

THE PCB DESIGN MAGAZINE

December 2016

an IConnect007 publication

Much Ado about Sales
and Marketing p.12

Marketing in the
Maturing EDA Industry
p.18

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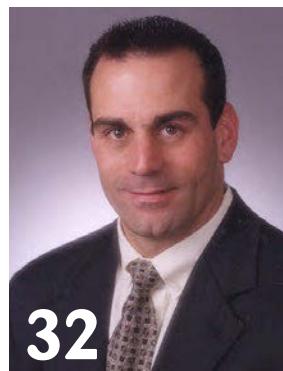
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Feature Content



Sales and Marketing

Sales and marketing in the PCB industry used to be fairly simple. Salespeople cold-called potential customers until they found a buyer, and marketing professionals stressed the importance of attending trade shows and writing conference papers. Then came the Internet, LinkedIn, Facebook, and Twitter. What approaches should you use?

- 12 Much Ado about Sales and Marketing**
by the I-Connect007 Research Team

- 32 Sales and Marketing with DownStream**
Interview with Rick Almeida

- 36 Flex and Rigid Sales and Marketing with Al Wasserzug**
Interview – Cirexx International

- 40 Altium's Sales Plan: Deal Directly with Designers**
Interview with Lawrence Romine

- 44 Five New Books that Will Change Your Perspective on Sales and Marketing**
by Dan Beaulieu

FEATURE COLUMNS

- 18 Marketing in the Maturing EDA Industry**
by Barry Olney

- 26 How Selling EDA Software Has Changed...or Not**
by Abby Monaco

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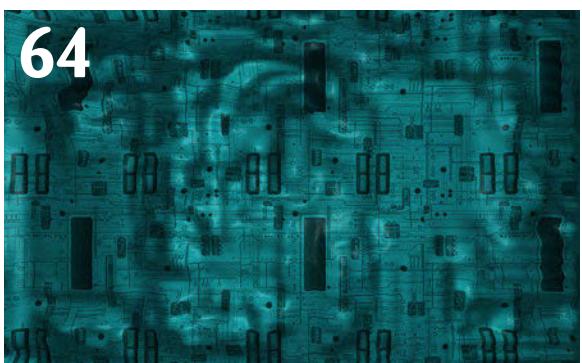
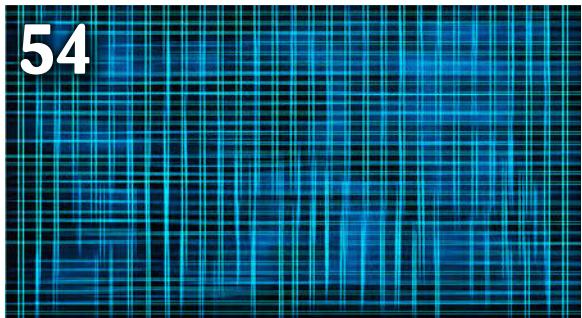
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HIGHLIGHTS

- 52 PCB007
- 58 MilAero007
- 68 Top Ten PCBDesign007

DEPARTMENTS

- 70 Events Calendar
- 71 Advertisers Index & Masthead

More Content

COLUMNS

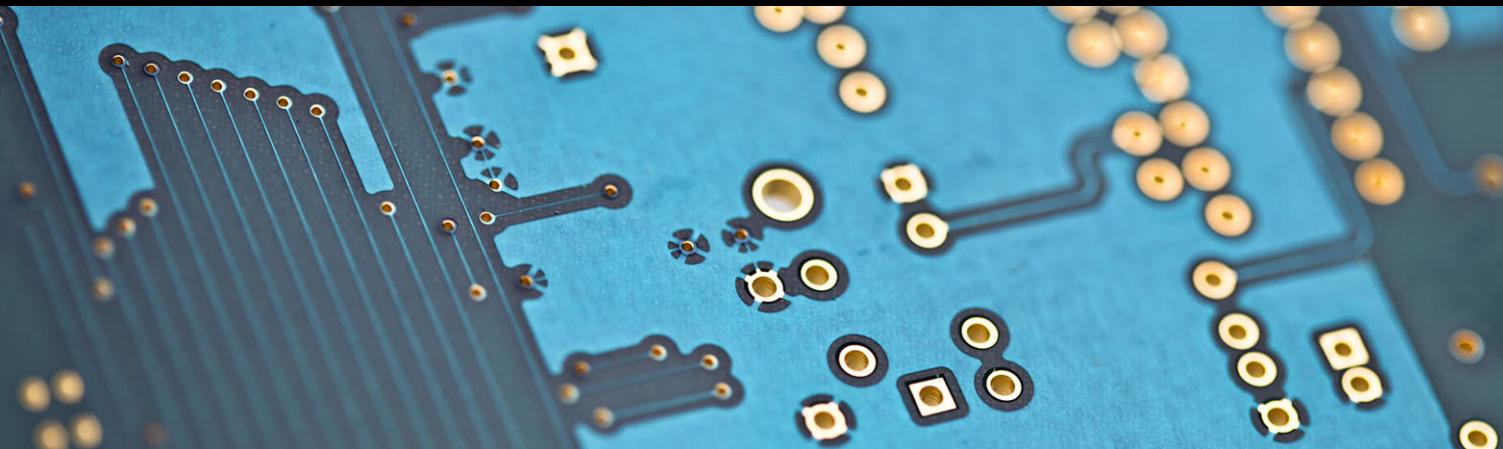
- 8 Sales and Marketing in PCB Design
by Andy Shaughnessy
- 54 PCB-Based Antennas and PIM Concerns
by John Coonrod
- 60 “Sparks” to the Rescue in RF Design
by Tim Haag
- 64 Understanding the Practicalities of Resin Application and Curing
by Alistair Little

SHORTS

- 10 Researchers Peer into Atom-sized Tunnels in Hunt for Better Battery
- 16 Tuning Magnetic Properties for Better Data Storage
- 24 Graphene Calligraphy
- 35 Paper-Based Skin Patch Monitors Dehydration
- 39 Screening of Databases is the Basis for Developing New Energy Materials
- 42 Novel Microsupercapacitor Exploits Three-Dimensional Porous Electrodes
- 50 LED Solution: An Opportunity to Stand out Through Design & Additional Functionalities



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Sales and Marketing in PCB Design

by Andy Shaughnessy

I-CONNECT007

Sales in the electronics industry used to be so simple: You started cold-calling and you called until you made a sale. Ditto for marketing: Your company attended and exhibited at trade shows, presented papers at conferences, and (hopefully) you advertised in the trade publications of your choice. And if you were selling EDA tools, you flew around the globe doing presentations.

Sometimes you salespeople even acquired some "hot leads" à la David Mamet's fine movie "Glengarry Glen Ross." (That movie should be required viewing for anyone in sales.) But still, it all came down to cold-calling.

All of those methods are still being used today. But in just the last decade, sales and market-

ing pros have gained an abundance of constantly evolving social media tools to help them ply their trades. LinkedIn, Twitter, and Facebook seem to be the most popular in the PCB landscape, especially among the more "techie" users.

But many of you are, ahem, veterans of this industry. When you turned 18 you voted for Nixon or Carter. Are you really going to learn every new social media tool? If you're in sales, you may have to.

Yes, your toolbox has a lot more tools in it. But selling and marketing hasn't gotten any easier, especially with millennials coming into the workplace. I've heard horror stories about young people blowing off appointments and refusing to

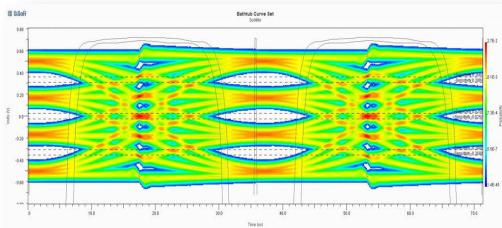


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answer emails from sales types. And they are the future of this industry, whether we like it or not.

The old saying, "Sales is like fishing out of a boat, but marketing is like convincing the fish to jump into the boat with you," still applies. You still have to reach out to potential customers any way you can. You still have to tell your company's story, and sell that story, any way you can.

So, this month we shine a light on sales and marketing in this industry. Naturally, we began with a survey. The survey results were surprising, especially when some respondents admitted that their company had no sales or marketing plan at all. They just winged it. I wonder how that's working? The results can be found in the article "Much Ado about Sales and Marketing."

Then we asked five contributors to share their take on selling and marketing in PCB design. In our cover story, Barry Olney of In-Circuit Design Pty Ltd explains how EDA sales and marketing techniques have evolved as EDA has matured, and he traces the drop in tool cost over time, along with the increase in tool capabilities. Next, Abby Monaco of Intercept Technology discusses how the Internet and social media have enabled salespeople to target exactly the right buyer, to the point that a salesperson already knows what kind of tool you need before he ever makes direct contact with you. She also

focuses on the near-death of the single-vendor software solution.

In an interview, DownStream Technologies founder Rick Almeida explains his sales and marketing philosophy, and DownStream's use of direct sales, telesales and value-added resellers. Al Wasserzug of Cirexx International focuses on the sales and marketing techniques that are specific to flex circuits, as well as rigid PCBs. And Lawrence Romine of Altium discusses the company's philosophy of selling directly to the PCB designer, not the suits in the C suite, and how Altium manages to gain market share without necessarily converting existing users of a rival's toolset.

We also have a great article by columnist Dan Beaulieu. In this piece, Dan reviews his five favorite books on sales and selling. If you're in sales, you'll want to order all five of these, pronto.

Have a great holiday, and I'll be seeing you in 2017! **PCBDESIGN**

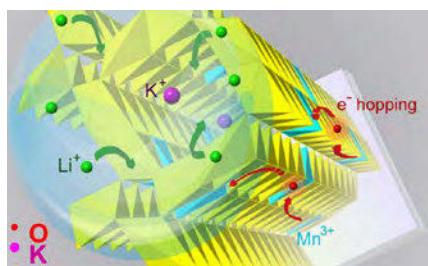


Andy Shaughnessy is managing editor of *The PCB Design Magazine*. He has been covering PCB design for 17 years. He can be reached by clicking [here](#).

Researchers Peer into Atom-sized Tunnels in Hunt for Better Battery

Battery researchers seeking improved electrode materials have focused on "tunneled" structures that make it easier for charge-carrying ions to move in and out of the electrode. Now a team led by a researcher at the University of Illinois at Chicago has shown that certain large ions can hold the tunnels open so that the charge-carrying ions can enter and exit the electrode easily and quickly.

"Significant research has been done to increase the energy density and power density of lithium ion battery systems," says Reza Shahbazian-Yassar, associate professor of mechanical and industrial engineering at UIC.



His team has focused on developing a cathode based on manganese dioxide, a very low-cost and environmentally-friendly material with high storage capacity. Manganese dioxide has a lattice structure with regularly spaced tunnels that allow charge carriers—like lithium ions—to move in and out freely.

The finding shows that tunnel stabilizers can help in the transfer of ions into tunnels and the rate of charge and discharge, Shahbazian-Yassar said.

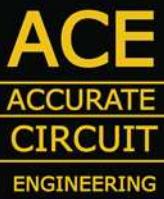
"With potassium ions staying in the center of the tunnels, the capacity retention improves by half under high cycling current, which means the battery can hold on to its capacity for a longer time," he said.

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Much Ado about Sales and Marketing

by I-Connect007 Research Team

We all know that without a concerted sales effort there are no customers, and without customers there is no business. It is also no secret that most companies in the printed circuit board fabrication and assembly businesses have suffered from lack of sales over the years—possibly because company leaders are traditionally technologists, engineers or operations people. And these people have very little, if any interest, in the art of sales and marketing.

In fact, until recently, most companies did not believe in marketing their companies at all—figuring that if they built great products, customers would show up at their door. But times are changing and companies have been forced to focus more on their sales and marketing effort as they realize that they must find new customers and win their business if they are going to live another day.

Realizing that, we at I-Connect007 recently surveyed our readers to get a better idea of what company leaders thought about sales and marketing. We did this for a couple of reasons. First, we were curious; second, we wanted to learn more about our readers, what they need and want, and how to best help them.

We sent this survey to several sales leaders; the results were informative, at times surprising, and even a bit disappointing, especially when some of the participants reported that they had no sales and marketing plan at all. Figures 1 and 2 illustrate the demographics of those who responded.

Primary Business of Respondents

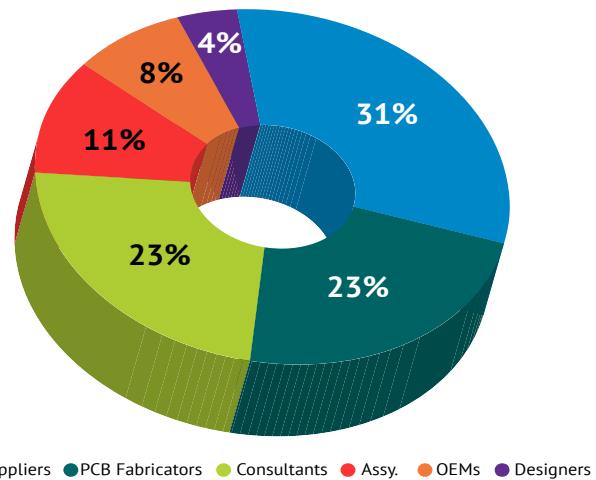


Figure 1: Primary business of respondents of the 2016 I-Connect007 sales and marketing survey.

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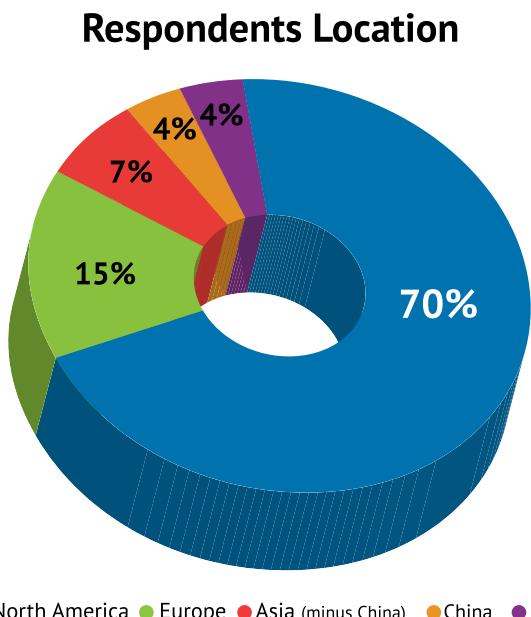


Figure 2: Location of respondents to the sales and marketing survey.

We also asked respondents' titles; more than 60% were in upper management positions ranging from owner/founder to general and business managers. Another 20%+ were in a sales function with the remainder in design, engineering and similar capacities, which indicated that responses were indeed from our intended audience.

The following is a summary of our findings.

1. What's your preference—direct sales people or sales representatives?

Essentially two-thirds of the respondents preferred direct sales, while one-third preferred sales reps. A variety of reasons were named, including:

- You own them and can therefore direct them
- They are better motivated because they sell technology...
- You can control their behavior tied to corporate goals

For the most part, our responders preferred direct salespeople but found them very expensive as opposed to reps.

2. What are the greatest challenges in working with reps?

Results indicated that people felt it was difficult to keep reps focused and working on the product. Also mentioned was making sure reps were properly trained and educated, to ensure complete product knowledge. Other issues mentioned were territory conflicts and distance, forecasting, and loyalty; some of you felt that reps' and company interests were not always fully aligned.

3. What are the greatest challenges in working with direct salespeople?

Some respondents stated no major drawbacks, while many cited the expense of direct salespeople. Motivating direct salespeople to get new business was considered a serious challenge as was lack of technical knowledge. Getting them out of the office was cited as one of the biggest challenges. And there was concern about getting them to sell what you build rather than what you don't build.

