150 video discussions](#) we produced, featuring the industry's leading personalities to keep you up to speed.

A big THANK YOU goes out to the crew at I-Connect007 and to our hard-working guest editors who made it all possible.



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Good or Bad, It's Up to You: Comments on IPC APEX EXPO 2013

by **Dan Beaulieu**, D.B. Management Group

While speaking to attendees at IPC APEX EXPO 2013, I came to realize two kinds of people come to trade shows: Those who come, set up their booth, expect things to happen, and then blame show organizers when, in fact, nothing happens, and those who go out of their way to make things happen. It's the latter who now think this year's IPC APEX EXPO was a great show.

A trade show is yet another opportunity to make something happen and, just like advertising, social media, or other forms of marketing, you get out of it what you put into it. If you want more traffic at your booth, send out a series of e-mails in advance to let customers and potential customers know you'll be attending, but also why they should seek you out. You can't expect to simply amble the aisles and meet the right people—you'll be sorely

disappointed with this plan of action. To ensure success, pre-schedule meetings with those you'd like to meet well ahead of the conference.

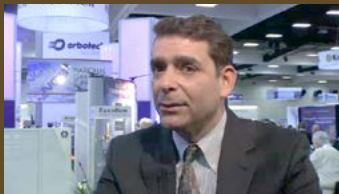
Want to make a splash at the show? To get noticed, and to leave a lasting impression, arrange to be interviewed. It's not a difficult process. Camera crews can be found all over the facility looking for content or for interesting people to discuss companies and products. All you have to do is be willing to give up a few minutes of your time. But, heed this advice: Make sure you know what you want to say and how you want to say it because you're creating a seven-minute, reusable commercial about your company. Make it good.

This was a great show for those who put in the effort. For those who expected something amazing to happen by simply showing up... well, maybe not so much.

Showcase Video Interview

High-Mix Placement Capabilities from Europlacer

by *Real Time with...*
IPC APEX EXPO 2013




John Perrotta, vice president of Europlacer, North America, joins Guest Editor Kelly Dack to describe how his company's machinery offers a wide range of unique placement solutions ranging from 01005 component specs to massive, four-inch challenges.



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IPC APEX EXPO 2013 Keynote from Dr. Michio Kaku: The Future is Closer Than You Think!

by Pete Starkey, I-Connect007



"Eternity is an awfully long time; especially toward the end...Prediction is awfully hard to do, especially if it's about the future..." Dr. Michio Kaku, author of *Physics of the Impossible* and *Physics of the Future*, quoted Woody Allen and philosopher Yogi Berra

in his preamble to the fascinating, entertaining, and, in many respects, disturbing, keynote address that opened IPC's 2013 APEX EXPO in San Diego, California, on February 19.

Dr. Kaku, famous as a theoretical physicist, futurist and populariser of science, held the attention of a packed San Diego Convention Center audience with his views on the way technology could dramatically reshape how people would live and play 20 years into the future.

Forget the future—in many respects, physicists cannot even predict the past. Or can they? Dr. Kaku began his talk of the future by looking back at the history of technology and deducing that wealth originates from science.

The age of steam, the Industrial Revolution, created enormous wealth. And what happened to that wealth? "Wealth is restless," Dr. Kaku declares. "It went to the stock exchange, the

bubble burst, and there was a great crash in 1850." The second wave, electricity and the automobile, created enormous wealth, which went into the stock exchange. The bubble burst and there was another great crash in 1929. The third wave, according to Kaku, was "high technology." Again, it generated the wealth that indirectly resulted in the crash of 2008. And history appeared to repeat itself every 80 years or so.

Against this background of a physicist's analysis of boom and bust cycles, Dr. Kaku asked, "What would be the basis of the fourth wave?" He predicts that biotechnology, artificial intelligence, and nanotechnology will be the basis of the home of the future.

Considering computing power and Moore's Law, and relating that a throw-away musical birthday card has more computing power than the Allied forces had during World War II, and that a modern mobile phone has more computing power than NASA did when it put the first men on the moon, Dr. Kaku extrapolates that, by 2020, a basic computer chip will cost about a penny and everything will just get smarter: Internet "everywhere and nowhere" (in terms of being conscious of it), with everyone connected all the time, whether by Google glasses, Internet contact lenses, or



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Michio Kaku *continues*

even electronic wallpaper. And children will be the driving force, not the Pentagon. There will be exponential growth in the digitalisation of information, with industry after industry following the precedents of electronic financial transactions and digital music.

He envisions a world of “augmented reality,” which Dr. Kaku describes as a virtual reality imposed on actual reality. He lists an extensive catalogue of potential applications. Intelligent wallpaper gives the scope for services like “RoboDoc,” where a robotic doctor can answer the most common medical questions, and “RoboLawyer,” can answer common legal questions at very low cost. Just ask the wallpaper! And 3D TV without glasses is already feasible. The car of the future will be driverless—Dr. Kaku has already ridden in an early prototype, and the term “traffic accident” will eventually disappear from the language.

The areas of medical diagnosis and treatment

are where outcomes can be truly beneficial: Smart pills with TV cameras and transmitters to carry out internal examinations; MRI scanners the size of cell phones; DNA analysers to detect the earliest signs of cancer; nanotechnology providing medicines to attack individual cancer cells at the molecular level; personal genomics offering individual “body owner’s manuals” at low cost; grow-your-own replacement organs... his list goes on and on.

What is the next frontier? The brain and synthetic telepathy, according to Dr. Kaku. Why do we have to grow old? Ageing is the build-up of errors and there’s no reason why the ageing process cannot be halted and the human lifespan extended. Reversible death, suspended animation—getting deep into the realms of science fiction here, but if we follow the logic of Dr. Kaku’s extrapolations, there’s no reason why fantasy cannot become reality.

The future is closer than you think!

Showcase Video Interview

SACM: Better Drop Test Performance by Indium

by Real Time with...
IPC APEX EXPO 2013

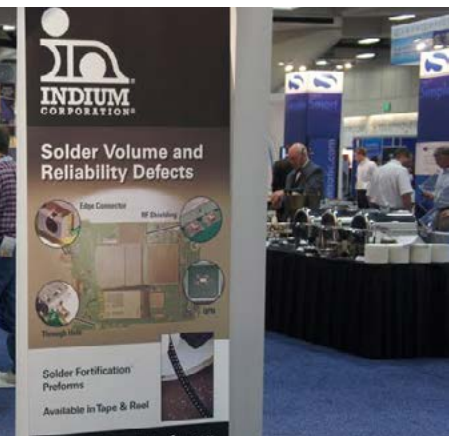


Editor Andy Shaughnessy sits down with Indium’s Global Product Manager Tim Jensen to learn more about SACM, a low-cost, high-reliability solder alloy that features better drop shock resistance than SAC105 and thermal cycle performance similar to SAC305.



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Real Time with... and Panel Discussions Make Waves in San Diego

by Andy Shaughnessy and Lisa Lucke, I-Connect007

It was a busy week in San Diego. IPC APEX EXPO and the Designers Forum drew attendees from around the globe and I-Connect007 covered the event from start to finish, shooting Real Time with... video interviews featuring the industry's top technologists and managers.

We interviewed the PCB design community's preeminent designers and design engineers for the [Real Time with...Designers Forum](#) program. Rick Hartley of L-3 Avionics, Ruth Conner of RADServices, and Mike Creeden of San Diego PCB shared their thoughts on the challenges designers face every day, as well as the need for continued design education. And Mentor Graphics' Julian Coates detailed some of the updates to the newest release of ODB++, as the ODB++ Solutions Alliance celebrated its first anniversary.

On the show floor, the [Real Time with... IPC APEX EXPO](#) stage and I-Connect007 booth stayed packed. Most of the time, it was impossible to find a seat, as some of the leading PCB fabrication and assembly experts mingled with one another while waiting their turn in front of the camera. At one point, the authors of the top PCB manufacturing books could be found chatting with guest editors.

Speaking of guest editors, we don't think we've ever seen such a talented group of industry professionals all working for a common cause—in this case, the cause was approximately 150 interviews produced during the four-day run of IPC APEX EXPO. These professionals work in the design, fabrication, and assembly segments, taking time away from their day

Showcase Video Interview

ECD's Revolutionary Plant-Wide Monitoring System

by Real Time with...
IPC APEX EXPO 2013



Guest Editor Stuart Hayton meets with Electronic Controls Design Inc.'s (ECD) Vice President of Sales and Marketing Todd Clifton and discovers how the company's SensorWATCH monitoring system can bring real and measurable benefits across an entire manufacturing plant.

