

October 2016

12 Leadership and...
You

18 Lessons in Leadership
from My Father

36 Six Leadership Lessons
from 20 Years in the
Electronics Industry

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2016 SEMICONDUCTOR PACKAGING

ROADMAP SYMPOSIUM

11.14.2016

MEPTEC INITIATES COLLABORATION WITH HETEROGENEOUS INTEGRATION ROADMAP

MONDAY, NOVEMBER 14, 2016 | SAN JOSE, CALIFORNIA

SYMPOSIUM 8:00AM - 5:00PM | EXHIBITS 9:30AM - 6:30PM | RECEPTION 5:00PM - 6:30PM

In this post ITRS era, there is great need for the industry to collaborate in charting a direction into the future. In 2015, the SIA announced their decision to bring ITRS to a close, with the 2015 edition being the final edition. The IEEE CPMT Society took the initiative to establish a technology roadmap focused on heterogeneous integration, to be modeled after the ITRS in purpose, structure, and governance. This initiative quickly found resonance with SEMI, and the IEEE Electron Devices Society (EDS) joined the effort, resulting in the launch of the Heterogeneous Integration Roadmap (HIR). **MEPTEC has moved to participate in this roadmap collaboration.**



MORNING KEYNOTE SPEAKER

Wilmer R. Bottoms, Ph.D.

Chairman, Third Millennium Test Solutions
Co-chair, Heterogeneous Integration Roadmap (HIR)



AFTERNOON KEYNOTE SPEAKER

William (Bill) Chen, Ph.D.

ASE Fellow and Senior Technical Advisor,
ASE Group
Co-chair, Heterogeneous Integration Roadmap (HIR)

MORNING SESSION:

Strategic Directions in Heterogeneous Integration

The morning session will address the strategic directions in heterogeneous integration that address the market inflection points and technology fault lines. What will be the crucial roles for integrated photonics for data to the cloud, and for sensing? What technologies will be developed and implemented for the self driven cars be introduced into our cities and byways? How embedded sensing will enable the transition from IoT to IoE around the world.

AFTERNOON SESSION:

Innovations in SiP and Integration

This session will address the major developments in heterogeneous components – power devices, analog, MEMS sensors, photonics, and in SiP integration – fan out, 2.5D, embedded, and co-design technologies. How will the momentum of these technology developments move forward to address road blocks moving ahead? What research areas and ecosystem collaboration will be needed for continued progress? These and more questions will be addressed.

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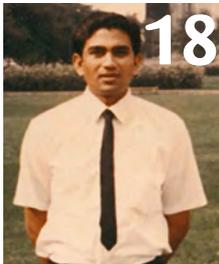
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October 2016

Featured Content



The Leadership Issue

Everyone has the chance to benefit from the wealth of experiences our contributors—leaders in the industry—are sharing this month, from real-world examples of leadership, to principles that have stood the test of time.

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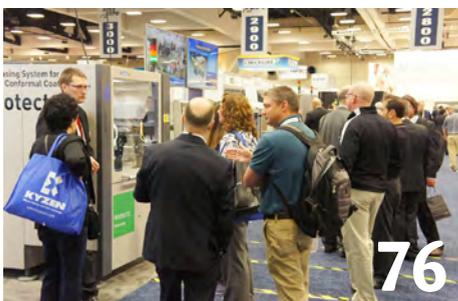
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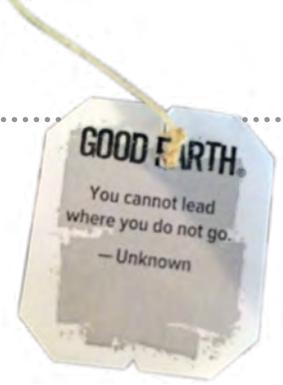
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Take Me to Your Leader

by Patty Goldman
I-CONNECT007



“You cannot lead where you do not go.” – Good Earth teabag, author unknown

We must have touched a real hot button when we decided to do this issue on *leadership*. When we sent out our survey on the topic, we received a lot of responses, which we’ll review in a separate article, plus many of our regular columnists were inspired to write on the subject.

So if you are looking to become a leader in your company or even a better manager, or even just a better person, this month’s issue is definitely for you. You have the opportunity to

benefit from the wealth of experiences of our contributors, as nearly everyone offers up real life examples—and no two are the same.