4. What is the overall greatest challenge in your sales process?

Representative responses include:

- Getting new accounts
- Price
- Selling against offshore
- Developing a plan and working that plan for results
- Forecasting and budgeting
- The entire lead generation process and making the sales people stick to it

Sadly, albeit truthfully, one person said, "The PCB industry has left the country."

5. How long does it take for you to convert a prospect to a customer?

The conversion-time breakdown can be seen in Figure 3. Generally, the respondents answered around three months to a year to convert a prospect to a customer. Others, meanwhile, said it depends on the scope and complexity of the project, and the qualification process by the customer.

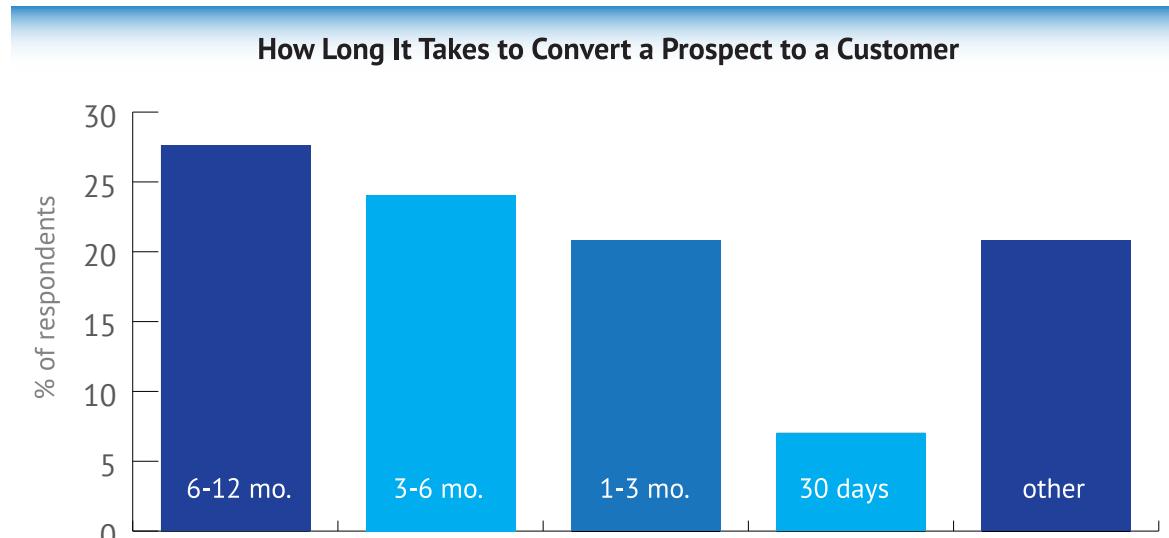


Figure 3: Length of time to convert from prospect to customer.

A few notable comments:

- “Be careful of customers who are too easy to convert.”
- “The larger the longer.”
- “...the day of the first meeting to 2 years.”

6. What advice/strategy would you give a salesperson in this market?

Most of the answers were covered by these comments:

- Treat your job as a career
- Be serious about it
- Know the product
- Shut up and listen
- What your customer says is more important than what you say
- Tell the truth always
- Know your prospects and understand their needs

And one person said, “Find another industry.”

7. Do you have sales training programs for your salespeople?

- Yes: 44%
- No: 56%

A sampling of the comments:

- “A good salesperson does not follow a canned approach.”
- “Some inside training and some outside training depending on the individuals.”
- “No sales department.”
- “We have a PPT training program covering every aspect of the sales from lead generation to...the first sales call... to winning the first quote, etc.”

8. How did you develop your sales plan?

The responses included:

- “We don’t have one.”
- “Our plan is to sell more.”
- “It’s confidential.”
- “President comes up with an idea of what to sell.... the rest of the team comes up with what the customer really wants.”
- “Doing a line by line analysis with the right people.”
- “Many years of experience.”

9. How do you target or select your customers?

We got quite a range of answers:

- “Poorly”
- “Develop ideal customer profile and use it as a filter”

- “Industry segments”
- “360-degree assessment”
- “Based on needs”
- “Type of products they need”
- “End-market segment”
- “Targeting specific organizations and applications”
- “Trade shows”
- “Target our competitors’ customers”
- “Face-to-face meetings”

We’re not quite sure if the question wasn’t clear or if perhaps there is not much real targeting going on.

10. What are the top three attributes of a great salesperson?

Responses were a variation of some great attributes:

- Hard working
- Passionate
- Trustworthy
- Honest
- Knowledgeable
- Motivated
- Relationship-oriented
- Aware of the importance of closing
- Personable
- Strategically minded
- Persevering

11. What do you think are the most effective sales strategies to use?

This question had the greatest number of responses, with most distilled into this list:

- Demand hard work
- Utilize direct sales calls
- Funnel
- Understand your capabilities
- Mention value, not price
- Offer a solution to the problem
- Pay them well and receive results
- Create a landmine map
- Trust them
- Measure and support the team to obtain goals

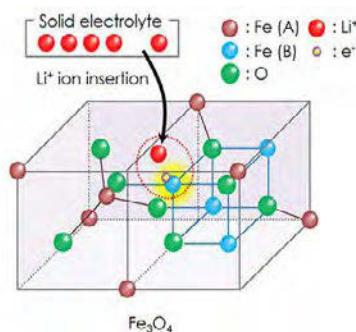
Conclusion

Although the results of this survey show that we still have a long way to go to be a sales-driven industry, it also reflects a growing interest in sales and marketing. We received many more serious and thoughtful answers than not and detected common themes among the various stated company philosophies, which we found interesting. Overall, results indicated a great deal more focus on knowing the product and the customers than we have found in past surveys, which means that our industry is taking sales and marketing seriously—and that’s a very good thing. **PCBDESIGN**

Tuning Magnetic Properties for Better Data Storage

The ever-increasing amounts of electronic data that we generate in our personal and professional lives require new storage technologies that can fit lots of data into small physical spaces. The most promising solutions include solid-state redox devices, which work by controlling the magnetic properties of materials.

Now, Tsuchiya, Terabe, and Aono at the International Center for Materials Nanoarchitectonics, NIMS and co-workers have developed a new



solid-state device in which several magnetic and electrical properties can be changed and reversed by inserting and removing ions.

The team believes that their device could pave the way for spintronics—novel devices that exploit not only the charges on electrons but also the intrinsic angular momentum, or spin, that is predicted by quantum mechanics. The new device contains a thin film made from the iron oxide magnetite (Fe_3O_4) next to a layer of lithium silicate.

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Marketing in the Maturing EDA Industry

by Barry Olney

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The EDA industry has evolved from its humble, free-for-all, Wild West beginnings into a mature industry employing a record 35,000 professionals and turning over a staggering \$2 billion per quarter. Whilst the Americas market is still recovering, Asia-Pacific and Japan have experienced double digit growth. But Europe, the Middle East and Africa (EMEA) have experienced a downturn over the past quarter.

Cadence Design Systems, Mentor Graphics, and Synopsys, a.k.a. "The EDA Big Three," have realized significant growth in IC design and signoff and the functional verification sectors. However, revenue for the PCB segment grew just 5.3% in 2014 to \$853.1 million. The rev-

enue comparison of these leading EDA companies is shown in Figure 1.

Although only a small part of the total EDA revenue, the PCB sector has a different pecking order: Mentor Graphics, Cadence, Zuken, Altium, Pulsonix, Intercept Technology and CadSoft. Mentor, Cadence and Zuken are all competing in the enterprise and the mainstream markets and all have double-digit market share. In terms of seat count, Altium, the relative new kid in town, is lower in the spectrum, but positioning themselves into enterprise-level solutions.

There are also many free or low-cost PCB applications available such as KiCad, DipTrace, Toporouter, DesignSpark, CircuitMaker, PCB123 and PCB Artist, just to name a few. But these packages mainly cater to the electronics enthusiast or entry-level market.

The major EDA revenue streams come from the following operations:

- Perpetual and term licensing of EDA software and intellectual property
- Software support and post-contract maintenance
- Professional services, including consulting and training

EDA companies generally innovate through acquisitions and mergers as it is easier to buy new technology than expend time and resources developing a product and risk losing market

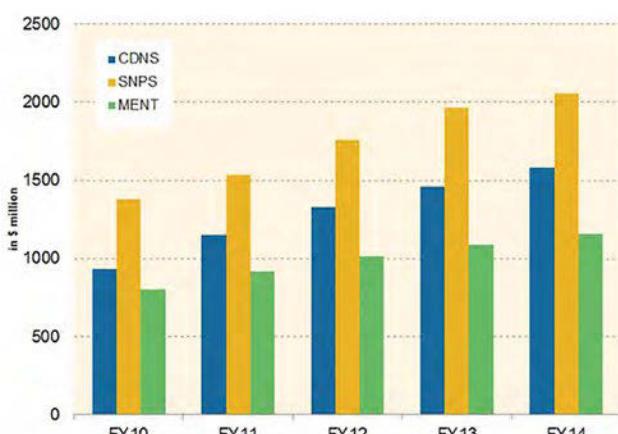


Figure 1: Revenue comparison of major EDA companies (source: Cadence 10-K filings).

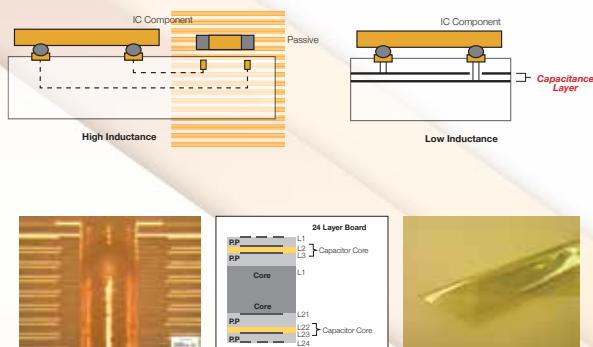
	Mentor Graphics	Cadence	Zuken	Altium	Pulsonix	Intercept	Cadsoft
Enterprise	Xpedition Multiboard	Allegro	CR-8000				
Mainstream	PADS Professional	OrCAD PCB SI	CR-5000				
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Table 1: Professional PCB design software tools.

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share. However, some tend to focus on partnering with other EDA vendors rather than acquisition. But this leaves them vulnerable to outside influence. Many small EDA start-ups develop niche technology, an innovation that adds value in a specific area. But their fast growth soon reaches a burn-rate threshold whereby their momentum can no longer be sustained. These companies are ripe for the picking, as their technology can be merged into existing applications to provide an end-to-end solution.

“The EDA industry is very competitive and is characterized by strong leadership positions in specific segments of the EDA market.”

The EDA industry is very competitive and is characterized by strong leadership positions in specific segments of the EDA market. These strong leadership positions can be maintained for significant periods of time as the software can be difficult to master and customers are disinclined to make changes once their employees, and others in the industry, have developed familiarity with a particular software product. For these reasons, much of the profitability arises from areas in which a vendor is the market leader. These industries can be cyclical and are subject to constant and rapid technological change and product obsolescence, price erosion, evolving standards, short product life cycles, wide fluctuations in product supply and demand, and industry consolidation.

If you consider the history of any EDA company, you will see multiple acquisitions and mergers over the years. The technology was once an expensive, difficult to use and administer, UNIX-based dinosaur. I recall having to pay in the order of \$100k per seat, for such systems, only to find multiple bugs. I guess the real breakthrough was back in 1995 when the Windows

NT operating system came of age, and was able to support large databases with huge memory requirements giving us a low-cost alternative to UNIX applications.

The thought of changing vendors, with no way to port libraries and databases, was a nightmare. And when you finally bite the bullet and purchased new software, it was often worse than the previous solution, plus it had an extended learning curve. Fortunately, EDA companies have cleaned up their act and are now providing feature-rich tools, capable of analyzing and designing extremely complex products.

The EDA vendors are working hard to keep up with the changing needs of their customers. Failure to respond quickly to technological developments or customers' increasing technological requirements could make their products uncompetitive and obsolete.

The early market is dominated by innovators and visionaries who will pay top dollar for new technology, allowing complex and expensive competitive tools to thrive. However, the mainstream market waits for the technology to be proven before jumping in. For instance, power distribution network (PDN) planning was previously overlooked during the design process but it is now becoming an essential part of PCB design.

The mainstream market, representing more than 65% of the total EDA software market (Figure 2), demands established technology at an affordable price. Most enterprise tools require a high level of expertise to drive. Enterprise tools differentiate based on the size of the team (more people equals faster design, usually), and specialization within the team (e.g., SI/PI, DFM, thermal engineering, etc). The specialist uses only a few tools, so he can learn them well and live with ease-of-use issues easier than a mainstream engineer. However, the mainstream market demands tools that are intuitive and can be used by any member of the development team from EEs to PCB designers to achieve quick results.

The major EDA companies, who once only sold enterprise-level solutions, now also provide entry-level and mid-range tools with highly productive features at very competitive prices. It is amazing how much bang you get

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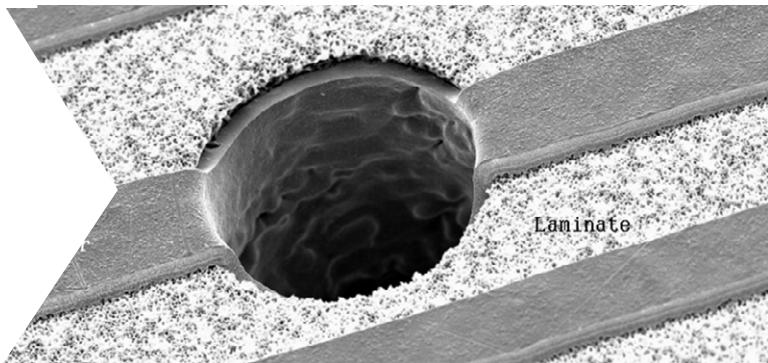
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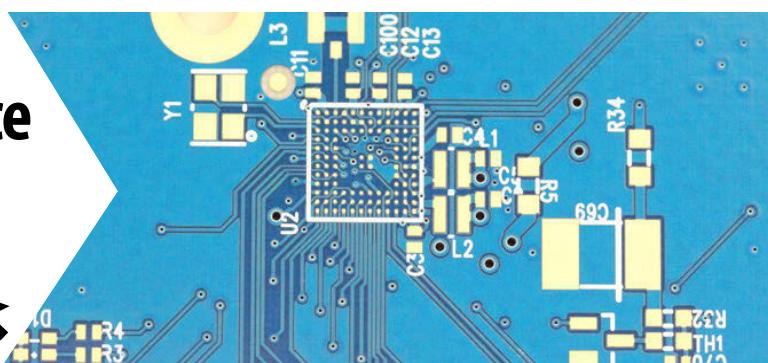
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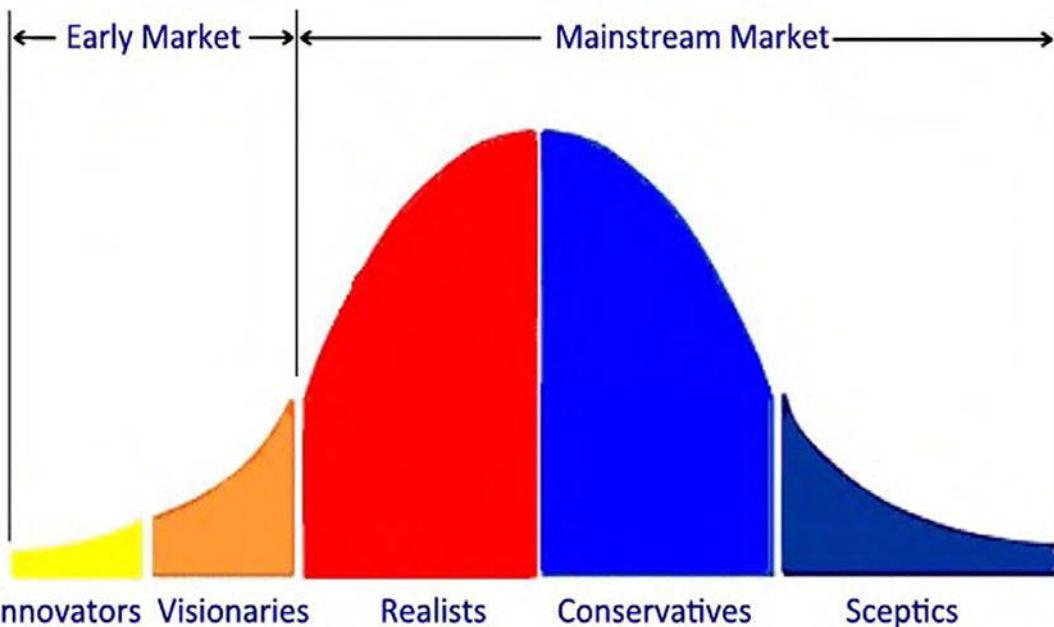


Figure 2: Technology adoption life cycle (source:Crossing the Chasm).

for your buck. Today, the PCB design process entails much more than just schematic capture and PCB layout. With increasing complexity in electronics systems, engineers need to develop with the whole product in mind. Having access to a design tool that encompasses PCB design, coupled with comprehensive simulation and analysis, really gives design engineers the confidence that their products will be delivered on schedule and at the highest performance and reliability. Also, as electronics becomes smaller, faster and more densely packed, engineers are compelled to consider virtual prototyping to meet stringent schedules.