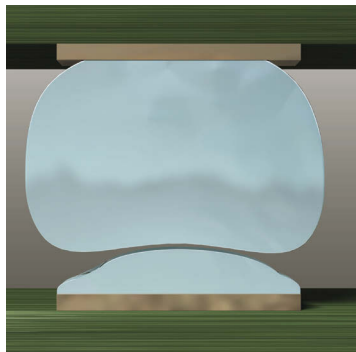


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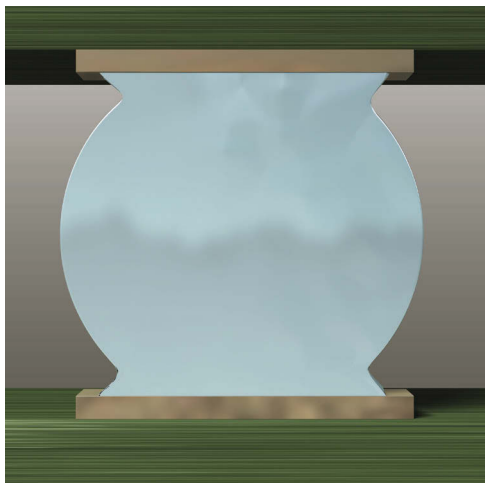


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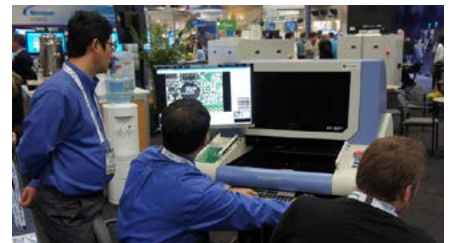


Real Time with... continues

jobs to work with I-Connect007 to bring the quality of our technical interviews to the next level. Guys (and gals) like Joe Fjelstad, Steve Williams, Stuart Hayton, Mark Thompson, Dick Crowe, Mike Carano, Kelly Dack, Dan Feinberg, Happy Holden, Michael Weinhold, Judy Warner, Jack Fisher, Greg Thomas, Bob Neves, Mike Konrad, Susan Mucha, Dan Beaulieu, Dr. Ron Lasky, and Jennie Hwang. Let's not forget Osvaldo Targon, who shot a handful of interviews in Spanish. These contributors help set I-Connect007 content apart from the pack, period.

Back with a little more punch this year was our Panel Discussion program, which debuted at last year's show. We took it up a

notch this year and produced 13 panels, each comprised of a moderator and three panelists. These panels delved a little deeper, and ran a little longer (approximately 20 minutes) than one-on-one RTW interviews. We definitely hit our goal of lively, informative debate—our guest panelists did not disappoint (Yash, are you listening?). Topics ranged from technical issues to marketing, onshoring, roadmapping, and beyond. It really seemed like a good time was had by all who participated. Look for these content-rich interviews again at IPC APEX EXPO 2014 in Las Vegas, Nevada. Settle in and check out this year's interviews by clicking [here](#) and scrolling down to the "Panels" section of our index.





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IPC APEX EXPO Press Conference Notes

by **Pete Starkey**, I-Connect007

The largest exhibit at IPC APEX EXPO was Koh Young Technology's Big Truck, ready to embark on a [90-day Truck Tour](#) of 25 states to bring the company's flagship SPI system aSPiRe2 and award-winning 3D AOI Zenith system to their customers' parking lot, enabling engineers to experience Koh Young's equipment hands-on. Sales Manager JD Shin demonstrated the benefits of 3D AOI, which could highlight potential defects that might escape conventional X-ray and ICT procedures.

[Speedline](#) announced three new products at the show this year: The Camalot Prodigy, a small-footprint dispenser with linear drives offering 30-micron accuracy at full system speed; the Camalot Momentum compact stencil printer; and the Electrovert Aquastorm AS50 batch cleaner with Powerspray-powered basket technology. The company also exhibited the Electrovert Vectra ES2, an entry-level wave-soldering machine, and the Omni ES7 reflow soldering machine.

Aegis Software launched their [FactoryLogix](#) suite of software modules at IPC APEX EXPO. CEO Jason Spera reported an unprecedented level of interest in the system, the first software package to support the entire spectrum of electronics manufacturing, from PCB assembly to complex box-builds and large system integrations. Spera explained that FactoryLogix is the single, elegant solution to challenges identified in 20 years' experience and 1,200 installations of software.

[Hitachi High Technologies](#) exhibited its new SL tape feeder, which represents a true innovation in component placement and dramatically shortened set-up time. The 8 mm self-loading feeder provides splice-free operation. A secondary reel supply can be added to the same feeder at any time during operation. The feeder uses a new cover-tape process described as acting "like a boat through water," mitigating the release of dust and debris inside the placement system.

Showcase Video Interview

What's up With the Truck?

by **Real Time with...**
IPC APEX EXPO 2013

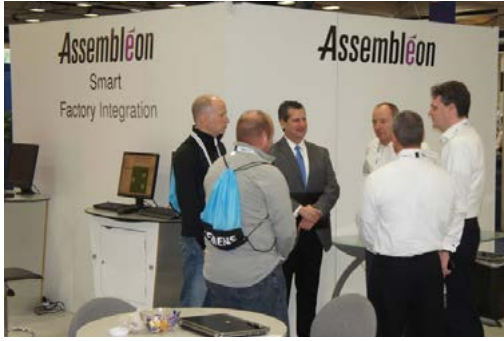


Yes, Koh Young brought a semi-truck to IPC APEX EXPO 2013. Why? Global Marketing Director Andre Myny explains that the company brings the truck to customers to perform demonstrations, allowing for hands-on training where a physical introduction to the tool is essential.



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The PCB List Demos a Hit!

The PCB List demos on the IPC APEX EXPO show floor attracted the attention of just about everyone possible—from fabricators to OEMs to EMS companies, according to I-Connect007's Project Manager Patty Goldman. EIPC Director Michael Weinhold even stopped by the booth for a Real Time with... interview to discuss The PCB List with Goldman and Dan Beaulieu. Watch the conversation [here](#).

Goldman answered a few quick questions immediately following the show for Editor Lisa Lucke.

Lisa Lucke: How would you describe the response to The PCB List?

Patty Goldman: Really good! We expected plenty of interest in the demos and weren't disappointed. We had quite a few people register to use The PCB List and a number of PCB manufacturers claimed their companies. We had many EMS companies commenting on how valuable The PCB List has been to them. They say they are using it often to find fabricators for their specific needs.

Lucke: How was traffic at the I-Connect007 booth?

Goldman: It was literally busy all the time. We did dozens of demos—lots of people sitting down and claiming their companies. All I really did was show visitors the "Go" button and they were off!

Lucke: Did I hear a rumor about a sister list for EMS?

Goldman: Yes, we've begun letting people know about The EMS List, a directory of EMS companies worldwide. Those I spoke to seemed quite interested to learn more. We'll announce the launch as the release date approaches.



Some companies tell you they are great. We let our customers speak for us...



Thank you!

You guys are terrific! I had my proto boards fabricated by you when I worked at Honeywell and you do first class work. Many of those proto designs ended in aircraft from the C-17, Air Force One, to the Presidential Helicopter! Once those designs were proven the production house handled the load. But many of your boards went up 40,000+ feet to start the certification process. Mark, you do great work getting the information we need!

Steve White, Sr. P.C. Designer C.I.D.
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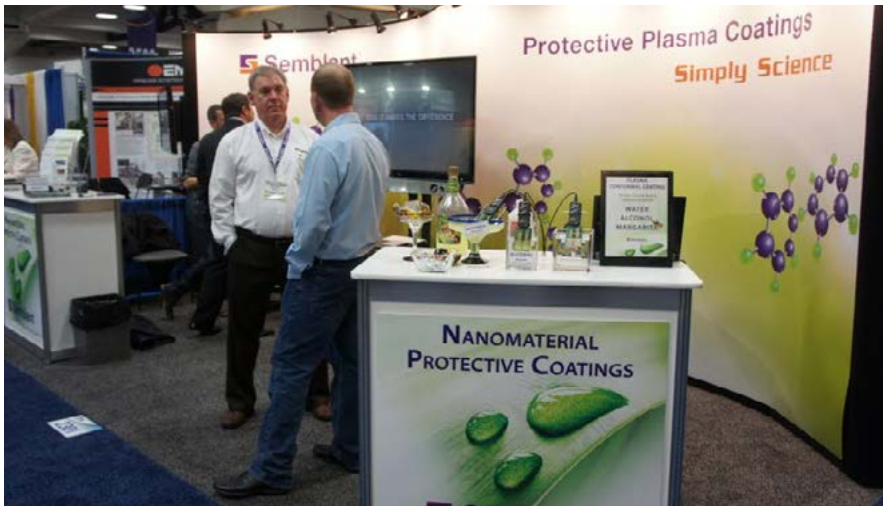
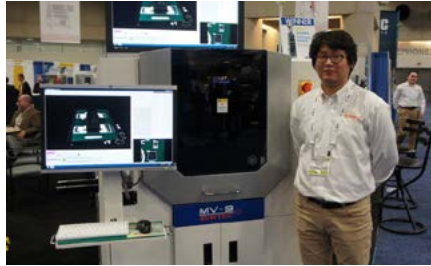
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Showcase Video Interview

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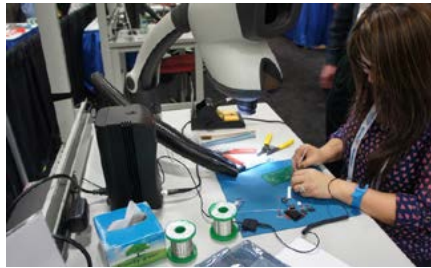
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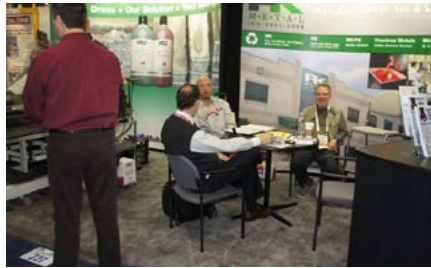


Kevin Pawlowski, senior product manager at Techspray, describes newly-released products and services that enable the environmentally-friendly cleaning of PCB assemblies. Pawlowski also introduces a new fast-curing, temporary, and easily removable soldermask for blocking solder from board features which are desirably left unfilled.