Small and medium enterprise (SME) companies now dominate the EDA market and as the number of global customers builds, the prices of the technology drop as it can be spread across the larger user base. Over the years, the cost of ownership has dropped from ~\$100,000 to ~\$15,000 per seat with even more advanced features. This is no doubt great for the customer, but not so for the EDA company and their global reseller network. From a salesperson's point of view, they now have to put in a similar amount of effort for far less reward.

Price competition in the EDA industry is intense, which can lead to price reductions, lon-

ger selling cycles, lower product margins, loss of market share, and additional working capital requirements. If competitors offer significant discounts on certain products, then other vendors may need to lower their prices or offer other favorable terms to compete successfully.

Any broad-based changes in pricing policies could cause new license and service revenues to decline or be delayed as the sales force implements these changes and the customers adjust to the new pricing policies. Some of the competitors may bundle certain software or hardware products with other more desirable products at lower prices or no marginal cost for promotional purposes as a long-term pricing strategy, or engage in predatory pricing.

EDA vendors promote their products and services through advertising, marketing automation, trade shows, public relations and the internet. They generally market their products and provide services to existing and prospective customers through a direct sales force consisting of sales people and applications engineers. They also selectively utilize value-added resellers to broaden their reach (especially internationally) and reduce cost of sales.

At the enterprise level, where huge profits can still be realized, months of sales and engi-

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personal automated design solutions

neering effort can be invested in a sale that may eventuate in multiple seats globally. The complexity and expense, associated with EDA products and services, generally require a lengthy customer education, evaluation and approval process and greatly depend on the customers' budgetary constraints and budget cycles. These salespeople use target account selling techniques to break into the closed circle of influence within a company to close the sale. However, at the SME level, this amount of effect can no longer be justified. So the lower-level sales are more a numbers game, where profit margins are much tighter. Rather than make sales visits to a prospective company, vendors now easily demonstrate online and market via public webinars.

While most design is now performed by the SME companies who now dominate the EDA market, EDA tools must evolve to satisfy the challenging needs of today's engineers and PCB designers. The latest EDA offerings provide highly productive tools for the ever-increasing number of global users, at an affordable price point. Really, it has never been better! **PCBDESIGN**

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Barry Olney is Managing Director of In-Circuit Design Pty Ltd (iCD), Australia. The company is a PCB design service bureau that specializes in board-level simulation. iCD developed the iCD Stackup Planner and iCD PDN Planner software. Visit www.icd.com.au.

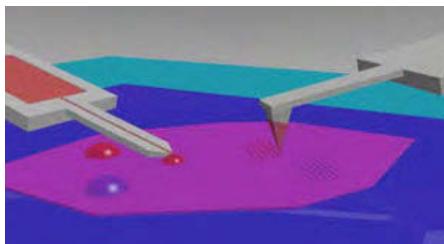
Graphene Calligraphy

Scientists at The University of Manchester and Karlsruhe Institute of Technology have demonstrated a method to chemically modify small regions of graphene with high precision, leading to extreme miniaturisation of chemical and biological sensors.

Writing in ACS Applied Materials & Interfaces, researchers led by Dr. Aravind Vijayaraghavan have shown that it is possible to combine graphene with chemical and biological molecules and form patterns, which are 100s of nanometres wide.

Graphene is the world's first two-dimensional material. It is strong, transparent, flexible and the world's most conductive material. Every atom in graphene is exposed to its environment, allowing it to sense changes in its surroundings.

Using technology that resembles writing with a quill or fountain pen, the scientists were able to deliver chemical droplets to the surface of gra-



phene in very small volumes. In order to achieve such fine chemical patterns, the researchers used droplets of chemicals less than 100 attolitres (10-16 L) in volume; that's 1/10,000,000,000,000th of a litre.

Two types of 'pens' were used, one which is dipped into the reactive 'ink' like a quill to cover the nib, and the other where the ink is filled into a reservoir and flows through a channel in the nib, just like in a fountain pen. An array of such micro-pens are moved over the graphene surface to deliver the chemical droplets which react with the graphene.

These techniques are key to enabling graphene sensors which can be used in real-world applications; graphene sensors fabricated this way have the potential to be used in blood tests, minimising the amount of blood a patient is required to give.

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How Selling EDA Software Has Changed...or Not

by Abby Monaco

INTERCEPT TECHNOLOGY

If at first you don't succeed, try, try again.
—William E. Hickson

Hickson, an elementary education reformer, popularized this proverb in the 1800s, but over a century later, it crisply sums up the art of sales and selling. There is a constantly expanding list of sales methods, theories, and strategies, but none of them mean a thing unless a salesman has the tenacity to keep trying.

Let's look at how sales and marketing in the PCB world have evolved over time.

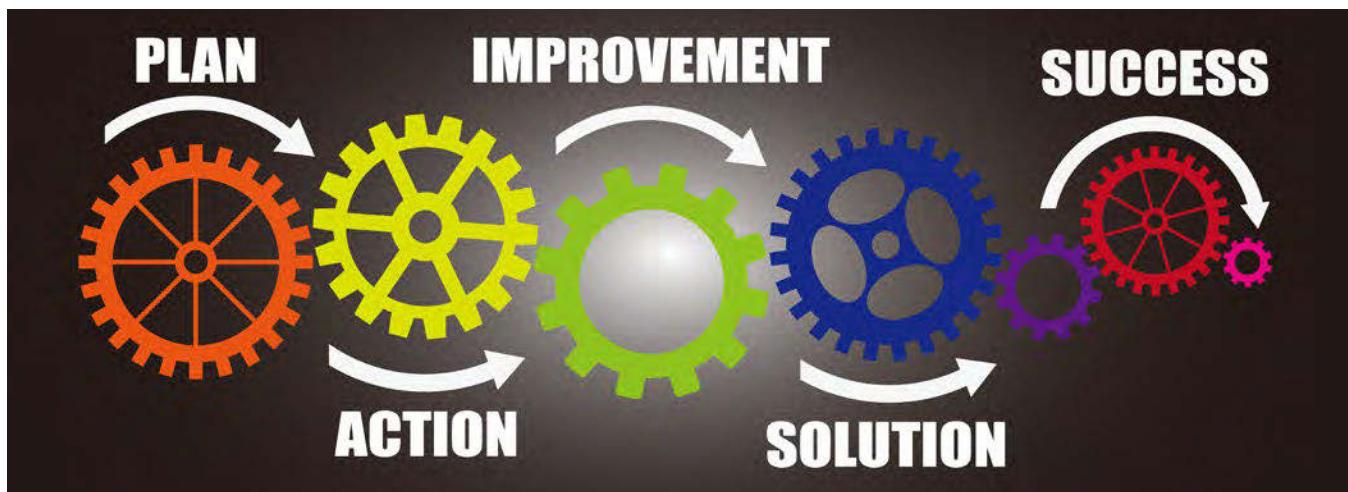
Marketing & Advertising

Prior to the boom in digital and mobile devices, print was the overwhelming vehicle for getting one's name out there. Every vendor competed for ad space. Sales and marketing personnel fought over ownership of such ad space, and large amounts of sales revenue went right back into funding the designing and displaying of these ads. Everyone knew that the cover, inside cover, and back cover were pure gold as far as getting name recognition and sales leads, and the spaces were coveted and closely watched. Good ads and bad ads generated industry con-

versation. (Who remembers the Bunny ad campaign?)

Alongside advertising in print publications, postcard mailers were regularly distributed. Industry trade shows were full of buyers, often with transactions occurring on the show floor. Trade show booths were huge affairs that took days to assemble, with side rooms for negotiations and contract signing. Potential leads were showered with gifts both during and after the shows.

Outside of the shows, phone calls were common and pre-sale face to face meetings and demos were expected. It was not at all surprising for a software vendor to receive several telephone inquiries each day about the software. Inbound leads were commonplace, mostly because there was barely any competition in the EDA marketplace at the time. Prior to the rise of cheap hardware and easy-to-use Windows-based user interfaces, there weren't many options for PCB designers, and certainly none that were affordable. When these engineers and designers saw advertisements in trade publications, a lot of them were excited to know there was another option out there.



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But with the rise of Google, Internet 2.0, and later, HTML5, marketing and advertising have become a much more complicated affair. The rise of digital advertising creates a new, more complicated matter: how to be heard above all the noise. The Internet has seen such proliferation of advertising that we are all numb to it, annoyed by it, and actively trying to block it from our view. Print and digital advertising are an obligation for generating brand awareness in an industry, but they are no longer viewed as a method by which to gain an interested prospect. They are carefully measured for page impressions and clicks, and the price of each lead is separated into “cold” and “warm” leads, making simple print and digital advertising more expensive as the real leads dwindle into the ether.

“The Internet is full of information that can be researched without making any human contact.”

The reality is that these coveted leads are human beings who are now able to educate themselves about their options long before a software vendor might know they are interested. The Internet is full of information that can be researched without making any human contact. In response, advertising and marketing have entered the big data phase, whereby every click and every web page visited is tracked. Your email address can be sent specifically tailored messages about whatever you've been clicking on, in an effort to shorten the lead-to-sales cycle. Keywords entered into Google searches are regularly culled and content on websites amended to include those search words. More often than not, Google tops the list of how leads ultimately visit a company's website for information—not those carefully placed digital ads, blog posts, tweets, and Facebook updates.

As salesmen and marketers are honing their skills and tracking these bits of data, we are all

becoming less and less involved with one another as human beings. Each person becomes bytes of data to be chased down until they are forced to make some kind of contact. But even this contact point is in the form of more clicks, signups to receive demos or white papers, registrations to download free software trials. We have all grown accustomed to avoiding sales people until we feel prepared for the pitch, as opposed to going in blind and listening from start to finish. By the time we decide to reach out to a live voice, that live voice most likely already knows the questions we're going to ask, and is prepared with the answers.

The fallout of this ultra-digital experience is that some people are actually returning to the old-school methods and simply picking up the phone to chat. Email is becoming tired and cumbersome, whereas online chat or a simple phone call has become quicker and easier than dealing with the world of digital noise. The time it takes to write an email and receive a response is a noticeable drain, and only serves to fracture our already bombarded attention spans.

Sales and marketing exist to reach customers and bring in sales revenue. But they are now trying to reach each customer on a tailored, customized, and very personal level. While this approach is labor-intensive for sales and marketing teams, it serves the customers nicely, and there is proven success with these data-driven methods. One aspect that bears further study is figuring out how much a company spends on database management systems, content delivery, and salaries of the people who know how to do this effectively, and how much that eats into the overall profits when leads do turn into sales. Are profits being exhausted just to get that new sale, or is it paying off in the long run?

Product Pricing & Bundling

In the past (and occasionally now), the “single vendor software solution” was the main paradigm in EDA software tools. Companies demanded that all design teams run the same software, often causing huge internal fights that would end with people resigning their positions over loyalty to a software vendor.

Big companies would shop around when a contract was up, sending each software vendor

a list of prerequisites and requesting a response to each item, usually by checking off each box. OEMs would demand that software developers give them the “check in the box,” regardless of how usable the actual solution might be. The bottom line was the sale didn’t go through without all the checks in place, mostly because the people signing over the purchase money had no idea that half those checks might be half-finished software functions. Sometimes the buyers would figure out which checks were real through the demo process, but sometimes not.

Of course, the level of integrity of the responses to these lists was particular to each vendor. But more often than not, vendors suffered from the lower common denominator’s desire to win sales over providing solid and forward moving solutions for engineers and designers. There were even some vendors in the mix that were built only on checking every box, creating a fissure between the managers making such purchases and the actual designers trying to use software that barely functioned. Whether the selected software solution was appropriate for the actual design group became a difficult issue, and this disconnect remains, even today.

Alongside the mainstream use of “the list,” there were a few different methods of product pricing and bundling that made competition stiff among EDA vendors. Software vendors with a lot of development resources went with a method routinely referred to as “the whole kitchen sink,” whereby users were handed software with so many options that they often couldn’t figure out how to get the job done. This “kitchen sink” approach was a way to justify the high prices of the software and entice managers to sign a deal even though a good 85% of what they were purchasing was either unusable or not needed. Software vendors and developers became so caught up in the number of extras they could throw into the sale that they lost sight of their real objective: improving the mainstream user flow so that the design job could be done more smoothly.

This approach worked fairly well when the market was able to support high prices for EDA software. But as heads were turned trying to offer this or that extra option to be more appealing than the competition, lower-cost solu-



Abby Monaco celebrates after running in the 2016 New Orleans Rock and Roll Marathon.

tions sneaked into the market. These solutions competed well because they had fresher user interfaces using newer coding methods, so they appealed simply by the way they looked and felt to the user. These solutions didn’t focus on offering “the whole kitchen sink.” Rather, they got the job done in an easier-to-use application package. With the entry of lower level solutions, the market place suddenly had to get smarter about pricing and bundling to win sales.

As the industry scrambled to create this or that package deal, or tiered pricing bundle to appeal to whatever end of the market a designer might fall into, a major change ensued that is worthy of note: *The value of the intellectual property and development work that was put into the product was no longer the driving force of the price set for the product.*

The high prices that the industry enjoyed in its early days began to fall, causing much concern among software vendors because the profit margin per sale was slipping. In our replacement market, this is very concerning, because the only way to make up for this profit is to bring in a large amount of new sales at this lower price. Volume sales suddenly became the rule, in a market that isn't exactly growing in leaps and bounds.

The New Normal

So here we are now. We are suffering from an ever-widening gap between the high-end design software used to push the envelope of the EDA industry, and the lower-to-middle end-market of designers who are trying to keep up with market demands for electronic products. EDA software companies are trying to diversify their offerings to make up for lost profits, and the nature of the business has become much more complex.