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Selecting a Foreign Provider: 10 Crucial Questions

by **Karla Osorno**

EE TECHNOLOGIES, INC.

SUMMARY: *All OEMs look for significant value-add, the management of costs and quality while ensuring timely delivery, when choosing an EMS provider in another country. Asking 10 specific questions will provide insight into the company's philosophies, priorities, and practices.*

For original equipment manufacturers (OEMs), selecting an EMS provider in Mexico, or any country for that matter, is a critical activity. Choosing the right provider can make the difference between achieving long-term success, or not.

All OEMs are looking for significant value-add which means managing costs and quality while ensuring timely delivery. The process of selecting an EMS provider in another country must be approached methodically to achieve this goal. The top 10 questions that those seeking providers in Mexico should ask potential providers include:

1. What are your capabilities?
2. What certifications do you hold and what standards do you follow?
3. Where are your locations?

4. Are you financially stable?
5. What are your quality metrics?
6. How do you manage costs?
7. What intellectual property (IP) security do you have in place?
8. Do you support new product introductions (NPI)?
9. What post-production support do you offer?
10. Why should we choose you?

As you ask these important questions of each potential supplier, keep in mind the following:

Capabilities

It is essential that you ask EMS providers in Mexico what their specific capabilities include. Although many companies say they provide EMS to those with whom they contract, the term "EMS" is not a homogenous one. Various classes of EMS providers exist in Mexico and in the market place as a whole.

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SELECTING A FOREIGN PROVIDER: 10 CRUCIAL QUESTIONS *continues*

Tier 2 EMS suppliers have solid capabilities and strengths, but are unable to provide the same services, on the same scale, as a Tier 1 electronics manufacturing supplier. Furthermore, there are smaller suppliers offering specialized services and the flexibility needed by many OEMs.

In addition to identifying the class of EMS provider in Mexico, it is critical to ask about their specific capabilities and specialized services. Some providers are more adept at some processes than others. Buyers must determine if a company's specific capabilities meet their particular and unique needs. Finally, it makes sense to observe the processes in action rather than relying on a slide show or a brochure to understand capabilities. Confirming results with other customers, by checking references, provides further evidence of a provider's capabilities.

Certifications & Standards

Most electronics manufacturing services companies in Mexico, and in other venues, will publish their certifications and standards on their website and/or informational literature. This is easy information to obtain. However, understanding the length of time, experience, and certifying body related to important certifications is key. Also, determining if the certifications are specific to products you require is important. Having a long list of certifications is irrelevant if the certifications are related to an industry other than the one that you're in.

Ask questions related to the decision processes the provider uses to identify standards to obtain and to maintain. Keep in mind that your preferred suppliers standards and certifications may have an impact on compliance with your certifications, as well. Additionally, it is important to verify that the EMS provider's current certifications and standards will be ongoing and not discontinued in the foreseeable future.

Standards related to products and processes provide confidence and external credibility. Once you know which standards are common

in your industry you can match them up to the potential provider's standards.

Often, the provider will also have training records. These identify the employees who are trained to the standard. They may also provide certificates of compliance with shipped goods as further evidence of compliance with industry standards. The time to understand the existing processes related to certifications and standards is before making a final choice.

Setting up an electronics manufacturing services plant in Mexico is a good low-cost option. Proximity to other partners in the supply chain can have a significant impact on logistics, costs, and delivery times also.

Manufacturing Locations

Location, location, location! We have all heard this phrase used many times, but what does it mean in the context of manufacturing? A lot! Knowing where the current manufacturing locations are and where future locations are planned can be an important factor in your analysis.

Location impacts logistics, costs, communication, and overall results. Understanding EMS product mix and stage of development will have an impact on this decision as well. In the early design stages, it may be important for engineering teams to collaborate in person. If this is the case, the location of the EMS provider should be close to the OEM.

Setting up an electronics manufacturing services plant in Mexico is a good low-cost option. Proximity to other partners in the supply chain can have a significant impact on logistics, costs, and delivery times also. In addition, labor, overhead, and component costs can vary greatly by geography. Weighing the differences between direct costs and indirect costs of doing business in differing locations is a significant factor.

Ask comprehensive questions about manufacturing locations and consider the benefits to the OEM of multiple and international locations. In addition to facilitating interaction between domestic and foreign staff, locating an electronics manufacturing services facility in Mexico can serve to lower freight and shipping costs when compared to those related to other global sites.

SELECTING A FOREIGN PROVIDER: 10 CRUCIAL QUESTIONS *continues***Financially Stable**

For most suppliers the answer to the financial stability question will quite probably be, "Yes, we are financially stable." This should prompt asking follow-up questions to understand the source of stability. And you will want to make sure that there is management strength to maintain financial stability.

The term financial stability means different things to different people. Is this based on a cash position? Based on assets? Or based on ratios? Are the EMS service provider's financial statements public and/or audited by a certified public accountant? OEMs will want to define financially stable for themselves, and then compare the EMS provider's results to the standard defined by the OEM.

The size of the EMS provider, and business type, may also affect this information. If the supplier is publicly traded the answers will be public information and available for analysis. If the EMS supplier is smaller, then another credible source, such as Dun & Bradstreet, must be used to obtain the information. There is a chance that the supplier will not publish or volunteer the information. A careful analysis will provide confidence that the relationship will not be short-term in nature due to negative financial issues.

Quality Metrics

Quality is non-negotiable when selecting an EMS provider. One hundred percent of your potential suppliers will tell you they believe in quality. Quality metrics themselves, in black and white, will tell you if those assertions are true. Types of metrics, frequency of reporting, and corrective actions taken in response to quality metrics all communicate the value placed on quality by the supplier. Historical trends will also indicate the priority placed on continuous improvement programs.

All organizations will have periodic quality or process issues. Assessing the quality metrics of the supplier will give you a great indication

of how issues are addressed. You will also learn how preventative measures are taken to ensure ongoing and consistently good performance.

Consider selecting a supplier that measures quality in a way that is consistent with your own organization. Choosing a company that uses similar metrics, and that gathers sufficient detail to understand and resolve issues, is vital for long-term success in a relationship.

Cost Management

The primary reasons for outsourcing manufacturing to another company are to save money and gain efficiencies—all while allowing the OEM to focus on product development and marketing. A key piece of the objective is to choose an EMS supplier that manages costs so that money is, in fact, saved. Thus, a significant part of making a good EMS supplier choice will be related to understanding how the company manages costs and shares their savings with the OEM.

First, it is necessary to understand what cost methodology is used in quoting and pricing products. Are buys aggregated by customer, by product line, or at all? Does the supplier use the bill of materials provided to obtain the best prices available in the marketplace and to pass a portion of the cost savings to the OEM or are historical costs used? Are time studies completed for each project or are historical assumptions used to calculate the time to complete? How do test fixtures and other one-time charges get assigned?

Second, ascertain how the supplier will reduce costs from first prototype run to future production runs. Determine answers to questions like: What are the buying strategies employed? How much purchasing power exists? When are costs savings passed along? How are improvements made to routed hours for a job? How often are work center and overhead rates calculated?

Third, determine how the EMS supplier maintains profitability and, therefore, long-

Consider selecting a supplier that measures quality in a way that is consistent with your own organization. Choosing a company that uses similar metrics, and that gathers sufficient detail to understand and resolve issues, is vital for long-term success in a relationship.

SELECTING A FOREIGN PROVIDER: 10 CRUCIAL QUESTIONS *continues*

term viability. What are target margins? Is the customer reviewed by product margin or total margin? When and why does the EMS provider decide to end the relationship? The costs of changing suppliers are significant so keeping your key suppliers in business is critical to managing overall EMS supplier costs for the long-term.

IP Security

OEMs have appropriate concerns about securing their designs and other intellectual property, especially when multiple domestic and international locations are involved in manufacturing their products. They want to make sure that their designs are secure and not shared intentionally or accidentally with competitors.

Processes for transferring files, network security, confidentiality policies, and employee hiring practices are all topics for discussion. Depending on the sensitivity of the information, additional topics of discussion might be guest access to production areas, use of cameras on-site, and use of pictures, logos, and customer information for EMS advertising purposes. EMS service providers are protected by intellectual property laws in Mexico that are akin to those in force in the U.S.

NPI

Determining the processes established for a new product introduction tells the OEM a lot about the processes and controls of the supplier. It is one thing to say in a brochure that capabilities include NPIs. It is another thing, however to successfully complete (timely execution with good results) NPI projects.

The outcome of the prototype run is important, but equally important is the gathering of information for use in future production runs. Discussion points in this area should include processes used, information gathered, team expertise, and demonstrated evidence of success.

Post-Production Support Offered

For many organizations the beginning stages of design, manufacturing, and shipment are the main focus. Unfortunately, after the product leaves the dock, little or no attention is paid to follow through because the organization has moved on to the next product or customer. De-

pending on the product additional services may be required. If quality concerns or issues exist, additional attention is absolutely necessary.

Learning about liability policies, warranty policies, and post production repair services almost seems like jinxing the outcome, but you want to have assurance that solid policies and procedures are in place to handle these issues should they arise. Viewing metrics, as discussed above, can add to your understanding of the expertise of the EMS provider. Checking on references speaks to these important issues as well.

Choice

As potential EMS suppliers in Mexico, or in other geographies, are responding to your thorough questioning, observe not only what they say, but evidence that supports what they say. Pay strict attention to how they back up claims and what references report.