“**EDA software companies are trying to diversify their offerings to make up for lost profits, and the nature of the business has become much more complex.**”

The complexity lies here: All the software vendors' design tools can take a board design from conception to manufacture. But each vendor provides its own set of unique strengths or weaknesses that make it either perfect for one company's flavor of designs, or not so perfect. There is also the question of time-to-market versus cost of time-to-market.

Engineering managers often overlook one aspect of cost: They try to save money with a \$10,000 seat of design software, but they often wind up paying a designer four times that in man-hours spent using software that lacks functionality. After paying the designer for his time, you still wonder if this budget software caught all of the manufacturing defects. But if you pay

\$25,000 for a seat of software for that PCB designer to produce a design in half the time, with fewer headaches and a greater likelihood of zero design defects, the money spent up front often pays for itself many times over.

This fact is often lost on engineering managers because of that age-old problem: There is a disconnect between what designers want and what their managers give them.

Where Are We Now?

It's a difficult market out there for EDA software vendors. It's glutted with some great players. This means that it's a great time for PCB designers and engineers. Picking and choosing among EDA software vendors to find just the right mix is creating a shift away from the single vendor solution that was so important not too long ago. If one designer can cut design time in half or more by using a software application that he knows inside and out, managers today seem more willing to allow him to use that application instead of the tool that company standard dictate. This means good things for software vendors too, because one vendor's win doesn't necessarily mean that another vendor is entirely shut out from use by that design group.

These trends and changes are certainly important, but it can also be argued that not a whole lot has changed. The bottom line is that PCB designers want their lives to be easier when it comes to laying out a board. An entire industry of software developers is working as hard as they can to provide easier, faster ways to do just that. It won't be a surprise if new competitor joins the marketplace, or if some older competitor dies a slow death.

From our perspective looking back over time, we can understand that this is really just another part of the cycle of selling and marketing EDA tools. **PCBDESIGN**



Abby Monaco, CID, is a product manager for Intercept Technology Inc. With more than 13 years of experience in EDA, Abby is actively involved in technical product planning and direction, and marketing.

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SALES AND MARKETING WITH DownStream

by Andy Shaughnessy

From its inception, DownStream Technologies has been a new kind of software tool company. DownStream's post-processing tools address one of the most unpopular parts of the design process: documentation. I asked DownStream founder and CEO Rick Almeida to discuss some of his firm's marketing and sales methods, the trends that he sees, and the influence of the Internet on marketing.

Andy Shaughnessy: *For anyone who may not be familiar with DownStream, give us a quick background on the company and your software tools.*

Rick Almeida: DownStream originated through our acquisition of CAM350 from Innoveda, now a part of Mentor Graphics. The founders of DownStream were previously the executive staff of PADS Software and were responsible for much of PADS current PCB technology prior to the sale of PADS to Mentor Graphics. DownStream markets and sells its products in 45 countries through a combination of resellers and direct sales.

Shaughnessy: *What is your philosophy regarding sales?*



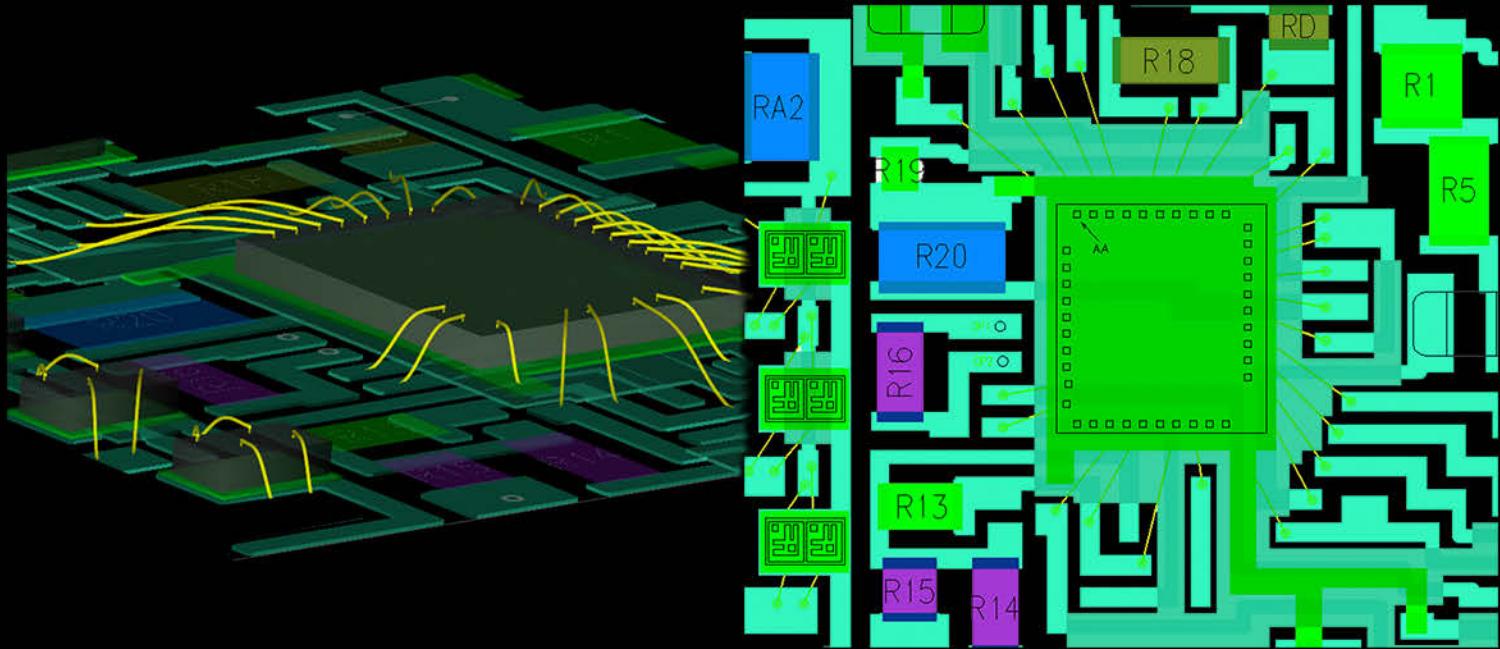
Rick Almeida

Almeida: The main philosophy, whether dealing direct with DownStream or through one of our resellers, is to understand the customers' problems first. Not just the technical issues, but the organizational, and financial structures so that we can help our customers configure the right solution that meets all of their needs.

Shaughnessy: *Do you use direct salespeople or reps, or both? What are the pros and cons of reps vs. salespeople?*

Almeida: We use mostly inside telesales in North America. There are also some key accounts that are managed by a direct sales approach. Everywhere else we use value-added resellers who have exclusive regional territories. This allows them to invest in our products and marketing as they reap the direct benefits from those activities. Using resellers is very economical, as you only incur a cost for sales when a sale is made. However, you must have very good partnerships with your resellers because you are one step removed from the customer base. We've had very long and close relationships with our resellers. Many of them we've worked with since our days at PADS Software. It's important when dealing with resellers that you understand their business motivations as

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well as your own. We've seen countless times where companies try to hire resellers and strong arm them to sell certain products that are not really a fit with the resellers business model. In the end, both the reseller and the OEM lose out.

Having direct sales, whether telesales or field direct, saves you the margin you would normally pay to a reseller and gets you closer to the customer. However, managing a hybrid channel typically requires focused channel management to avoid conflict between your direct and reseller channels.

Shaughnessy: How do you identify potential customers? And what is a typical timeframe for making a sale?

Almeida: Our customer acquisition is largely done through outbound marketing activities. DownStream in particular has the benefit of having a product with very strong brand recognition which helps pull customers in. For our products and price points, sales cycles can range from 1-3 days to 1-6 months.

Shaughnessy: DownStream is kind of a different animal, because you don't have any direct competitors. Still, you're asking designers to add another

step to their process. How do you make your case to designers?

Almeida: DownStream provides CAM verification and documentation solutions. Neither step is a new, additional step per se. It's really the use of automation to drive that step.

Designers use our products for CAM file verification. From easy netlist comparison to more specific DFM detection. This has always been part of the PCB post processes but was largely a manual effort using human optics to detect issues before going to manufacturing. It's only natural that with more complex PCB topologies that optics would need to be replaced with automation. And now with shrinking product lifecycles, ensuring manufacturability on the first pass is becoming very import for companies to realize a return on investment in shorter time frames.

Almost every design requires some level of documentation to fabricate and/or assemble the PCB. These are the instructions and specification for fit and finish of the product as intended by engineering. When documentation is vague or unavailable from engineering, it typically has to be documented further downstream in manufacturing. To ensure that product quality assurance is maintained both for the incoming bare PCB and other outsourced components, as well as the outgoing finished product.

In both cases the customer must realize a certain amount of pain in executing these tasks to realistically justify purchasing software to solve those problems.

Shaughnessy: How would you describe DownStream's marketing philosophy?

Almeida: Because our products are sold to mainstream market, it typically means that the problems are well known and the solutions are proven. This allows us to avoid having to be evangelicals for our products. Instead, our philosophy is two-fold based on product and communication marketing. We typically try to make buying our products as easy as possible. Which means that our policies and configurations must be easily understood by the customer so that when working with our sales chan-

nels the right solutions is quickly identified by both parties. From the communication/branding standpoint, we use an approach that puts us in as many places as possible to create awareness and drive customers to our sales channels. We also have programs in place to encourage our resellers to also invest in marketing DownStream products in their respective territories.

Shaughnessy: *We've all seen how marketing has changed in the last 10 years or so. There are so many new ways to market your tools now, with social media leading the way. What works best for DownStream?*

Almeida: We still subscribe to the same philosophy of brand awareness as mentioned above. From our standpoint, Internet marketing has created more of a change to marketing dynamics than just social media. It's interesting because the internet and its emerging technologies have made it very easy for customers to find what they are looking for. We are seeing a shift to more of a "self-serve" dynamic. For instance, we see a growing participation in online webinars while a simultaneous drop in physical seminars. So while our philosophy of being

in many places as possible has remained, we've adjusted our budgeting to invest more in new marketing channels and decrease investment in some of the more obsolete channels.

Shaughnessy: *What would you like to do to improve your sales and marketing processes?*

Almeida: I think the biggest area of improvement is to follow the growing self-service marketing trend. This is a big challenge as customers are more removed from your sales force, which makes understanding their problems more difficult. So you have to really focus more on ensuring that your message and your product solutions are really understood by the customer without external support. But in the end, this is the direction of not just the EDA industry, but across many industries and markets. There is an old saying that when dealing with change you must either adapt, migrate, or die. We're still young and have a lot to offer!

Shaughnessy: *Thanks, Rick. I appreciate your time.*

Almeida: Thanks, Andy. **PCBDESIGN**

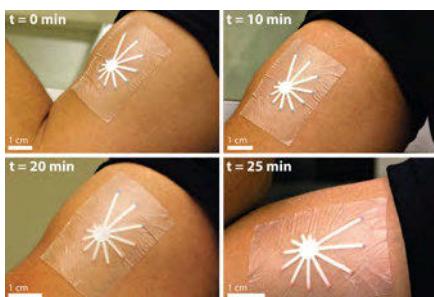
Paper-Based Skin Patch Monitors Dehydration

Researchers have developed a low-cost skin patch that changes color to indicate different levels of hydration, representing a potential new medical technology.

Such an innovation might be used by marathon runners, military personnel and others to help prevent dehydration.

"Hydration in humans is a delicate parameter," said Babak Ziaie, a professor of biomedical engineering and electrical and computer engineering at Purdue University. "Even small deviations such as 2 percent from normal levels can affect a person's cognitive and physical performance by more than 30 percent."

The palm-size patch consists of filter paper that is laser-machined to create a radial array of strips,



which are laminated with a water-impermeable film to form microchannels. The channels are loaded with a water-activated dye at one end. As sweat secretion increases, the strips are activated sequentially, changing from blue to red and providing easily identifiable levels of moisture loss.

"We have talked to many experts including marathon directors, the Ironman World Championship, Olympic triathlon athletes and many collegiate and professional coaches, athletes, race directors and EMTs to validate the need for this kind of product," said graduate student Vaibhav Jain.

The patch was tested at a sweating rate of 90 microliters per hour over a square centimeter of skin, which corresponds to normal human sweat rates.

FLEX AND RIGID SALES AND MARKETING WITH **Al Wasserzug**

by Andy Shaughnessy

After decades in the PCB industry, Al Wasserzug of Cirexx International has seen marketing and sales trends come and go. I recently caught up with Al and interviewed him via email about the latest sales and marketing techniques, the value of traditional methods such as trade shows and conferences, and the particular characteristics of marketing flex circuits.

Andy Shaughnessy: For anyone who may not be familiar with Cirexx, give us a quick background on the company and your own background.

Al Wasserzug: Cirexx was established in 1984 in Silicon Valley as a PCB manufacturer and has grown over the years to become a full service PWB supplier. The company offers design through assembly of printed circuit board and flex circuit products for a variety of markets and holds several professional certifications and registrations.

I have been in the PWB industry for more than 38 years and have served in nearly every facet of a manufacturing organization. With Cirexx, I manage business development in the



Al Wasserzug

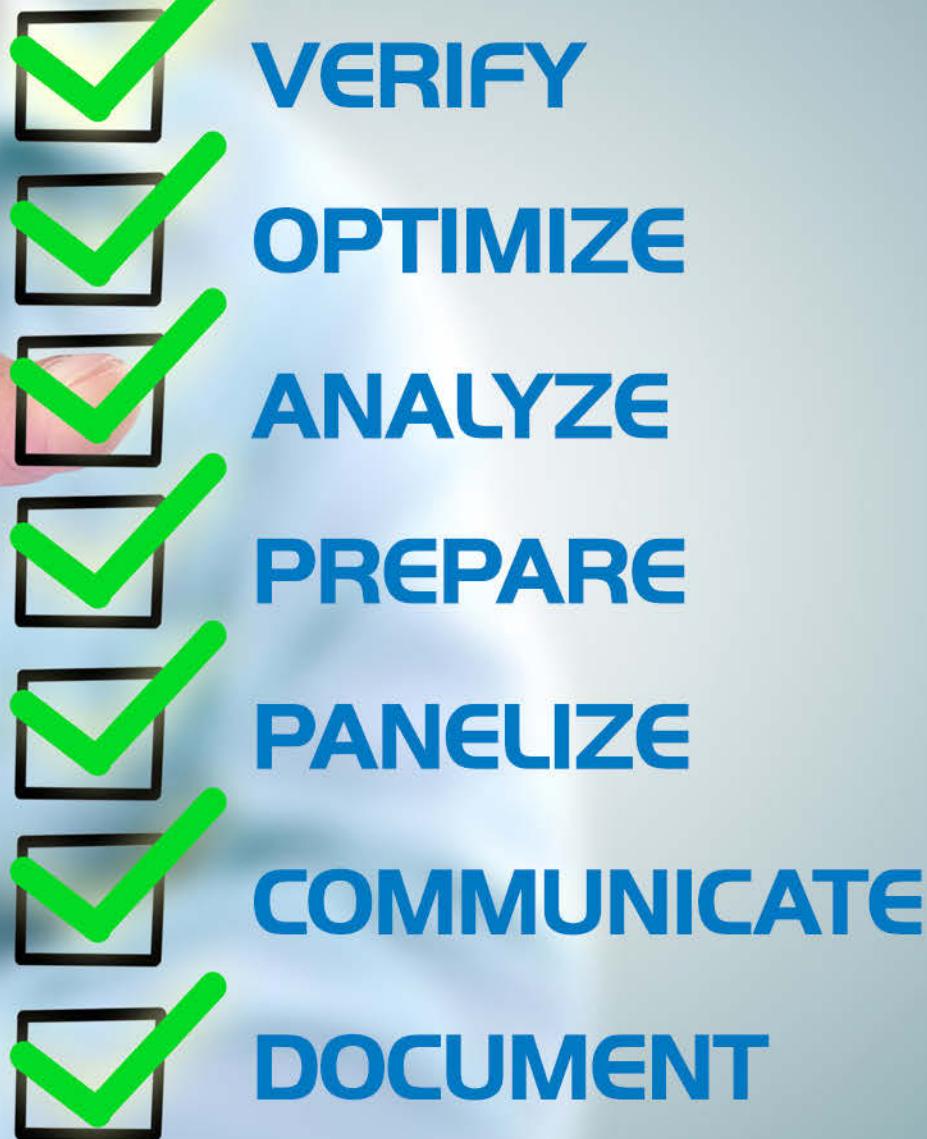
Midwest and Southeast U.S. where I have an opportunity to utilize most of the skill set I have developed over my career. While I continue to specialize in flex circuits, I have also enjoyed learning and participating in the growing RF/microwave PCB niche.

Shaughnessy: How would you describe the Cirexx marketing philosophy?

Wasserzug: The Cirexx marketing approach can be wrapped up in one word: focus. We focus on a particular market segment, technology, region and/or customer account and then saturate that entity with all things Cirexx. We use all available tools: The Internet, trade shows, "lunch-n-learn" events, sales reps, cold calling, technical interface/assistance and a lot of face time with key individuals.

Shaughnessy: Do you think trade shows, conferences and advertising are still important marketing avenues? I hear this argument, pro and con, quite a bit.

Wasserzug: These are all tools that continue to have great value within the context of a larger



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marketing plan. They will individually seem like a waste of time and money if they are not incorporated into a dedicated strategy from which the entire sales team is working. You can add all forms of other common sales instruments to this list and similarly get pro and con on each for the same reason: use of social media; sales reps vs. direct sales; value of “lunch-n-learns,” etc. Every organization must have an overall plan to achieve a specific objective. Then, and only then, will they readily see the wisdom—or lack thereof—in any one particular approach.

The value of trade show exhibition is something that I hear often argued amongst colleagues. The larger shows have become a costly endeavor with questionable concrete results (actual leads). However, consistent exhibition at a large trade show is an excellent means of building and maintaining a brand within a market segment. You may not be seeing actual leads from the show, but when your salespeople walk into accounts that typically attend that show the company name will be recognized—and that is very valuable in developing and shortening the sales cycle. For specific and territorial lead-generation regional trade shows can be a very good value.

Conferences are still one of the best ways to learn about technology trends and to meet the people driving them. There continues to be some reluctance amongst PWB manufacturers to “give away the secrets” of their processing ingenuity, but mostly amongst companies who do not network well or often and are most likely operating in a bubble. White paper presentations at industry conferences continue to be one of the best methods of identifying those who could most benefit from the presented technology.

Shaughnessy: We've all seen how marketing tactics have changed in the last 10 years or so. Do you all use social media or any of the newer media formats?

Wasserzug: We do use social media at Cirexx, and we often discuss how we can use it more. It is a challenge for a PWB manufacturing company to develop a relevant following on Twitter. However, you would be surprised how many us-

ers will “like” and “follow” the same company’s Facebook page. The internet in general has become an extremely valuable tool for the field salesperson. It instantly provides a ton of information that previously would have taken years to amass. Social media and use of the internet, including email, are all tools that can help the marketer to be more efficient. However, there is no replacement for incredible value of face-to-face contact.

Shaughnessy: What marketing trends do you see overall in the PCB industry?

Wasserzug: In my 38 years in the business, I have witnessed first-hand the dramatic changes that have occurred during in our industry. From 3,000+ shops in the late ‘70s to roughly 260 PCB manufacturing locations today in North America, the process of earning revenue making circuit boards is completely different. Also, the rise of the large public company has created a vast divide between them and the traditional small, privately-held, family operations. The two do almost everything differently to survive, much less grow. With the larger, public companies it is all about branding and volume, developing an image and participating in large chunks of business. For the smaller shops success lies in specialization and flexibility—developing competencies in niche markets and serving those markets with the best customer service available.

From a macro perspective, I see a continuation of these trends going forward, along with more consolidation to correct for the continued over capacity in the North America PWB industry. There is also an overcapacity situation in Asia that may be interesting to watch play out. The Chinese PWB industry is at a point not unlike North America in the early 1980s. The shake-out will affect the industry globally.

On a more granular level I see a continuation of technology developments in flex circuits concentrating on high-speed signal integrity and HDI features. These developments will involve materials, like DuPont’s HT, and process techniques, like resin via fill.

Shaughnessy: Is there anything else you’d like to add?

Wasserzug: Flex circuits as a commercial product, in my view, are exiting their adolescence and entering adulthood. This is evidenced by the broad acceptance and recognition of flex circuits and the amount of support products, consumables and equipment available, specifically for their manufacture. When I first worked with flex circuits in the early 1980s at Hughes Aircraft Company, the marketer needed to often explain what the product was and why one would want to use it. Today, nearly everyone knows what a flex circuit is and the benefits it brings.

With flex circuit adulthood comes a maturation of the economics and the industry

structure. The product will move even more towards a “commodity sale” than a “technical sale.” Price erosion will continue due to mostly overcapacity, including pressure from overseas, and lack of supplier differentiation. And finally, adulthood will bring more consolidation amongst flex circuit companies, especially those who offer only flex circuit products.

Shaughnessy: Thank you, Al.

Wasserzug: Thanks, Andy. **PCBDESIGN**

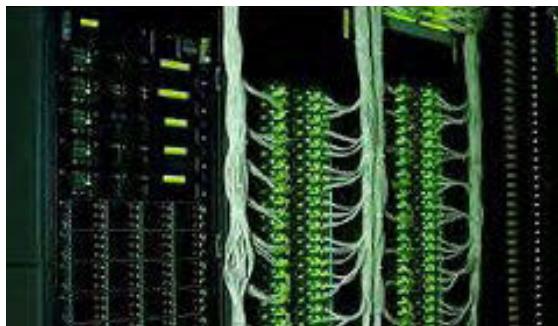
Screening of Databases is the Basis for Developing New Energy Materials

The growing volume of computer-generated data and calculations makes it possible to quickly develop new energy materials. A recently published screening focuses on materials with a light-absorbing effect.

Two researchers from The Villum Center for the Science of Sustainable Fuels and Chemicals at DTU Physics were recently asked to write a perspective for the journal *Science*. Researchers do not receive such requests or such recognition every day. This was the result of their work on the calculation of atomic structures and the structure of materials.

“The findings of innumerable laboratory experiments have been published and compiled in databases in recent decades, and thousands of computer-based calculations have been run using this data. The available knowledge is vast, and our perspective suggests that, despite the great challenges presented by the large volumes of data—which are not directly comparable and compatible—some very promising opportunities do also present themselves,” explains Professor Karsten W. Jacobsen.

In their research, Jacobsen and Professor Kristian



S. Thygesen found that an interesting development is taking place.

“At DTU Physics, we have created our own databases with computer-based calculations, and we participate in the big international NoMaD database. Both of these activities are

based on DFT, Density Functional Theory, which provides information on the properties of a material by calculating its electronic structure. The challenge has been the use of common standards, so that all researchers work in identical file formats and can therefore incorporate and build on others’ results. This is where there is currently an exciting move towards a level of conformity that is opening up new opportunities,” Jacobsen continues.

The two researchers’ work at the Villum Center for the Science of Sustainable Fuels and Chemicals involves developing better materials for light absorption for use in photoelectrochemistry—and ultimately fuels. Alternatives to oil for aviation, for example, are one of the two major challenges in connection with phasing out fossil fuels on which the Center is working, and the development of better catalytic converters is also part of the solution.



Altium's Sales Plan: Deal Directly with Designers

by Andy Shaughnessy

Altium has been shaking up the EDA world for quite some time. The Australian company once slashed the cost of Altium Designer by 75% to grow market share, and who could forget their famous (or infamous) "Bunny" ad campaign? In this email interview with Lawrence Romine, Altium's global head of field sales, he shares his views on sales and marketing in the EDA world, as well as Altium's philosophy on selling EDA tools.

Andy Shaughnessy: *For anyone who may not be familiar with Altium, give us a quick background on the company and your software tools.*

Lawrence Romine: Altium has a rich history, starting out in 1985 as one of the first providers of PCB design tools and over time developing into one of the market leaders. Our growth over the past 5 years has exponentially exceeded the CAGR of the industry. We are the fastest growing EDA company at present.

Shaughnessy: *What is your philosophy regarding sales? Altium is known for being the "rebel" EDA*

company; does that attitude guide your sales process?

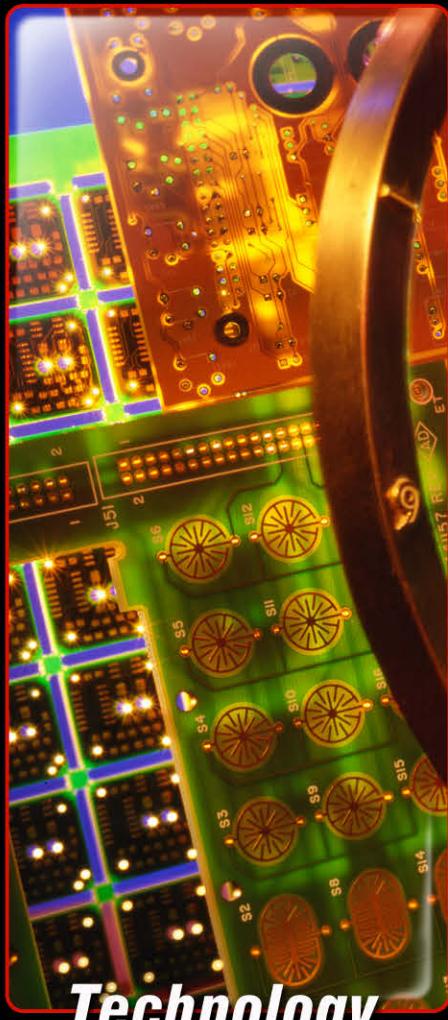
Romine: Simple. Altium has always had a focus on the user as opposed to "the people in the corner offices," and this has really added an extra gear to Altium's growth as we exited the early 2000s. Whereas the focus in the 90s and early part of the 2000s was primarily cost and highly regulated design processes, now the focus is on having an agile design process in which the tool selection process was returned to the users. The combination of Altium's focus on empowering its users and our sales and marketing approach has served us very well in this new environment.

Shaughnessy: *Do you use direct salespeople or reps, or both? What are the advantages and challenges for working with each?*

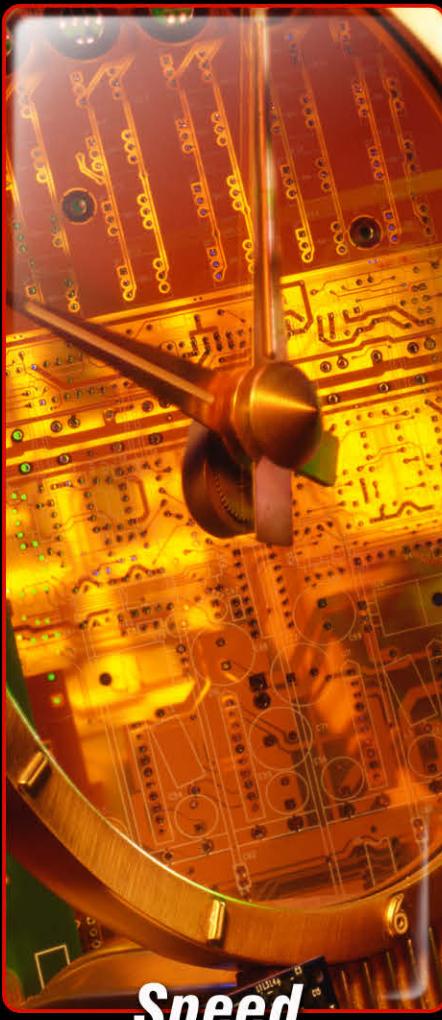
Romine: We have predominately direct sales, with a handful of exceptions. Now that the users have the buying and decision power, and access to limitless information directly related to the use of the product, the resale channel becomes challenging. In this environment where

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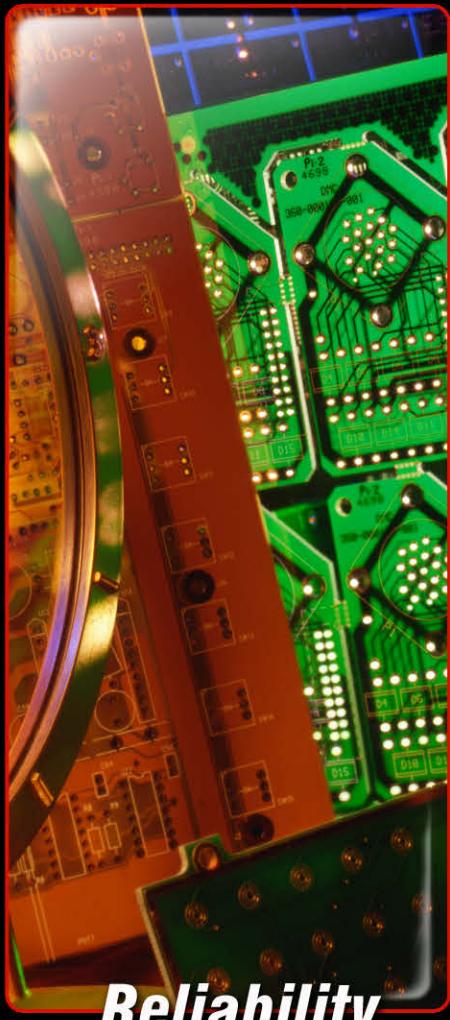
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a reseller is not exclusively covering just our products, often the customer is more knowledgeable than the sellers. Moreover, the pace at which our products are developed further challenges the reseller model and creates "information asymmetry."

Shaughnessy: How do you identify potential customers? And what is a typical time frame for making a sale?

Romine: Because our PCB design products cover all facets of the market (from "makers" to agile enterprises), we are now literally applicable to any company that designs PCBs. Our typical sales cycle is measure in days to weeks.

Shaughnessy: For the big EDA companies, making a sale usually means converting someone from a rival's EDA tool. But I know designers who use Altium as well as another design tool. How do you make your case to that sort of potential customer?

Romine: This is not unusual, no. Historically, when we saw this, our users in these companies would say, "We keep Altium around for when we want to do something fast." As the industry has pivoted to agile processes, our footprint has



Lawrence Romine

grown dramatically as everything needs to be developed fast and our products really empower the users to make the most of the creative process. Whereas the older enterprise solutions of the '90s and early 2000s are typically punitive to the creative process.

Shaughnessy: How would you describe Altium's marketing philosophy?

Romine: We do business with the USERS in our market.

Shaughnessy: We've all seen how marketing has changed in the last 10 years or so. There are so many new ways to market your tools now, with social media leading the way. What avenues work best for Altium?

Romine: All of them, and we have a line in all the ponds, literally. And each offers some level of ROI. Our core focus is now optimizing each, but more importantly linking the marketing experience with the sales experience in this age of information.

Shaughnessy: Thank you, Lawrence.

Romine: Thanks, Andy. **PCBDESIGN**

Novel Microsupercapacitor Exploits Three-Dimensional Porous Electrodes

A research team from King Abdullah University of Science & Technology (KAUST) has now developed a microsupercapacitor that exploits three-dimensional porous electrodes.

These micropower units are expected to enable a new generation of "smart" products. However, for these units to be tiny yet still efficient, the highest energy density must go into the smallest area.