While listening to the reasons provided for selecting this particular supplier, take note of whether or not the answers focus on meeting the OEM's need. It is no surprise that the supplier will know their capabilities well. You also want to be sure they know what the OEM (you) values. Just as important is a summary of why this will be a good partnership for the OEM and the EMS provider.

The answers to all of these questions provide insight into the philosophies, priorities, and practices of an EMS provider. Ultimately, you want to know with confidence that the EMS provider has the ability to meet your ongoing needs. **SMT**



Karla Osorno is business development officer for [EE Technologies, Inc.](#), an EMS provider delivering complete engineering and manufacturing services with locations in Nevada and Mexico. With education and more than 20 years' experience in finance and operations, Osorno drives completion of projects in marketing, business development, operations, and process improvement. Her passions are to educate and empower others to make changes and a daily difference in the world. Contact Osorno [here](#).

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Throughput Versus Wet-Out Area Study for PoP Underfill Dispensing

by **Brad Perkins and Jared Wilburn**
NORDSON ASYMTEK

SUMMARY: *The use of package-on-package during assembly helps save space on a board, but, to insure reliability, underfill is required. This paper discusses the relationship between the wet-out area of the underfill reservoir and production time for the entire process.*

Package-on-package (PoP) has become a relatively common component used in mobile electronics as it allows for saving space in the board layout due to the 3D package layout. To insure device reliability through drop tests and thermal cycling, as well as for protecting proprietary programming of the device, either one or both interconnect layers are typically underfilled. When underfill is applied to a PoP—or any component for that matter—there is a requirement that the board layout is such that there is room for an underfill reservoir so that the underfill material does not come in contact with surrounding components.

The preferred method of dispensing the underfill material is through a jetting process that minimizes the wet-out area of the fluid reservoir compared to traditional needle dispensing.



To further minimize the wet-out area multiple passes are used so that the material required to underfill the component is not dispensed at once, requiring a greater wet-out area. Dispensing the underfill material in multiple passes is an effective way to reduce the wet-out area and decrease the distance that surrounding components can be placed; however, this comes with a process compromise of additional processing time in the underfill dispenser. The purpose of this paper is to provide insight to the inverse relationship that exists between the wet-out area of the underfill reservoir and the production time for the underfill process.




Introduction

Industry trends are driving mobile electronics such as cell phones, digital cameras, and multimedia devices to smaller form factors with increased functionality. This trend is resulting in thinner circuit boards, smaller components, and 3D packaging to provide greater functionality in a smaller-sized device. These mobile products are also expected to have functionality after being dropped and thermal cycling. To provide the intended robust functionality underfill is applied to PoPs to provide a mechanical connection between the substrate and package. The underfill material absorbs the mechanical

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THROUGHPUT VERSUS WET-OUT AREA STUDY FOR POP UNDERFILL DISPENSING *continues*

stresses between the substrate and component as the PCB flexes upon impact of a drop or CTE mismatches during thermal cycling. This prevents the solder joints from fracturing, which would result in an electrical short and device malfunction.

Underfill is dispensed in a weight-controlled pattern along one or two sides of a component, and then capillary action draws the underfill to the other side of the component completely encapsulating the solder joints under the component holding them in hydrostatic compression once cured. When initially dispensed the underfill forms a fluid reservoir that requires a wet-out area. The fluid reservoir is depleted once capillary forces have pulled the material to the other side of the component and underfilled the package. With PoP both interconnect layers are underfilled simultaneously from the same fluid reservoir as seen in Figure 1.

The size of the wet-out area determines the proximity of neighboring components. For manufacturing reliability and rework requirements the underfill should only come in contact with the component being underfilled. If underfill comes in contact with other components surface tension pulls the material to that area and can cause an incomplete underfill of the desired component.

A reliable underfill process is achieved when enough material is dispensed to completely flow under the component. The use of equipment with integrated weight scales allows for closed-loop processing of the dispensed mass ensuring that the fluid reservoir underfill flow fronts appropriate amount of underfill is dispensed for each component. If too little material is dispensed there is an incomplete underfill

leading to a lack of reliability in the underfill process. If too much material is dispensed there is a waste of valuable underfill material increasing the process cost, excessive wet-out areas, and the possibility that in contaminating surrounding components the intended package is starved for material resulting in an incomplete underfill.

When the appropriate amount of underfill is dispensed, there is a direct correlation between the amount of material dispensed in a single pass and the size of the fluid reservoir corresponding to the wet-out area. The more material dispensed at one time, the larger the wet-out area and conversely the less material dispensed the smaller the wet-out area. This is the major factor when investigating the inverse relationship between throughput and the wet-out area required for complete underfill.

PoP Package Types

This study focused on two different PoP package types: The current-generation PSvFBGA PoP (Figure 2) and next-generation through mold via (TMV) PoP (Figure 3). The PoP typically has a logic device in the bottom package and a memory device in the top package.

Next-generation TMV PoP allows for higher density memory interface as well as higher data transfer rates. The trends for PoP mimic that of the devices themselves in that they are being reduced in footprint size and height while increasing in functionality. As this footprint is reduced the available area for underfill wet-out will also be pushed to smaller distances with reduced underfill keep out zones. There is a drive to improve the solder joint reliability without the use of underfill at one or both layers [1].

Underfill Material

A single underfill was used in the study to limit the number of variables. The chosen underfill was a two-part epoxy premixed and frozen prior to use, non-reworkable, 3,000 centipoise (cps), and fast-flowing underfill with 50% filler content. The scope of this paper is to investigate the flow properties of a representative underfill; however, as the rheological properties of the underfill changes with chemistry, viscosity, and filler content the results will differ



Figure 1: Underfill reservoir and flow fronts.



Figure 2: PSvfBGA PoP.

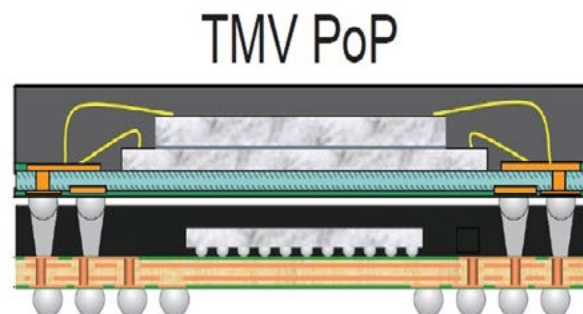


Figure 3: Through mold via (TMV) PoP.

slightly. Generally speaking, as the material viscosity goes down the wet-out area will extend further away from the edge of the component and the time to flow under the component will decrease. If the viscosity is too low it can be challenging to achieve a complete underfill of the second layer interconnect as the material will not support itself to stay in contact with the bottom layer of the top package. Conversely, as the viscosity increases the wet-out area will decrease and the flow-out time will increase.

It is important to note that for device reliability there should be careful consideration given to the underfill material's cured properties. While underfill in general improves the reliability of the device during drop tests, the CTE, Tg, and filler content are properties to consider when evaluating the device performance with respect to thermal cycling [2]. Additionally, the uses of reworkable underfills are a process consideration as well as a consideration for protecting the package logic.

Throughput Versus Wet-out Area Study

The experiment was designed to first qualify the amount of material required to completely underfill both of the interconnect layers and only the first interconnect layer. This was done first by approximating the amount of material required based on the volume in the interconnect layer and taking the underfill material's specific gravity to convert to a mass. The approximated mass was then dispensed using an Asymtek S-920 dispenser with integrated weight scale capable of calibrate process jetting (CPJ) with a DJ-9000 Dispense Jet to further refine the mass based on the way that the fluid fil-

leted on the non-dispensed sides. It was found that 120mg was required to completely underfill both layers while only 65mg was required to completely underfill the bottom layer.

The dispense pattern was an "I" pass (single side) to minimize any chance of incomplete underfill. The flow-out time is less when the underfill reservoir utilizes multiple sides of the package (L-pass), however, the testing was designed to only look at a single side as that incorporates the longest flow-out time and the highest probability for a void-free underfill. The parts were prebaked to drive out any residual moisture in the organic substrate and 90°C substrate heat was used to ensure proper flow of the underfill. The dispenser was programmed so that the center of the DJ-9000 Dispense Jet Nozzle was 0.3 mm from the edge and 0.5 mm above the top of the component for each weight controlled line. Sample parts were destructively tested to ensure that complete underfill was achieved on the intended interconnect layer(s) so that the testing reflected optimal underfill.

The wet-out area was studied utilizing one, two, or three passes to dispense the underfill material. As the cumulative mass of dispensed material is the critical variable in a successful underfill process the total mass was divided equally between passes. The wet-out area respective to the number of passes on the PSvf-BGA PoP was qualified for underfilling both interconnect layers simultaneously as well as underfilling only the bottom interconnect layer; the wet-out area for the TMV PoP only qualified for underfilling both interconnect layers simultaneously. Due to similarities in the volume of the bottom level interconnect level and

THROUGHPUT VERSUS WET-OUT AREA STUDY FOR POP UNDERFILL DISPENSING *continues*

| # of Passes | Dispense Time per Pass | Wait Time Between Passes | Flow Out Time on Last Pass | *Approximate Time to Dispense One Device |
|-------------|------------------------|--------------------------|----------------------------|--|
| 1 | 2 sec | 0 sec | 30 sec | 2 sec |
| 2 | 1 sec | 10 sec | 20 sec | 12 sec |
| 3 | 0.66 sec | 6 sec, 10 sec | 20 sec | 18 sec |

Table 1: Time requirements relative to number of passes.

the height of the solder joints results should be similar between package types when holding all other variables constant.