One approach to carrying this out is to construct microbatteries using films with a thickness of just a few micrometers or less and to replace traditional electrolytes with solid-state ones. Microsupercapaci-

tors are a faster alternative, and these may prove suitable for applications requiring power pulsing and very long cycle life.

The team has now developed integrated microsupercapacitors with vertically-scaled three-dimensional porous current collectors made from nickel foams to improve microsupercapacitor performance. The pores in the foam work to increase the surface area.

This is superior to state-of-the-art microsupercapacitors, which achieve between one and forty milliwatt-hours per square centimeter, and is comparable to various types of thin film batteries.



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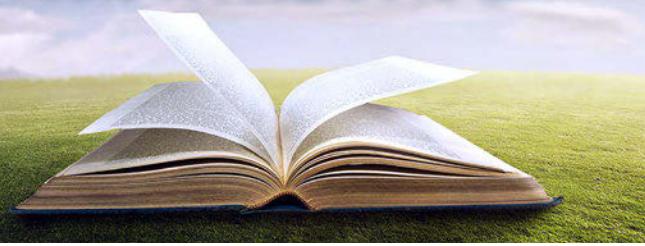
Learn more about the roadmap used to build great companies with a high level of profitability in this article from the March 2016 issue of **The PCB Magazine**.

For 25 years we have been doing Four New Agreements consulting and training, significantly improving businesses. This stuff really works!

—David Dibble



Five New Books that Will Change Your Perspective on SALES AND MARKETING



by Dan Beaulieu

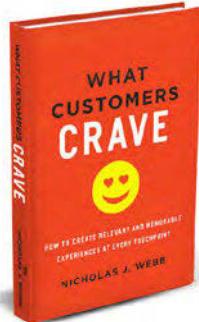
In honor of this month's topic of sales and marketing, I'm providing a review of five books that can directly influence the way we think about sales, marketing, customers and customer service.

When selecting these books, I considered the following criteria:

- I wanted the books to be relatively new—no older than 24 months
- I wanted them to represent a new way of thinking
- I wanted books with innovative ideas
- I wanted books that could make a sales and marketing person better

What Customers Crave: How to Create Relevant and Memorable Experiences at Every Touchpoint

Author: Nicholas Webb
Amacom, 2017
Price \$25.00



Customer service is out and customer experience is in. It's not enough to deliver great customer service any more—you must instead deliver an entire customer experience and a great experience at that. Customers want to feel good about the very act of working with you. They want to feel that you are on their side and that you have their best interests at heart.

This book goes beyond traditional thoughts about service. In the first part of the book, the author discusses something we have all become aware of and that is creating customer value. He points out that it is much more effective to keep a customer happy than it is to get a new customer. From the book: "...probability of selling to a new prospect is 5 to 20 percent, while the probability of selling to an existing customer is 60 to 70 percent."

Mr. Webb goes on to explain just how we can provide value to our customers. He describes in detail how to create customer confidence in you, your company and your products and services.

This is one of those books that inspires great thoughts and ideas by giving the reader "triggers" that encourages thinking about customers in a way you have not done before. He shows you how to put yourself in their place and grow your understanding of how they view you and your company, and most importantly, what they expect from you.

I especially like the section entitled, "Make an upset customer a lifelong customer in five easy steps." From the book:

- 1. Affirm:** Create a complete understanding of the problem and what it means to the customer.
- 2. Listen:** Yes, shut up and listen and hear exactly what the customer is saying to you.





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- 3. Confirm:** Repeat back to the customer what the problem is so that he understands that you understand... that you get it.
- 4. Fix:** You know what the problem is, now fix it.
- 5. Follow up:** Yes, follow up to make sure that the problem is solved and the customer is completely satisfied.

I would add one of my own and that is to do all of this as quickly as possible so that the situation is alleviated in the blink of an eye. Doing this will in fact make the customer respect you for life.

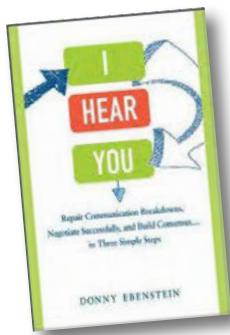
There is much too much in this book to cover it all. There is valuable information, from learning everything you can about your customers to getting referrals and recommendations.

This is a must have for anyone who is serious about customer service and retention...and who isn't?



I Hear You: Repair Communication Breakdowns, Negotiate Successfully, and Build Consensus...In Three Simple Steps

Author: Donny Ebenstein
Amacom, 2013
Price \$24.95



If your life is conflict free you don't need this book, but then again who are you kidding?

This is the kind of book that you just don't expect to see on a business bookshelf. In fact, you probably would not go looking for this book in the first place. After all, who thinks they need a book about resolving conflicts?

It turns out we all do, whether it's communicating with our boss, a co-worker, a customer or a neighbor; we all need the skills that Donny Ebenstein writes about in this book.

My favorite part of this book, besides the tools he teaches of course, was the fact that he

uses real-life examples to set the stage for each step—each simple step, as he says. By using those specific examples (names changed to protect everyone, by the way) he then shows that by using the techniques laid out in the book you can, as he says, "repair communication breakdowns."

The key to what Ebenstein is writing about is flexibility to get in the other person's head, walk in their shoes, if you will, and see things from their point of view...but without giving up on your own. Not an easy task that. This is why we need techniques laid out here so that we can hold two points of view at the same time, thus allowing us the ability to work with the other party, come together, and develop a consensus that both sides can not only just live with but be able to love with.

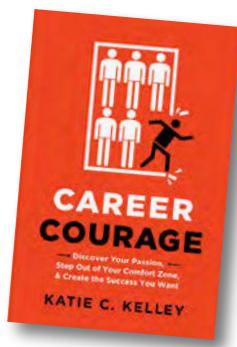
Like every elegant solution, this all sounds very easy, but it is only by following Ebenstein's expert advice that we can even hope to get to the point where we can do this on our own while leaving our emotions at the door.

Whether you are a teacher dealing with an administrator, an attorney trying to mediate a divorce, or a salesperson trying to make that sale with a difficult customer, this one is for you. Don't live another day without it.



Career Courage: Discover Your Passion, Step out of Your Comfort Zone, and Create the Success You Want.

Author: Katie C. Kelley
Amacom, 2016
Price \$16.95



This is a great book for all ages but particularly for those starting a career. If you have a son or daughter carving out a career path, this book is chock full of the right kind of advice for them. Or if you're a person who started down one path, but are finding that it is just not you, this is a great book for you. If you're middle-aged and are looking to re-invent yourself, you'll find this book especially helpful.

Writing with the insight of someone who has been there, Ms. Kelley offers a virtual handbook for finding yourself and what you want to do with your life. Not only will this book show you the way to get started it will also show you the way to accelerate your journey once you are on the right path.

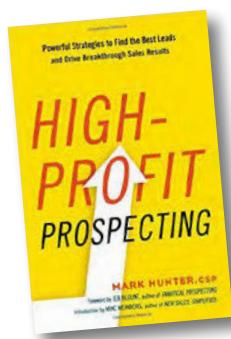
I especially appreciate the examples of real people that the author includes. Each chapter, on topics ranging from motivation and confidence to vision and harmony, expressively defines each step of the way, highlighting it with true life examples.

The book is filled with helpful, delectable little sections designed to allow the reader to participate in activities that drive the point of that chapter home. The book includes sections like: "Coach's Challenge," which helps the reader to think things through by applying the challenges to his own situation; and "Game Time," where the author wraps up each chapter with summaries of what we have learned in that chapter and applying them to our own situations.

This is one of those books that you don't realize you need until you open it. This book stimulates your mind and makes you think about things you should be thinking about, from your career to your life. People of all ages can benefit greatly from reading *Career Courage*.

**High Profit Prospecting:
Powerful Strategies to
Find the Best Leads and
Drive Breakthrough
Sales Results**

Author: Mark Hunter
Amacom, 2016
Price \$18.95



Man, this is a great book. This is by far the best book on prospecting and lead generation I have ever read or, I should say, used. As a sales columnist and consultant, I am always on the lookout for books that are not only going to give me ideas to help me help my clients but also books that will give me some thought-

provoking subjects for my columns, and I feel that with this book I have found a virtual gold mine. Truth be known, I have already based three weekly versions of *Its Only Common Sense*, my weekly PCB007.com column, on subjects that I found in this book. The first was based on Hunter's myths about prospecting; the second one was on working with the right prospects.

I have also recommended that two of my clients buy copies of this book for their sales teams.

From why to prospect, to how to prospect, to choosing the right prospects and making sure they are the right ones, this book has everything a salesperson novice or old timer needs to be successful.

I especially like the way the author deals with the difficult subjects of getting appointments and what to do at those appointments to dealing with voice mail and how to leave an effective voicemail message.

This book does more than give the reader the basic rules of successful prospecting. It also motivates the reader into taking action, getting down to work, and getting it done. *High Profit Prospecting* is the have-to-have book for your sales library. I urge you to get it today and oh yes, make sure you have a highlighter nearby when you start reading it—you'll need it!

***Fail Fast or Win Big:*
*The Start-up Plan
for Starting Now***
Author: Bernhard Schroeder
Amacon, 2015
Price \$21.95



Stop aiming and start firing!

Every so often you find a book that ends up being more of a stimulant for ideas than just a book. This is one of those books. I want to call it the "Nike—just do it" book because that's exactly what the message is. He claims for example that business plans are a thing of the past, that they take too long to do and that they are not as effective as well as just doing it.

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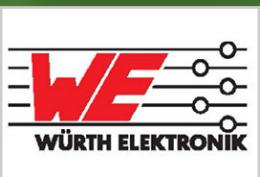
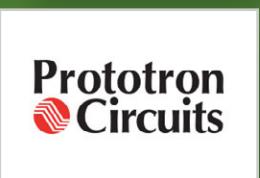
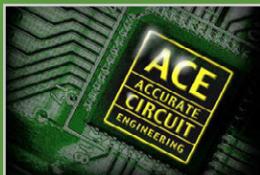
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The business model, a short business model with the good and the bad and the ugly of just trying something is the way to go.

Schroeder gives numerous examples of entrepreneurs who gave it a go before most people would have thought their new product or service was truly ready for prime time.

So many times, people have a great idea but they wait too long to execute that idea, and instead they spend their time writing long business plans to please those bankers who are never going to give them the funds to start the business anyway. Schroeder tells us to just get going. He says that all we need is a great story, a story that will explain exactly what we are trying to sell and how it will work.

He says that instead of a full-blown business plan, all we need is what he calls “the Lean Model Framework,” consisting of the following slides:

- Company Purpose
- Problem and Solution
- Why now?
- Market Size
- Competition
- Product
- Business Model
- Revenue Model
- Team and Financials

And that is all you need to launch your new business.

He wants us to develop a model as soon as possible with the understanding that it will not

be perfect but that it will be good enough to exemplify what the product or service should look like, enough to get someone interest in the product and thus the company.

From the book:

Lessons learned:

- Believe in your product, not foolishly, but with common sense
- Find ways to get things done
- Follow the trend
- Look at alternate sources of distribution if traditional sources don't work
- Seek out other people or companies who have the same beliefs and look for either leverage or distribution opportunities

Schroeder ends Chapter five with this quote:

You really don't know if you have a company until you have created a product or service prototype and have sold it in the marketplace. That is, you can't improve a product unless you get customer feedback. And you need to move faster than potential competitors. So create a prototype sooner rather than later.

If you are passionate about your career, then you will eat and breathe and drink sales. This also means that you will read every good business book you can get your hands on. You might start with these five that I just recommended. Good reading, and good learning, means good selling. **PCBDESIGN**

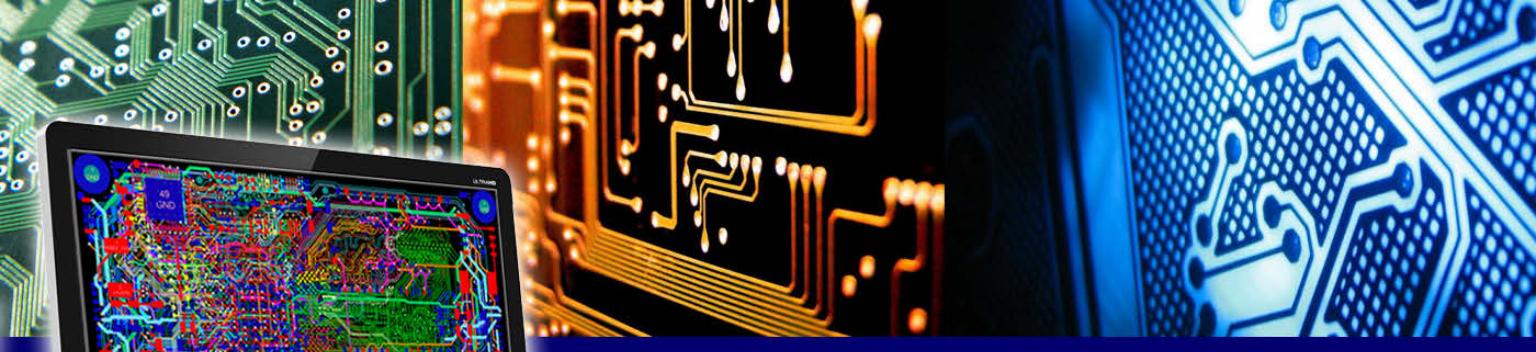
LED Solution: An Opportunity to Stand out Through Design & Additional Functionalities

LED technology is no longer exclusive to the lighting industry. Changes due to innovative LED technology have probably been the most impressive in the automotive sector. For this reason, recent the use of LEDs has evolved from being a basic, functional feature to a distinctive feature with high-value potential.

LED technology has given manufacturers the opportunity to stand out through lighting design and additional functionalities. The innovative platform PISEO offers a unique global approach, including technology scouting, strategic market analysis, in-

novative product planning, design and qualification. PISEO's strategy evaluates market needs to develop comprehensive disruptive solutions that use LED technology.

“Today, LED technology is no longer just an alternative solution,” comments Joel Thome, Director at PISEO. “At PISEO, we are completely re-thinking the system to develop an end solution that uses all the benefits of LED technology.” PISEO will reveal its activities and detail the added value of its services at its press conference at FORUM LED 2016.



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- Extensive Capacitor Library – over 5,650 capacitors derived from SPICE models

PCB007 Highlights



[EPTE Newsletter: Printable Electronics— A Practical Solution?](#)

I attended a printable electronics workshop in Japan a couple of weeks ago. The 200-person crowd was made up of people from R&D organizations, material suppliers and machine manufacturers. No one there could be termed a customer; everyone was there to learn and discuss the latest printable electronics.

[Standard of Excellence: Let's Get Flexible](#)

Although flex and rigid-flex technology has been around for many years, it is only in recent years that it has come into its own. The reason for the increased requirements for the flex and rigid-flex technology is simple: Devices are getting smaller.

[Schoeller Electronics Presenting a New Organizational Structure in North America](#)

At the recent SMTA International show in Rosemont, Illinois, I met Padraig McCabe at Schoeller Electronics Systems' booth. It was obvious that they had a lot going on so it was good to be able to sit down and get the full story of their new organizational structure, name change and the recent acquisitions of PCB companies.

[Streamline Circuits: The Importance of Being a Sales-Driven Organization](#)

I recently had the pleasure of catching up with Tom Doslak, senior VP of sales and marketing for Streamline Circuits. We discussed how the company got started, technologies that seem to be driving the marketplace, critical equipment for today's PCB fabricator, and how being a customer-centered, sales-driven organization serves as the key to their success.