Testing also qualified the amount of flow-out time required for the underfill to flow under the component with each of the passes. This allowed for software programming of the S-920's multi-pass wait timers to be set so that subsequent passes were not dispensed prior to the fluid reservoir flowing out thus increasing the wet-out area and skewing the results. Dispense and wait times are provided in Table 1.

*The Asymtek S-920 dispenser can be equipped with pre-heat and post-heat stations in addition to the standard heated dispense station allowing for the parts to ramp to temperature prior to dispensing and to be subsequently held at temperature after the last pass has been dispensed. This allows maximum throughput out of the dispenser as the DJ-9000 is not sitting idle while parts are at the dispense station ramping to dispense temperature or waiting for complete flow out.

As such, the approximate time to dispense one device does not include bringing the parts to temperature in the pre-heat station or holding them at temperature in the post-heat station as that is masked in most applications. For maximizing throughput on the dispenser the number of parts per load cycle need to be considered as

the flow-out time with multiple passes can be masked because dispensing of other PoPs and the wait time between passes can be done concurrently. For very high-throughput applications the time to ramp the parts to temperature also needs to be considered as common pre-heating ramp rates are between $\sim 2^{\circ}\text{C}/\text{second}$ to $\sim 8^{\circ}\text{C}/\text{second}$.

Results

The wet-out area, and thus the distance that surrounding components can be placed, is directly proportionate to the number of passes that the material is dispensed in and if one or both interconnect layers of the PoP package are being underfilled (Figure 4). Increasing the number of passes results in decreasing the wet-out area allowing for tighter surrounding component density. The reduced wet-out area comes at a cost of process throughput as increasing the number of passes also increases the time that parts are in the dispenser (Table 1).

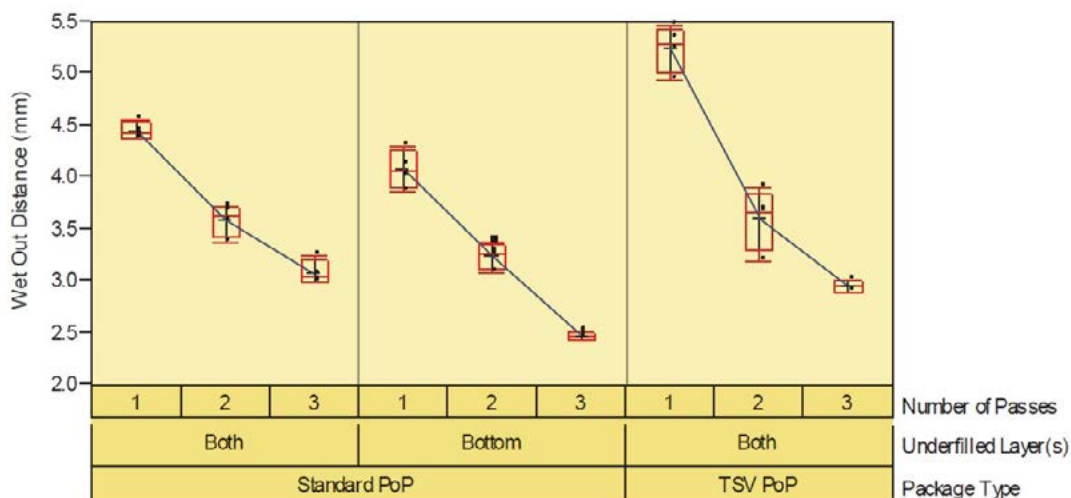


Figure 4: Variability chart for wet-out distance (mm).



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THROUGHPUT VERSUS WET-OUT AREA STUDY FOR POP UNDERFILL DISPENSING *continues*

This study showed that the second-generation TSV PoP requires slightly more wet-out area than the first-generation PSvfBGA when using a single pass. While this was a small sample size, it is possible that the slower flow on the second-level interconnect on the TSV PoP (due to the smaller gap between packages) caused the underfill material to wet-out slightly more than with the PSvfBGA when all the material was dispensed in a single pass. Interestingly both packages showed similar wet-out areas if multiple passes were used which points to a logical correlation between wet-out area and flow-out time—the longer the flow time the further the wet-out area.

The wet-out area is heavily dependent on if one or both interconnect layers are underfilled. When comparing the wet-out distance on the bottom interconnect versus both interconnects we see that the smallest wet-out area occurs when only the bottom level interconnect is underfilled. This is understandable when looking at the height required to underfill each layer and the associated fillets on the non-dispensed edge. Figure 5 shows how the wet-out and fillet areas are related to interconnect level.

This is also supported by the difference in wet-out and fillet areas between CSPs and flip chips, where the lower solder bump height of a flip chip allows for significantly less wet-out than with a CSP [3].

The underfill reservoir is greater than the underfill fillet; the fillet is the underfill that is

visible around all sides of the component in a cured package. The dimensions of the fillet are determined by the underfill material contact angle, the height of the solder joints, and the amount of material dispensed relative to the amount required for complete underfill. Wet-out areas can become relatively close to the fillet dimensions; however, this occurs with numerous dispense passes where more material is deposited once the fluid reservoir has flown underneath the component. In this study the fillet on the non-dispensed sides was ~0.5 mm when both interconnects was dispensed and ~0.2 mm when only the bottom level interconnect was dispensed. Figure 6 illustrates both level underfill fillets (not the dispense edge corresponding to wet-out) and single level underfill fillets.

Conclusions

With underfill dispensing for PoP, the wet-out area is greater the fewer the number of passes. The wet-out area is also greater if both interconnect layers are being underfilled. For devices that are lower cost and not designed for minimal size it is advantageous to allow for a greater area for underfill wet out so that the underfill process takes less time and thus requires less capital equipment for manufacturing reducing cost. For devices on the leading edge of technology for small form factors and high functionality the use of multiple passes and jet dispensing allows for minimal wet-out areas and the highest component density. It should

Full Fillet for Single Level
Interconnect Underfill

Full Fillet for Both Levels
Interconnect Underfill

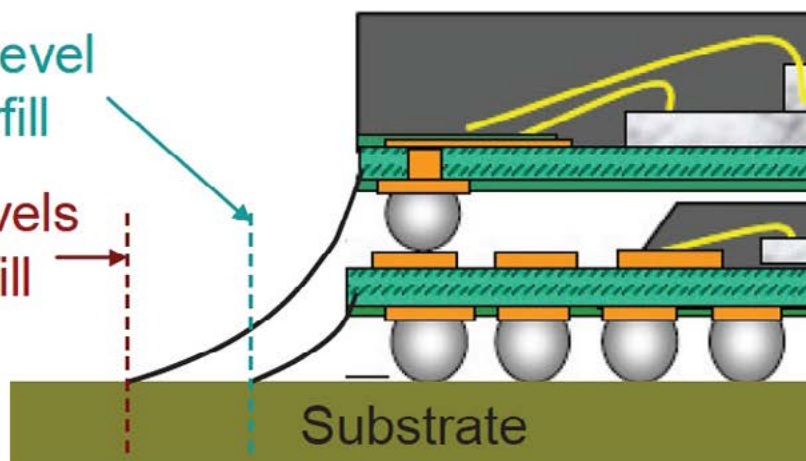


Figure 5: Fillet wet-out relative to interconnect height.

THROUGHPUT VERSUS WET-OUT AREA STUDY FOR POP UNDERFILL DISPENSING *continues*

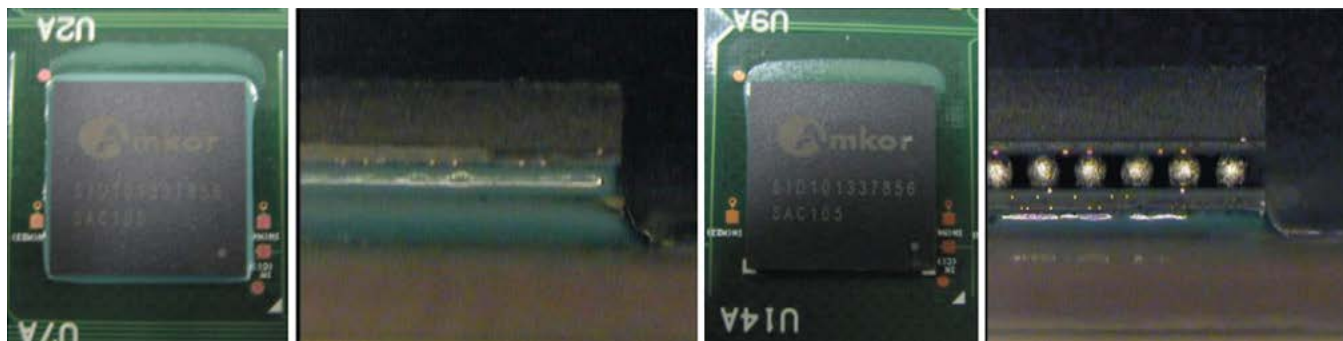


Figure 6: Underfill fillets for both level interconnects (left) and single level interconnects (right).

also be studied as to if one or both of the interconnect layers require underfill as underfilling both layers requires additional wet-out area and material.