[electronica 2016 Impressions](#)

Germany's third-largest city, and capital of the southeastern state of Bavaria, Munich was once more the host to electronica, which can justifiably claim to be the world's leading trade fair for electronic components, systems and applications.

[Weiner's World](#)

This year's TPCA (Taiwan Printed Circuits Association) show held October 26–28 seemed to have lighter attendance than last year. Robots were on display everywhere, with lots of loaders and unloaders as well as the multi-axis, multipurpose types.

[Walt Custer's Global Market Outlook](#)

With 2016 winding down, Walt Custer shared his end-of-the-year market research data with me at the recent electronica trade show in Munich, Germany. In our interview, Walt breaks down his findings and offers insight into the changing trends as we head into 2017.

[IPC Standards Committee Reports— Printed Board Design, Testing, FlexCircuits, High-Speed/High-Frequency, Rigid Printed Boards](#)

These standards committee reports from IPC's 2016 Fall Committee Meetings have been compiled to help keep you up to date on IPC standards committee activities. This is the first in a series of reports.

[All About Flex: Specifying a Flexible Circuit](#)

IPC has created a specification document, IPC 6013, which is referenced for many flex circuit applications. This commercial document, in combination with the CAD data and print, is used as the product specification. Most flexible circuitry fabricators' internal quality standards are based on IPC 6013.

[Lenthor Engineering Adds Salina Galindo-Luna to their Executive Team](#)

California based designer, manufacturer and assembler of rigid-flex and flex printed circuit boards, Lenthor Engineering, announces the addition of the newest member of their executive staff, Salina Galindo-Luna. In her new position, Salina will help Lenthor improve their services by streamlining production processes and eliminating waste to promote sustainable change.

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PCB-Based Antennas and PIM Concerns

by John Coonrod

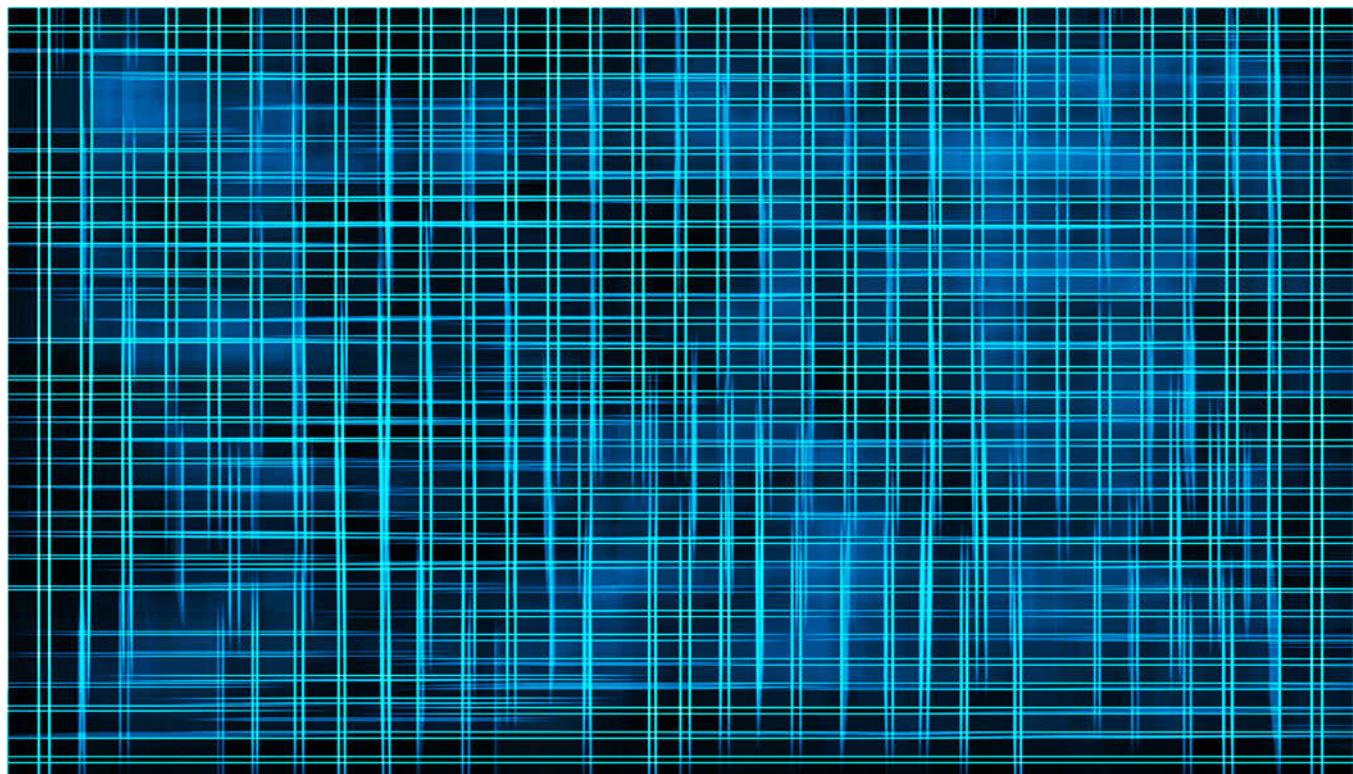
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A large variety of PCB-based antenna structures are used at microwave frequencies, and some are used at higher frequencies. A common PCB antenna structure is a microstrip patch antenna. A microstrip structure is a two-layer copper circuit with a signal plane and a ground plane, but it is more common for this type of circuit to be the outer layers of a multilayer circuit.

The size of the copper feature or patch, for a microstrip patch antenna, has to do with a fraction of a wavelength, usually $\frac{1}{2}$ wavelength. The patch will radiate (transmit) or will be very sensitive to receive energy at a specific frequency, which is related to the $\frac{1}{2}$ wavelength circuit feature size. Wavelength is associated with frequency as well as the dielectric constant (Dk) of the circuit material. Just for reference, a higher

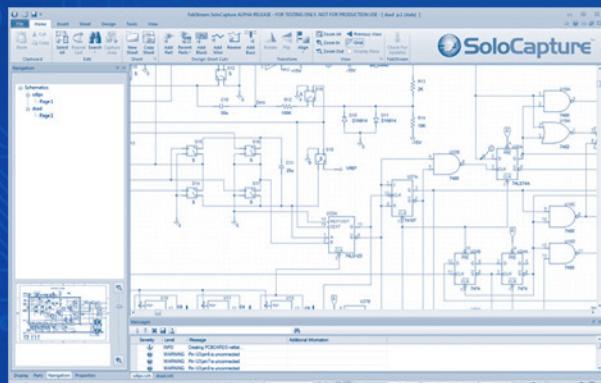
frequency will translate to a shorter wavelength and a smaller patch. Also, using a circuit material with a higher Dk will also decrease the wavelength and make a smaller patch. As a general statement, the circuit materials used for PCB-based antenna applications typically have a lower Dk and commonly have a Dk value in the range of 3-4.

Additionally, circuit materials with higher Dk will cause the electric fields to concentrate more between the signal plane and the ground plane of the circuit. The field concentration will reduce radiated energy and accordingly, PCBs with antenna radiating elements will often use a material with a relatively low Dk value. Another common attribute for antenna designs using PCB technology is the use of thicker laminates. A thicker microstrip circuit will radiate

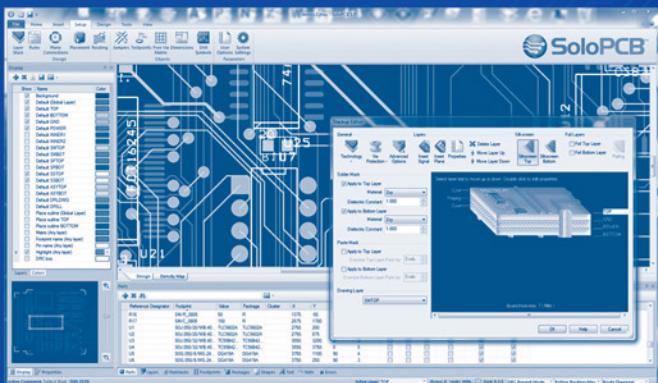


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energy better and it is common for microstrip patch antenna designs to use thicker material (30 mils or thicker).

As with most engineering issues, there are tradeoffs. The combination of a thicker circuit material with a low Dk is good for antenna radiation but may not be good for the feedline properties. The feedline is typically a 50-ohm transmission line which brings energy to and from the radiating elements of the antenna circuit. A microstrip transmission line using a thick material can be limited by RF performance due to natural resonances that can occur between the signal plane and the ground plane or across the width of the signal conductor itself. These resonances can interfere with the clarity of the energy being transferred on the feedline to the

“If the energy is not cleanly transitioned to the radiating elements, less energy can be transmitted or the reception of the energy is altered. Multilayer antenna PCBs have a buried feedline and are often a stripline structure.”

radiating elements. If the energy is not cleanly transitioned to the radiating elements, less energy can be transmitted or the reception of the energy is altered. Multilayer antenna PCBs have a buried feedline and are often a stripline structure. This type of feedline offers the benefit of energy transitioning cleanly in the circuit and then transitioning to the radiating elements on the outer layer of the PCB using plated through-hole vias.

Passive inter-modulation (PIM) interference can be problematic with some PCB-based antennas. In the case of PCB-based antennas, PIM is a potential type of interference which affects antennas that are in close proximity to each other and are using different frequencies. Basi-

cally, one tone (or frequency) can blend with another tone to create a new tone. The newly created tone can be at a frequency which could interfere with the receiver of one of the antenna systems. PIM is typically problematic for PCB antennas used in base station antennas for cellular phone technology. The level of PIM which can cause a problem in these technologies is an incredibly low energy. The acceptable level of PIM is debatable; however, it is mostly due to the sensitivity of the system and currently a PIM level of -150 dBc is considered good. A larger negative number is even better, where -160 dBc is considered very good PIM performance. The unit of dBc is a power level (dB) in relationship to the carrier signal (c) power. If the measured PIM power is -110 dBm and the carrier power level is 40 dBm, subtraction is performed and the PIM value in units of dBc would -150 dBc. This is an extremely small number and in decimal form the -150 dBc is equivalent to 0.000000000000150.

Some of the problems with measuring a circuit for PIM performance include an extremely low power level and finding equipment accurate enough to measure it. Additionally, when trying to evaluate circuit performance, these extremely low power numbers are sensitive to many variables which can influence the results. PIM testing is very difficult to do properly, when we consider all the possible variables. At Rogers, we have been performing PIM testing on antenna-grade high-frequency circuit materials for about 15 years and have enabled us to formulate materials with consistently good PIM performance. As with any application that has special considerations, the PCB designer should consult their material supplier when considering which circuit materials to use for PIM sensitive applications. **PCBDESIGN**



John Coonrod is the technical marketing manager at Rogers Corporation. To contact Coonrod, [click here](#).



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MilAero007 Highlights



[**All About Flex: Flex Circuit Specifications for Commercial and Military Applications**](#)

Applications across the various markets for printed circuit boards can have significantly different specifications and performance requirements. Circuits for toys and games logically have lower performance requirements than those used in medical devices. IPC-6013 is an industry-driven specification that defines the performance requirements and acceptance features for flexible printed circuit boards.

[**The Sum of All Parts: Three Keys to Successful Leadership**](#)

It is often easy to lose sight of, particularly in the manufacturing sector, your most valuable resource: people. You can't take purchase orders, operate equipment and develop new strategies all on your own. With so much focus being driven toward quality, margins and customer satisfaction, upper management develops a tendency to forget what keeps all those things in the positive.

[**The Sun to Power the Starliner**](#)

Boeing will use solar energy to power the company's CST-100 Starliner for crew missions to and from the International Space Station as part of NASA's Commercial Crew Program. The sun's energy offers a reliable and efficient power source for the Starliner just as it does for the space station and satellites.

[**Kitron Receives Contract from Northrop Grumman**](#)

Kitron has been selected by Northrop Grumman Corp. as an international source for manufacturing of a sub-assembly for the F-35 Joint Strike Fighter.

[**It's Only Common Sense: ITAR—The Good, the Bad, the Ugly, and the Very Ugly**](#)

Has there ever been a more nebulous qualification than ITAR? It's one of those topics that everyone has an opinion about, but no one really understands. To some of us it's a game with ever-changing rules,

and to others it's simply a hurdle to overcome. And for others, it is something to ignore altogether.

[**NASA Small Satellites Set to Take a Fresh Look at Earth**](#)

Beginning this month, NASA is launching a suite of six next-generation, Earth-observing small satellite missions to demonstrate innovative new approaches for studying our changing planet.

[**U.S. Circuit Goes Green with Solar and LED Installation**](#)

U.S. Circuit has just completed a \$1 million installation of a 251 kWh solar system covering their entire parking lot. This system makes U.S. Circuit one of a kind within the U.S. PCB fabrication industry.

[**NASA Aircraft Arrival Technology Gets Big Test in 2017**](#)

Commercial airline pilots who as children played "Follow the Leader" will have no problem with a new air traffic control innovation NASA and its partners are working on that also will make passengers happier.

[**IPC's President on IPC EDGE: Cutting Edge and Education**](#)

Chatting with IPC President John Mitchell is always a good time—he never fails to be upbeat and full of ideas, and his eagerness to fill us in on what's happening with IPC was evident during our recent interview at the IPC Fall Committee Meetings, co-located with SMTAI in late September.

[**Millennials in Manufacturing: A Long-term Career Prospect**](#)

The next millennial in this series is Alex Johnson, an associate engineer at Saline Electronics, who has been with the company for over two years. Even though Alex received a lot of negative information about manufacturing throughout his lifetime, his work experience in engineering has directly challenged those preconceived notions.

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“Sparks” to the Rescue in RF Design

by Tim Haag

INTERCEPT TECHNOLOGY

Do you ever watch old military TV shows or movies, specifically those featuring naval vessels such as battleships, destroyers, or submarines? Well, I do, and I’m betting that I’m not alone.

In a lot of these old shows, the captain of the ship refers to the radioman as “Sparks.” This tasty little sobriquet dates back to the early days of radio when radiomen were traditionally nicknamed “Sparky” or “Sparks” due to their early use of spark-gap transmitters. In those old TV shows and movies, the radioman, Sparks, was the go-to guy to get the job done.

It probably wouldn’t occur to some younger people that there used to be a time where we couldn’t just pick up our cell phone and call

someone halfway around the world. But in those days, it took the powerful resources of a ship or submarine to power those early radios, and the guy with the know-how to make it all work was good-ol’ Sparks.

In today’s world of PCB design, we are also dealing with radio, specifically radio frequencies that we classify as RF design. And just as with the early days of radio where Sparks the radio specialist was in demand to get the job done, we now need RF specialists to help us get the job done. The specialists in demand today are circuit board designers like you who working together with electrical engineers to create the intricate designs required for RF circuits.





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You are Sparks, the go-to specialist who will take care of business. But this isn't standard PCB design; this is RF design with different, unusual design requirements that require specific design tool resources to complete the design. So, let's take a look at some of the common requirements of RF design, and what specific design software enhancements are needed to help PCB designers to better accomplish their task.

One of the first things that will help the PCB designer in the RF world is the ability to manually modify their components on the fly as needed. Often the quickest way to get the desired shape in an RF component is to simply do a manual change to the part, and RF specific design tools offer the designer this flexibility. Changes in a pin shape, moving a pin, or adding fill should be able to easily be done at the component level.

RF specific design tools will also feature many routing enhancements. Among those is the ability to add via fencing automatically. It is very helpful for the designer to be able to specify an area either by selecting a pre-existing object to use as a fence template or by manually drawing in the fence shape that the design tool will then fill in with vias. These via fill algorithms will usually include the ability to specify the via part to be used, the net, the spacing and how many rows of vias are required.