When laying out a board with a PoP, the keep-out zone should not necessarily be symmetrical as the dispense side(s) require a wet-out area and the filleted sides of the package are primarily dependent on the height of the interconnect layer and contact angle of the material. This study showed that the wet-out area on a PoP was approximately 6 to 10x the fillet dimensions (~3 to 5 mm versus ~0.5 mm). While the intent of the study is to show the relationship between wet-out area and throughput, it is not optimized for the absolute minimum for wet-out area. In looking at the slope of the curve with additional passes it appears to stay relatively linear with a downward slope. It is reasonable to expect the curve will flatten out with additional passes giving the absolute limit to the wet-out area. Based on the data, there appears to be the capability to increase the passes and decrease the wet-out area further. The caveat is that if the passes do not dispense enough material the fluid reservoir will not be high enough to underfill each layer. This is because a limiting factor is how high the material must build up to underfill both layers. This is illustrated in Figure 7. A material viscosity change using a ma-

terial that flows less (higher viscosity or lower substrate temperatures) may also be capable of providing higher dispensing aspect ratio stacking the material to reach the second interconnect layer while reducing the wet-out area. This would most likely add additional flow-out time as well.

The proximity to other components determines the percentage of the total amount of material required to be dispensed in each pass. Dispensing less fluid in a pass enables the wet-out areas to be closer to the fillet dimensions because the fluid doesn't spread as much and can flow under the component quicker. Obviously, more passes take more time. If boards are not designed for underfill, the only solution is a high number of passes, which requires more

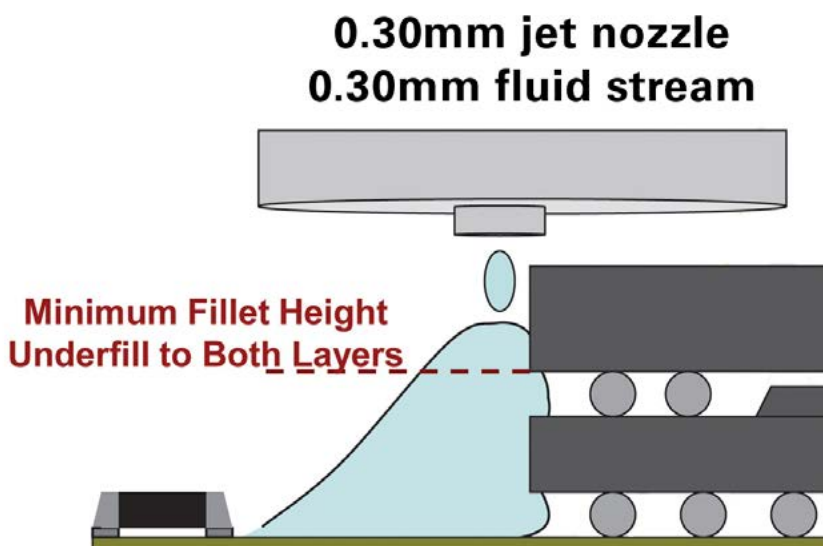


Figure 7: Minimum height to underfill both interconnect layers.

THROUGHPUT VERSUS WET-OUT AREA STUDY FOR POP UNDERFILL DISPENSING *continues*

processing time and adds to the cost of the underfill process due to the equipment investment. It therefore becomes advantageous from a cost and reliability standpoint to design the boards with an appropriate wet-out area for either single level interconnect or multiple level interconnect underfill. **SMT**

Acknowledgements

The authors would like to thank Amkor for the assistance in providing the test vehicles for the study and for the PoP drawings. TMV is a registered trademark of Amkor. The authors would also like to thank the application's engineering team in Carlsbad for the assistance in defining PoP underfill process considerations.

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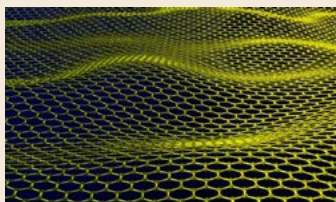
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working as an applications engineer for Nordson ASYMTEK from 2006-2011. He may be reached at jwilburn@asymtek.com.

Europe Boosts Graphene Investment

The European Commission has announced that it has chosen graphene as one of Europe's first "Future Emerging Technology" flagship programs, described as "the largest research excellence awards in history." Worth a total of €1 billion, the project will aim to take graphene and other related layered materials from academic laboratories to society.

Professor Andrea Ferrari, Director of the Cambridge Graphene Centre, said, "The grand challenge for the flagship is to target applications and manufacturing processes, at the same time broadening research to other two-dimensional materials and hybrid systems. The integration of these new materials could



bring a new dimension to future technologies, creating faster, thinner, stronger, more flexible broadband devices. We recognize that there is still much to be done before the early promise of graphene becomes reality. The large funding the EU is ready to invest in our vision puts a huge burden of responsibility on our shoulders, and will require us to focus on results and stay away from hype."

The Graphene Flagship is a joint, coordinated research initiative of unprecedented scale. It brings together an academic and industrial network from 17 different countries and 126 research groups. Together, they will work on graphene development programs designed to cover the entire value-chain, from production through to the manufacturing of graphene-based components and systems integration.

For more information, click [here](#).

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Top Ten Most-Read Supplier/ New Product Highlights



JUKI, Sony SMT Equipment Plan Merger

This integration is intended to strengthen the competitiveness of each company's respective SMT equipment and related businesses. The new company is expected to be established by capital injection from JUKI and Sony, respectively, with JUKI holding more than two thirds of the total shares.

New ACE KISS-205 Cuts TAKT Time by 50%

The new in-line automated selective soldering system effectively combines tasks of fluxing, preheating, and soldering into simultaneous functions to reduce TAKT by up to 50%. Open accessibility simplifies maintenance and access to the process area; easy-change swappable solder pots simplify changeover in high-mix environments.

H.B. Fuller Debuts New Epoxy Potting Compound

"We have seen an increasing demand for materials that meet the UL 94-V0 certification. This UL 94-V0 certification gives our customers the confidence to specify this material for use in electronic applications," said Ralph Velazquez, business development manager advanced materials at H.B. Fuller. This material also provides a lower moisture vapor transmission rate than other materials like silicones.

Murrietta Circuits Employs ACE LTS200 Lead Tinning System

The KISS-LTS200 system utilizes a central fluxing station with two solder pots, one to each side of the fluxing station. One solder pot is typically dedicated to flushing off the original coating (or plating) while the second solder pot is usually dedicated to applying "virgin" alloy for the final coating. The system works in conjunction with programmable controls that hold palletized components in a known position throughout the process.

Intertronics: Microcapsules in Adhesive Dispensing Tech

An ideal dosing system must impart no shear stress on the material and be highly precise. Intertronics is pleased to have the "endless-piston" technology from ViscoTec GmbH which offers these features. Volumetric dispensing pumps dispense or dose independent of input pressure, material viscosity, and ambient temperature. The special geometry of the stator and rotor configuration works as a progressive cavity pump.

Nordson Names Stockunas Group VP Electronic Systems

The company has announced the appointment of Joseph Stockunas to group vice president for Electronic Systems, a new role within the company's Advanced Technology Systems segment that will support Nordson's continued profitable growth in global electronics end markets.

Spectrum Assembly Boosts Capability with Jet Printer

The company is enhancing its manufacturing capability with the purchase of Mydata's MY500 jet printer. The new printer is expected to integrate well with SAI's highly-automated, paperless factory strategy. "In making equipment choices we focus on equipment that maximizes our ability to offer our customers fast turnaround time and superior quality. Jet printing is software-driven and contact free," said Mike Baldwin, vice president.

Manncorp: Improved Quality, Efficiency with New ULTIMA TR2

Companies that are hand soldering through-hole components on surface mount and mixed-technology PCBs can speed up the process, achieve consistent results, and improve product quality and reliability with the ULTIMA TR2 selective soldering system. The company's new selective soldering machine offers superior performance in a compact, benchtop design at a price point that puts it within reach of low- to medium-volume assemblers.

JTAG Debuts PMBus IC Programming Solution

JTAG Technologies, worldwide provider of board test and device programming tools based chiefly on IEEE Std 1149.x, has broadened its portfolio by offering a unique Power Management Bus (PMBus) IC programming solution that supports devices from leading vendors Linear Technologies and TI.

Ellsworth Adhesives Acquires Tennessee-based AMT

With operations based in Memphis, AMT specializes in industrial adhesives and dispensing equipment. This acquisition strengthens Ellsworth Adhesives' presence throughout the mid-south and allows the company to provide enhanced service, support, and infrastructure throughout the area.



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ZULKI'S PCB NUGGETS

FAI: An Ounce of Prevention, Worth a Pound of Cure

by Zulki Khan

NEXLOGIC TECHNOLOGIES, INC.

SUMMARY: *Shrinking PCB real estate, ultra-fine-pitch devices, package-on-package technologies, thinner boards, and the recent adoption of challenging device packaging give the use of first article inspection greater importance.*

Many years ago, Benjamin Franklin said, "An ounce of prevention is worth a pound of cure." Today, those famous words speak volumes to those of us in the PCB design and assembly business. You can interpret that quote several ways, but, in modern terms, what Franklin's ageless universal truth means is that the best approach to any project is to scope out, analyze, and avoid problems from the beginning—not waiting until later to fix them once they arise. By doing so, costs to all parties involved will be reduced and the OEM customer can meet time-to-market requirements.

The reason I call Franklin's quote an "ageless

universal truth" is because it is highly applicable to our industry and particularly to first article inspection (FAI) on the PCB assembly floor. In this day and age, FAI takes on a more definitive meaning and an even greater importance. We're at the threshold of a changing technology. Large numbers of products are becoming smaller, wireless, and portable. This means shrinking PCB real estate, ultra-fine-pitch devices, package-on-package (PoP) technologies, in some cases thinner boards, and the recent adoption of challenging device packaging.

The land grid array (LGA) is one such package (Figure 1). Although it is not exactly a new packaging concept, it is gaining popularity and creating mayhem on the manufacturing front. The LGA has flat bumps and, due to that geom-

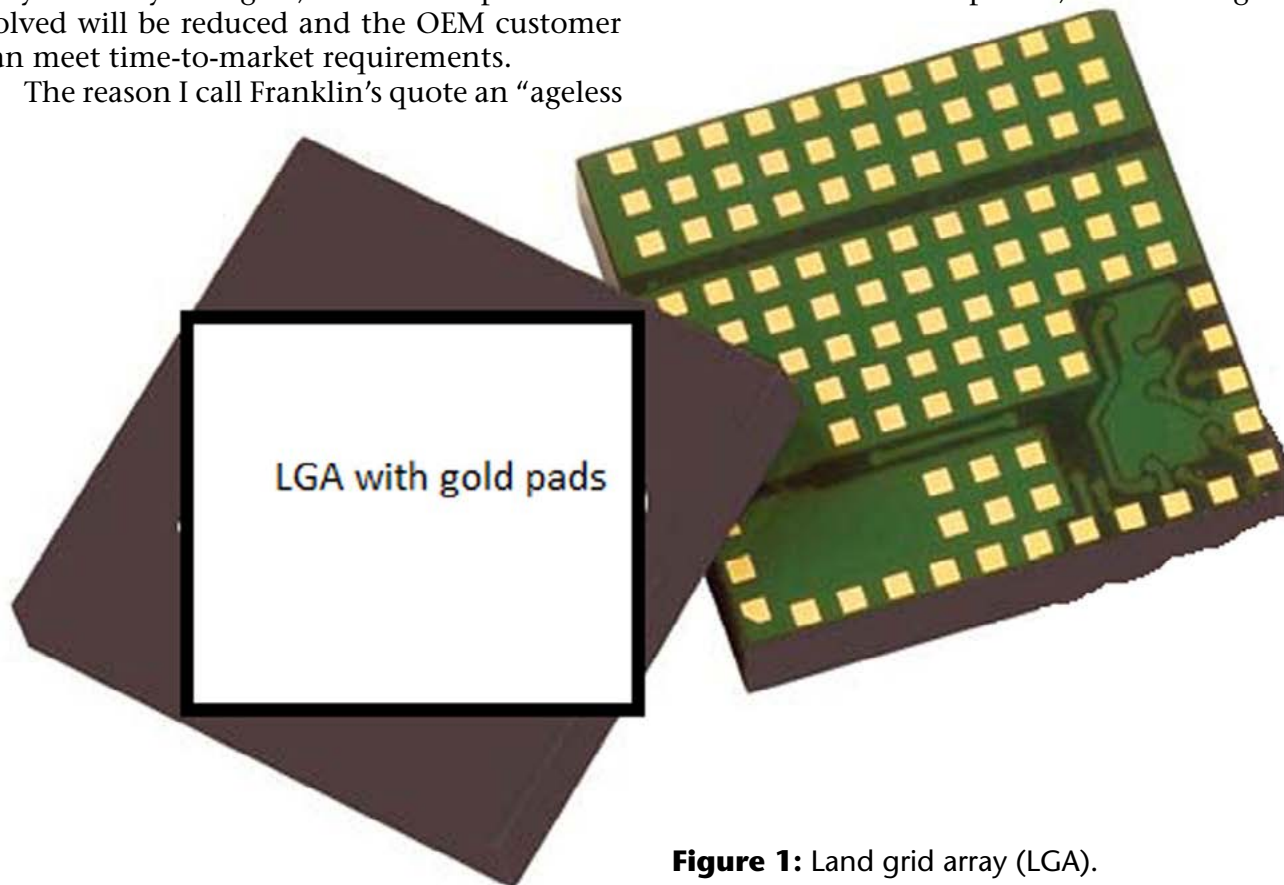


Figure 1: Land grid array (LGA).



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INTRODUCTION

Electronic products, particularly consumer products have become more complex with greater circuit density, finer lines and spacings and more functionality. Reliability issues continue to be a major concern for industrial, bio-medical, aerospace and automotive applications and require materials, manufacturing, test and quality engineers and scientists to be creative in planning for the future. Challenges such as the use of finer powders in solder paste, the greater need for heat dissipation, the use of novel components and technologies are included. Due to cost considerations, new low silver or silver free alloys are being studied. The use of tailored alloy systems, the variety of alloy choices, and smaller passive components are among the concerns being addressed. Now, a new group of engineers and scientists involved in the design and manufacture of (a) medical devices, and (b) monitoring and control

instruments must be ready for the requirements of RoHS recast, also known as RoHS 2. This EU directive officially required that it be made into

national laws by January 2, 2013 and these two new categories of electronics must become compliant by July 22, 2014.

Soldering and reliability professionals need to come together to share their knowledge and their vision for addressing these challenges.

KEYNOTE ADDRESS

Solder Assembly Solutions for 3D IC Packaging

Charles G. Woychik, Ph.D.

Director of 3D Technology and Marketing,
Invensas Corporation

3D IC packaging is transitioning from the lab to commercial adoption. The arrival of the first commercial 2.5D (silicon interposer) product challenges us to question "which parts of the process and supply chain are maturing, and which parts are ripe for reinvention?" Invensas has been developing HVM fine-node 2.5D interposer technology in partnership with AllVia, in conjunction with advanced micro-bumped die that accommodate interconnect schemes exceeding 10,000 I/O. Modeling of the assembly process has been used to evaluate different process flows in order to develop a high yielding, and reliable 3D package design. An overview will be given of this development activity, as well as a brief discussion of the remaining "choke-points", those areas in need of reengineering and reinvention.

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International Reliability Consultant, Program Chair

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Matthew Kelly, P. Eng, MBA, IBM Corporation

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FAI: AN OUNCE OF PREVENTION, WORTH A POUND OF CURE *continues*

etry, is difficult to rework. Whether or not PoP, thinner boards, advanced packaging, or other PCB technology is involved, the point to be made here is that FAI is critical to detect issues newer technologies introduce.

Let's now look at a more basic example. Let's take a batch of 500 boards and say that one particular component was incorrectly placed or not placed at all. But FAI isn't used on the assembly floor. That means those 500 locations must be reworked. Not only does that incur extra cost, but also subjects the boards to an unnecessary thermal cycle, which could have been avoided if the FAI oversight had not occurred.

Speaking of reworking, BGAs, QFNs, CSPs, and similar package types incur an inordinately large amount of time and money. Sometimes in the course of the rework those expensive BGA or QFN components are damaged due to excessive rework, adding considerable expense for replacements. In particular, military and aerospace OEMs and subcontractors limit the amount of PCB rework to just one instance.

Golden Board

A first article is also known as the "golden board" and FAI can best be described as a process validator. It provides a way to investigate issues at the root causes. FAI defines how the manufacturing process instructions (MPI) are set up in the process engineering department. Once quality control checks the first article, that golden board tells the process engineer and manufacturing personnel how efficiently thermal profile creation, solder paste printing, and placement have been performed.

At this stage, the first article auditor checks the golden board after printing. Here, the amount of paste on the pads is measured and verified using a paste height inspection machine. With today's 0.4 mm ultra-fine-pitch BGAs, QFNs, LGAs, and flip chips becoming

more common, the amount of paste deposition on these pads is extremely critical. An assembly issue may arise due to improper printing, if the stencil design is flawed, or if the fabrication house has manipulated the data for ease of fabrication.

For example, let's say the fabrication house is working on a board using ultra-fine-pitch devices. Those devices have individual solder masks separating these leads or slots. If the fabrication house decides on making a change and creating a "gang relief" on the solder mask, meaning combining the solder mask, that change will not only create an assembly issue, but will also create shorts between those pins or pads.

FAI then moves to the next step for post-placement. The auditor checks to determine that SMT components have been correctly placed, SMT programming is properly performed, and that those components are picked and placed in the right manner.

Or, to put it another way, the auditor discovers whether or not components are skewed, wrong components were used, components are missing, or wrong values added.

For example, let's say we're dealing with a 10-board batch and each board has 10 tantalum capacitors with the same value and same footprint. However, due to a small error in the pick-and-place machine, these caps were placed incorrectly. In this case, due diligence at FAI was not performed after pick and place. Consequently, 100 locations need to be reworked after assembly is complete.

At the third stage, FAI looks into the thermal profile to determine if any component was skewed, tilted, or burned during reflow. Perhaps there's a capacitor or resistor tombstoned as a result of an improper profile or paste deposition. If the thermal profile isn't properly created, FAI will reveal issues or problems at this stage.

At the third stage, FAI looks into the thermal profile to determine if any component was skewed, tilted, or burned during reflow. Perhaps there's a capacitor or resistor tombstoned as a result of an improper profile or paste deposition.

FAI: AN OUNCE OF PREVENTION, WORTH A POUND OF CURE *continues*

The beauty of a thorough FAI is that it allows sufficient time to make corrections. On the other hand, sometimes the substitute for FAI in a zero-defect manufacturing organization is the mantra to “do it right the first time.” However, there are times when operator error creeps in and the result isn’t caught, or a fixture is omitted and again the result goes undetected. Or when using a big panel, printing may shift in one direction or another and the problem goes unnoticed. But with proper FAI those issues and many others are highlighted and corrected.