Another important routing enhancement is the ability to copy sections of routing. This will give the designer the ability to reuse copied sections of routing, or export routing to another design. Different options here allow copying to other layers, copying specific portions of routing, setting anchor points for the copied routing to paste to, etc. The ability to copy routing is a pretty standard function for PCB design tools, but in RF design there can be an even heavier reliance on these capabilities.

Area fills will also have enhanced functionality, and one of those is the ability to create an area fill as if it were a routed trace. This is very useful for RF designers so that instead of manually digitizing multiple vertices of a complex area fill, they can instead route in their area fill as if they were routing in a very fat trace. Other area fill enhancements will include the ability to change the parameters of the fill to specify cross-hatching and outline widths. Also, there will be specific control over pins in the fill to specify pad sizes, clearances, and thermal dimensions for all pads or just specific pads and/or specific layers. And it is also helpful to be able to create fills within component shapes that can then be replicated for each placed instance of that component.

One enhancement that we've found really useful in the RF design realm is the ability for designers to manually draw in primitive graphical shapes, and then convert those shapes to intelligent net objects. This gives the designer the ability to draw in either primitive paths or polygons, or complex polygonal shapes such as arcs, circles and rectangles—and then convert those primitives to intelligent traces and area fills that carry net information. This eliminates the need for a designer to spend lots of time trying to create a uniquely specified area fill shape when instead they can create their shape out of the standard drawing tools



within the layout application, and then convert it to an area fill.

RF designs incorporate a variety of different design elements than what the average PCB designer is used to seeing. For instance, certain sections of routing are actually components in the schematic. They are referred to as routed components, and the PCB design tools that are enhanced for RF design will have the ability to route a parametric component. The designer will start routing the parametric component, and the design tools will add virtual pins to each end of each segment allowing for those lumped components to be represented in the schematic. The design tools will also assign and store for each lumped component the model type for external RF simulation tools.

This brings us to one of the most important enhancements of RF-specific PCB design tools: the ability to connect to external RF simulation tools with a bi-directional data transfer. In this way, the external simulation tools can send their designs over to the PCB design tools for incorporation into the design, and the design tools can send over their data for simulation. The bi-directional work flow between the two tools will allow the designer to easily simulate and then incorporate those simulation changes back into the main design. This is a much more efficient design flow than what was available with older single-directional design flow tools that would force the designer to have to re-create the design changes manually once the simulation was complete.

The last enhancement to talk about is the ability to add RF specific components dynamically to the design. Older design flows would require the manual creation of a specific RF component shape on the layout side as well as the addition of a corresponding symbol in the schematic. Once annotated, the user would then go through a process of many manual edits and annotations in order to get the correct size and shape of that component finalized in the layout.

With the ability to automatically generate RF components parametrically, however, the designer need only get the component attributes forward-annotated from the schematic into the layout, and then the parametric com-



ponent generator can create the RF component on the fly. With a parametric component generator, the shape and parameters of the component can be altered by the designer in the layout without having to manually alter and annotate a regular static component.

For instance, the parametric generator can change the size, trace width, and ring count of a spiral inductor producing the desired part that now only needs to be placed and routed. Since the parametric generator creates RF components with reference designators, the design can be easily annotated back and forth with the schematic and will also be in sync with external RF simulators.

RF design can bring some real challenges to the table, and as we've discussed, the unique requirements of an RF design can be greatly helped with some of these RF design specific software enhancements. None of us will probably ever need to connect the admiral with the joint chiefs in Washington DC to avert an international conflict like Sparks did on the late, late show. But hopefully some of what we've covered here can help you and the rest of your design team to be successful in your efforts and to become those go-to RF design specialists that everyone depends on. Aye, aye, sir! **PCBDESIGN**



Tim Haag is manager of customer support and training at Intercept Technology.

Understanding the Practicalities of Resin Application and Curing

by Alistair Little

ELECTROLUBE

Over the past few months, I've covered quite a bit of ground regarding the choice of encapsulation and potting resins and the problems you are likely to encounter when using them. I hope these *Sensible Design* columns have provided plenty of food for thought as well as giving you a basic understanding of the principal resin materials, their benefits and limitations.

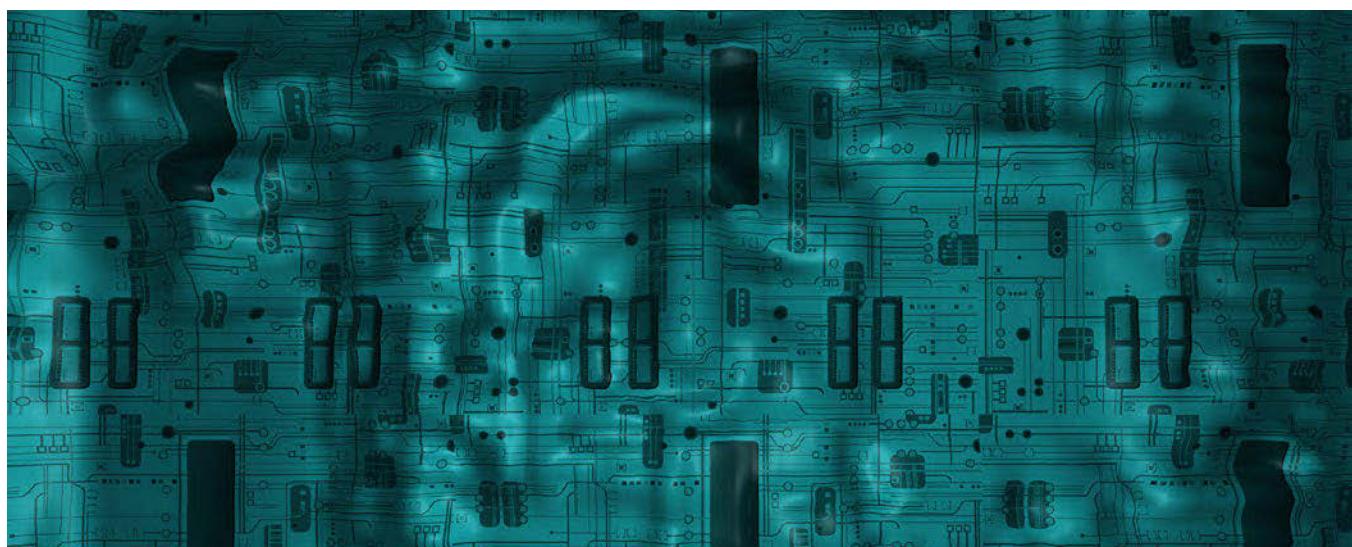
This month, I'm going to focus on the practical aspects of applying and curing resins—what you should look out for in terms of material condition and the environment in which you are mixing and applying the resin, deciding on which mixing and application techniques are appropriate to your production circumstances, and paying due attention to achieving a satisfactory cure.

It is important to check the state of your material stocks before you proceed to use them. Just as you might give a cursory glance to the "use-by" date of packaged food in your refrigerator, before you even consider mixing together part A (the resin) and B (the hardener), always check that these materials are in date and that, visually at least, their condition is good.

For example, part B of conventional two-part polyurethane resin formulations (the isocyanate) reacts strongly with moisture in the air, so should the packaging have been inadvertently opened or compromised in any way and air has entered it, then a foam layer can form on top of the isocyanate and carbon dioxide gas will be released, pressurising the container. This provides evidence of a despoiled product, which should not be used and instead, be disposed of responsibly.

If you purchase your resins and hardeners in bulk quantities and use just a fraction of the contents for each production run, then repeated opening and closing of the containers will allow moist air to enter the air space above the liquids, with water being absorbed into the materials as a result. Containers should be opened and closed as quickly as possible, or given a quick flush with dry nitrogen before closing to help prevent these problems.

If this is not a practical proposition, a better solution might be to purchase the material in smaller container sizes, if your supplier stocks them (we supply resins in quantities ranging



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from 5kg bulk cans to 250g packs). Generally, unless you intend to use the resin and hardener in a single run, precautions like those outlined above should be taken to ensure that a dry atmosphere is maintained within the containers and that they are well sealed between runs/usage, otherwise you are going to suffer an awful lot of waste product!

“Do you mix manually or make use of a special mixing machine?”

And then we come to the all-important mixing stage: Do you mix manually or make use of a special mixing machine? Manual mixing is perfectly adequate for small-volume/short production runs or when developing prototypes. For these smaller jobs, the best approach is to use flexible plastic resin packs that provide measured quantities of resin and hardener in separated compartments of the pouch. When you are ready to use the pack, you simply remove the separating clip and ‘massage’ the pouch to mix the components thoroughly together.

For larger volumes and/or longer runs, manual mixing could introduce variations in the mixed volumes of resin and hardener, which will lead to variations in cure times as well as compromising the quality of the cured product. In this case, machine mixing is the better alternative as the mix ratio is set within tight tolerances and maintained throughout the run.

Again, when running two-part polyurethane resins through mixing and dispensing machines, it will be necessary to protect both components from moisture, either by fitting desiccant traps to the product holding tanks or by flushing the tanks continuously with dry nitrogen.

Resin systems—be they epoxy, urethane or silicone—differ with regard to the curing conditions they require to obtain an optimum cure. Generally, most resins will cure at room temperature (20–25°C) over a period of 24 hours;

however, some will require much higher temperatures to cure successfully, while others may benefit from a post cure—applying an elevated temperature to the encapsulation or potting area after it has achieved a partial cure.

The curing process for epoxy resins is generally slow, though the manufacturer can obtain a range of different cure speeds and cured properties by altering the hardener chemistry. However, beware that for epoxy resins, a fast cure can also mean a very exothermic reaction. Depending upon the size of the unit being potted and the amount of resin used, it might require some cooling to control the resultant exotherm. In the case of polyurethane systems, which have a lower exotherm during cure, even for fast cure systems, it's the humidity you must consider, as environments with high humidity might cause the formation of bubbles and craters on the surface of the resin.

After curing, and particularly for those units that have been heated to cure the resin, a period of carefully controlled cooling may be necessary to minimise the development of stress points between the unit, the resin and the components. Curing is a process affected by many variables and consequently it can be very difficult to predict the outcomes with any accuracy. For example, the temperature at which a resin is cured will affect not only its cure speed, but also the quality of the end-result, so it's as well to carry out some trials before committing to a specific cure rate and/or cure temperature.

Moreover, it is always advisable to check the product's technical data sheet to obtain the recommended guidelines for curing; should these not meet with your requirements or you foresee any conflicts between the curing process and your production procedures, be sure to contact your supplier's technical support team for further advice. Remember, they have a wealth of experience at their disposal and most technical support teams that I have had any dealings with will relish a challenge! **PCBDESIGN**



Alistair Little is technical director for Electrolube's Resins Division.



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TOP TEN



Recent Highlights from PCBDesign007

1 Siemens to Acquire Mentor Graphics for \$4.5B

Siemens and Mentor Graphics have entered into a merger agreement under which Siemens will acquire Mentor for \$37.25 per share in cash, which represents an enterprise value of \$4.5 billion. Mentor shareholder Elliott Management has committed to support the transaction.



2 Barry Hurley, PCB Designer and Porch Dawg Guitarist, Dies at 57

Barry Hurley, a longtime PCB designer, instructor, and guitarist with the Porch Dawgs, passed away in Bonham, Texas on November 12. He was 57. Barry was a great designer and a serious guitar player and collector. We'll miss him.



3 DownStream Technologies: Building the Interface Between Designers and Fabricators

DownStream Technologies founder Rick Almeida speaks with Editor Pete Starkey at the recent electronica show in Munich, Germany. He discusses DownStream's efforts to build an interface between PCB designers and fabricators.



4 CAT's David Wolf on Via Reliability Analysis

Conductor Analysis Technologies has been analyzing test panels and coupon designs for over 20 years. In this e-mail interview, Vice President of Technical Marketing David Wolf discusses some of the trends he's seeing in via structures, and the common reliability and quality issues related to vias.



5 Milwaukee Electronics Merges with San Diego PCB

"San Diego PCB Inc. is a best-in-class engineering PCB layout design service. We see it as a great fit for our engineering-driven focus in the electronics manufacturing services (EMS) market and we have chosen to refer to this transaction as a merger to better reflect the collaborative environment it is creating," said P. Michael Stoehr, Milwaukee Electronics president and CEO.



6 Beyond Design: Rock Steady Design

How do we ensure that our high-speed digital design performs to expectations, is stable given all possible diverse environments, and is reliable over the product's projected life cycle? One word: Impedance! For the perfect transfer of energy and to benefit from the highest possible bandwidth, the impedance of the driver must match the impedance of the transmission line and be constant along its entire length.



7 IBR Optimizes Incoming Customer Data Handling using Ucamco's Integr8tor

IBR Leiterplanten has optimized their data handling by implementing Ucamco's Integr8tor. Integr8tor analyses all incoming customer files for obvious errors, bottlenecks and manufacturability, coming up with a complete report of all the specifications within a few minutes, without any input from the user.



8 Leo Lambert Discusses EPTAC's Evolving Mission

One of the biggest problems a manager faces is training—getting employees trained, and keeping them current on constantly changing technologies. I asked Leo Lambert, VP and CTO of EPTAC, what his thoughts were on the subject of leadership, and more specifically, what strategies EPTAC embraces with regard to training—both initial and ongoing.



9 Altium Releases New Version of PCB Design Software Committed to Passionate Design

After experiencing record user growth in the past year, Altium has launched the latest version of their leading PCB design software with Altium Designer 17. This release further embodies Altium's commitment to passionate design by significantly reducing the time spent on non-design related tasks.



10 What's the Difference Between a Manager and a True Leader?

Why would I want to work for you? The role of the manager is complex; it means balancing business needs with creative opportunity and flexibility, building trust and providing inspiration with a team. It is the manager who is the immediate point of contact, and the one person who holds the key to job satisfaction. How can today's manager maintain an effective and motivated team?



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Events

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[46th NEPCON JAPAN](#)

January 18–20, 2017
Tokyo Big Sight, Japan

[DesignCon 2017](#)

January 31–February 2, 2016
Santa Clara, California, USA

[MD&M West](#)

February 7–9, 2017
Anaheim, California, USA

[IPC APEX EXPO 2017 Conference and Exhibition](#)

February 14–15, 2017
San Diego, California, USA

[China International PCB & Assembly Show \(CPCA\)](#)

March 7–9, 2017
Shanghai, China

[14th Electronic Circuits World Convention](#)

April 25–27, 2017
Goyang City, South Korea

[KPCA Show 2017](#)

April 25–27, 2017
Goyang City, South Korea

[Thailand PCB Expo 2017](#)

May 11–13, 2017
Bangkok, Thailand

[JPCA Show 2017](#)

June 7–9, 2017
Tokyo, Japan



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ADVERTISER INDEX

Accurate Circuit Engineering.....	11	IPC.....	25
American Standard Circuits.....	53	Isola.....	5
Candor Industries.....	21	Mentor Graphics.....	23
Coast to Coast Circuits, Inc.....	27	Miraco.....	45
Dibble Leaders.....	43	Oak Mitsui.....	19
Downstream Technologies....	37, 55	The PCB List.....	2, 67
Eagle Electronics.....	17	Precision Technologies.....	57
Electrolube.....	61	Prototron Circuits.....	41
EMA Design Automation.....	13	Rogers Corporation.....	59
Geek-a-Palooza.....	48, 49	SiSoft.....	9
General Circuits.....	65	Sunstone Circuits.....	7
I-Connect007.....	72	US Circuit.....	3
In-Circuit Design Pty Ltd.....	51	Ventec International Group.....	31
Intercept.....	33		

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