The Right Mindset

By its very nature, FAI is cumbersome and demands a correct, positive, and disciplined mindset. The contract manufacturer or EMS provider must invest and devote time and resources for the process to be validated. Generally speaking, contract manufacturers not in the top tier tend to take shortcuts by bypassing FAI.

Shortcuts are often taken due to quickly approaching shipping deadlines, for instance, and there simply isn’t time to perform FAI. But let’s use that 500-board batch again as an example. That extra day or so wasn’t allocated to applying FAI to assure no issues exist. Consequently, there’s a high probability this batch incurred defective assembly.

Plus, a number of other reasons exist as to why FAI is omitted in the assembly process. Sometimes, assembly engineering gets cocky

and believes a certain board is so simple, so easy to correctly manufacture, there’s no reason to spend time and money on FAI. Other times, avoiding FAI is due to pure callousness and laziness. In these cases, assembly personnel don’t want machine downtime. A machine might be down for three to five hours while FAI is performed and this means another project is left idle and waiting.

Reputable CMs and EMS providers, on the other hand, implement FAI as standard practice with a positive mindset of creating whatever is needed at the end of the FAI process. FAI is imperative because, as Franklin said, “An ounce of prevention is worth a pound of cure.” **SMT**



Zulki Khan is the founder and president of NexLogic Technologies, Inc., in San Jose, California, an ISO 9001:2008-certified company, ISO 13485-certified for manufacturing medical devices and a RoHS-compliant EMS provider. Prior to NexLogic, Khan was general manager for Imagineering, Inc. in Schaumburg, Illinois. He has also worked on high-speed PCB designs with signal integrity analysis. He holds a B.S. in EE from NED University in Karachi, Pakistan, and an M.B.A. from the University of Iowa. He is a frequent author of contributed articles to EMS industry publications.

A Breakthrough in Board-level Photonics

Dow Corning and IBM scientists are using a new type of polymer material to transmit light instead of electrical signals within supercomputers and data centers. This new silicone-based material offers better physical properties, including robustness and flexibility.

With exabytes of structured and unstructured data growing annually at 60%, scientists have been researching a range of technological advancements to drastically reduce the energy required to move all that data from the processor to the PCB within a computer. Optical in-

terconnect technology offers bandwidth and power efficiency advantages compared to established electrical signaling.

“Polymer waveguides provide an integrated means to route optical signals similar to how copper lines route electrical signals,” explains Dr. Bert Jan Offrein, IBM Research. “Our design is highly flexible, resistant to high temperatures and has strong adhesion properties—these waveguides were designed with no compromises.”

Scientists for the first time fabricated thin sheets of optical waveguide that show no curling and can bend to a 1-mm radius and is stable at extreme operating conditions including 85% humidity and 85°C. This new polymer offers an optimized combination of properties for integration in established electrical PCB technology.

For more information, [click here](#).

TOP TEN

SMTonline
News

Most-Read News Highlights from SMTonline this Month

① **Plexus' Fiscal 1Q13 Revenue Meets Guidance**

Dean Foate, president and CEO, commented, "Our revenue of \$531 million and diluted EPS of \$0.47 was consistent with our updated guidance issued on January 7, 2013. Relative to our original expectations, manufacturing demand softened across all of our sectors during the quarter, particularly for our networking/communications sector in the final few weeks."

② **Jabil Expands, Acquires Nypro**

"The combination with Nypro will extend Jabil's materials manufacturing capabilities into the healthcare and consumer packaging markets as well as add depth to our consumer electronics business," said Timothy L. Main, chairman and CEO. "We think this is an important strategic step in Jabil's development of engineering and capability intensive businesses. Combining Nypro's capabilities and market presence with Jabil's global scale and expertise should result in great things for customers, employees, and investors."

③ **Budget Cuts Slash CTS EMS Sales**

Commenting on fourth quarter 2012 results, Vinod M. Khilnani, executive chairman, stated, "We are pleased with our improved gross margins and strong cash flows despite continued weakness in EMS sales. We completed several restructuring initiatives and further improved our global footprint and cost structure. Our new smart actuator for commercial diesel engines, which was launched late in the fourth quarter, will be transformational to CTS as this product alone will provide over \$40 million in annual sales at full ramp, to a new customer in new markets."

④ **Flextronics Reports Q3 Sales of \$6 Billion**

"It is clear that the macroeconomic environment is challenging with limited visibility and many economic risks remain. We are aggressively optimizing our operating footprint and improving our cost structure to better position us for our multi-billion-dollar pipeline of recent bookings, and the eventual improvement in the business environment," said Mike McNamara, CEO.

5 ACW to Sell China Facilities

Chris Woods, founder, commented, "In a notoriously difficult environment for Western businesses to establish themselves, these Chinese companies could save a buyer at least three years in establishing operations of such complexity. The facilities in our Zhuhai operation are comparable to top OEMs and global contract manufacturers, and we anticipate a fast sale."

6 IEC Disappointed with 1Q13 Results

W. Barry Gilbert, chairman of the board and CEO, stated, "Q1 of 2013 was disappointing. Entering the quarter we expected to exceed our 1Q fiscal 2012 and our 4Q fiscal 2012 performance, despite a shifting mix of business and softening demand from some of our industrial customers. At the time, we expected that some new programs, which were ramping up, would absorb much of the envisioned shortfall."

7 Sanmina's Q1 Revenue Below Expectation

"First quarter revenue and EPS were below expectations due to weak demand across most of our market segments," stated Jure Sola, chairman and CEO. "Our second quarter guidance reflects seasonality along with continued uncertainty in the macro-environment. Based on the pipeline of new business opportunities and the ramping of new programs in fiscal 2013, we should see improvements in the second half of the year."

8 EMS Transactions Down in 2012

Twenty-nine EMS transactions were completed in 2012, down from 32 recorded in 2011. EMS consolidations were the most common type of transaction with 14 transactions in 2012, or 48% of total activity, compared to 15 transactions in 2011 which represented 47% of activity last year.

9 IPC Standard Expands Focus on Mechanical Reliability

Design, assembly, inspection, and repair personnel have a new tool to help improve reliability of ball grid arrays (BGAs) and fine-pitch ball grid arrays (FBGAs) in high-density applications, thanks to the newly-released C revision of IPC-7095, Design and Assembly Process Implementation for BGAs. IPC-7095C addresses design and process considerations of particular importance to portable handheld products in which BGAs are a dominant interconnection technology.

10 OnCore Opens Medical Center-of-Excellence

"For over 20 years the medical device market has been one of the three markets OnCore was created to serve. The company has continually enhanced the services offered our medical customers to address their evolving product life cycle requirements. OnCore's Medical COE makes it easier for our customers to engage the breadth of existing and expanded services by providing a 'one-stop-shop,'" said Sajjad Malik, president and CEO.

A man in a dark suit and light-colored shirt is holding a tablet computer. The screen of the tablet displays the 'SMT NEWS' website, which features various articles, images, and a sidebar. The man is looking directly at the camera with a serious expression.

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Application of Printed, Organic & Flexible Electronics

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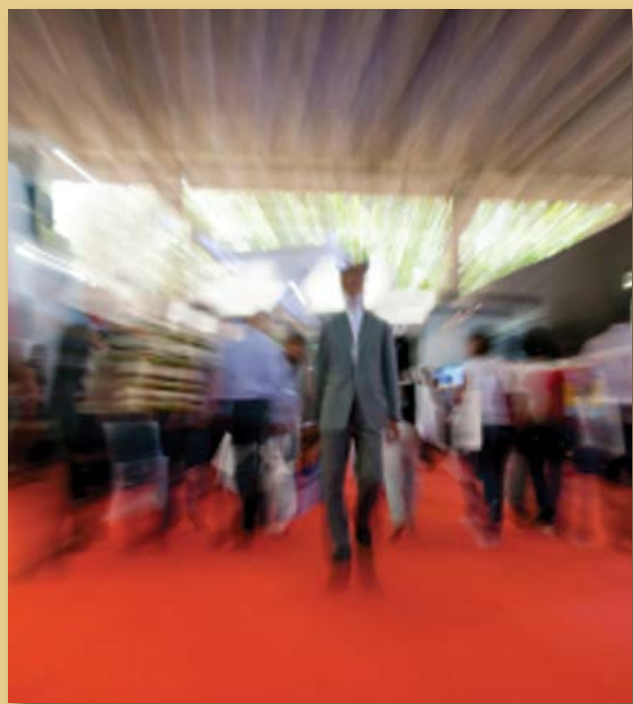
April 17-18, 2013
Berlin, Germany

South East Asia Technical Training Conference on Electronics Assembly Technologies 2013

April 17-19, 2013
Penang, Malaysia

2013 Defense, Security, and Sensing Exhibition

April 29-May 3, 2013
Baltimore, Maryland



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Next Month in SMT Magazine

The April issue of *SMT Magazine* will address paste printing and component placement, including stencils, paste printing/dispensing, component handling, ESD control, component placement, and odd-form placement.

The issue will feature 3M's James T. Adams, explaining how to find the perfect cover tape; Dr. Bill Coleman, vice president of technology at Photo Stencil, addressing the stencil printing of small apertures; and many more articles and columns from industry experts, including Dr. Jennie S. Hwang, Zulki Khan, Chris Torrioni, Karla Osorno and Michael Ford.

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See you in April!