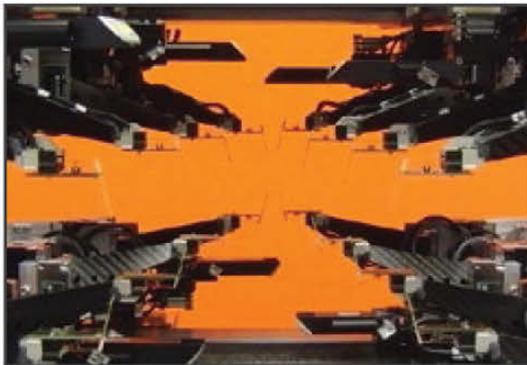
Or if you are a tried and true techie with no such desire to “move on up,” read on anyhow—you will still learn plenty and not just about being a leader or manager. Our features contain plenty of opportunities to lead that do not involve your day job. Most, if not all, of this issue applies to every aspect of work and play (think teams and coaching), plus there are plenty of life lessons in here too.



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We have quite the line-up for you, plus a few technical columns at the end to keep everyone happy. First, about that survey... I-Connect007's Research Team presents and analyzes the results. It's amazing the things you learn from open-ended questions. We throw in quite a few quotes from you, our readers, as you really do say it best.

Our first article is by Yash Sutariya of Saturn Electronics/Saturn Flex and he is writing on lessons in leadership he learned from his father Nagji, who recently passed away. It is both instructive and poignant—I just wish that in my earlier sales travels I had had the opportunity to get to Saturn and meet Nagji.

Next, Dave Dibble of Dibble Leaders discusses the results of the 10-question Biz Brain IQ survey that has been in our magazines for the past few months. The results, and Dave's analysis, include the "correct" responses and how the scoring process. Missed it? Then check out the test page and take it *before* reading his article.

It's not always easy for busy people to find time to author a column or article for us, even when you just know they are the right person for it. But IPC President John Mitchell was pleased to provide us with six totally practical lessons in leadership from his experiences in the electronics industry. Something to take to the bank, so to speak. And they are definitely for everyone. John is also going to be our newest columnist, so we can all look forward to more wisdom from him.

Next, I am very pleased to have our Brazilian columnist Renato Peres of Circuibras center his column around the 2016 Summer Olympics and lessons he learned about leadership from a few of the outstanding athletes. Como apropriado!

Regular columnist Todd Kolmodin of Gardien Services USA departed from his usual testing topics to write on the basic differences between leaders and managers. His perspective is interesting and thought-provoking.

Sam Sangani of PNC Inc. talks about the people element—your most valuable resource—of leadership. He explores three valuable aspects of good leadership centered on one's employees.

Next, Steve Williams of The Right Approach Consulting shares three personal experien-

ces that helped him transition from manager to leader. He alludes to more lessons learned, so perhaps we can tease some of those out of him over the next few months.

Happy Holden has contributed a column from his Essential Skills series, a 10-step business plan process for use by engineers or others wishing to present a new idea or product to management. Happy used the process himself during his tenure at HP.

And now to some good technical info to round out this issue. Mike Carano of RBP Technology discusses troubleshooting roughness or nodules found after copper electroplating. I hope you are all collecting Mike's articles into a nice guide for your plating department.

Engineers, and I suppose others, feel a great need to solve problems, often on their own—it's a sort of challenge to them. But in his column, Keith Sellers with NTS-Baltimore exhorts us to make use of the extensive knowledge already out there. In particular, he cites IPC conferences and meetings, as well as IPC's Validation Services and the Defense Logistics Agency as sources of knowledgeable people.

We're making it a tradition to wrap up each issue with marketing guru Barry Lee Cohen of Launch Communications. This month, BLC discusses trade shows as a part of your marketing plan. Very appropriate, as the season is almost upon us.

Next month it's back to technical when we focus on all things vias. You think you know all about them? Think again! Don't miss out—[subscribe](#) now and you will have it in your virtual mailbox the day it publishes. **PCB**



Patricia Goldman is a 30+ year veteran of the PCB industry, with experience in a variety of areas, including R&D of imaging technologies, wet process engineering, and sales and marketing of PWB chemistry. Active with IPC since 1981,

Goldman has chaired numerous committees and served as TAEC chairman, and is also the co-author of numerous technical papers. To contact Goldman, [click here](#).

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Leadership and...You

by I-Connect007 Research Team

In our now well-known monthly topic survey, we got some very interesting results on leadership. Most of the questions were designed to be open-ended (i.e., not multiple choice), specifically to encourage original answers—to keep our respondents from just checking off a few boxes.

Many of the answers were rather intriguing—and unexpected. Here is a breakdown of the survey questions/responses:

QUESTION 1: What are the three most important traits and skill sets of a great leader today?

The top three responses were:

- 1. Ability to inspire others 72.7%
- 2. Empowerment of employees 47.7%
- 3. Integrity 40.9%

These were closely followed by:

- 4. Clarity of vision 38.6%
- 5. Positive attitude 34.1%

It's pretty clear that most people want to be inspired. Perhaps at this moment you may be asking, "Do I inspire others?"

Much further down the list were:

- 6. Creating a great business plan and following it 18.1%
- 7. Passion 13.6%

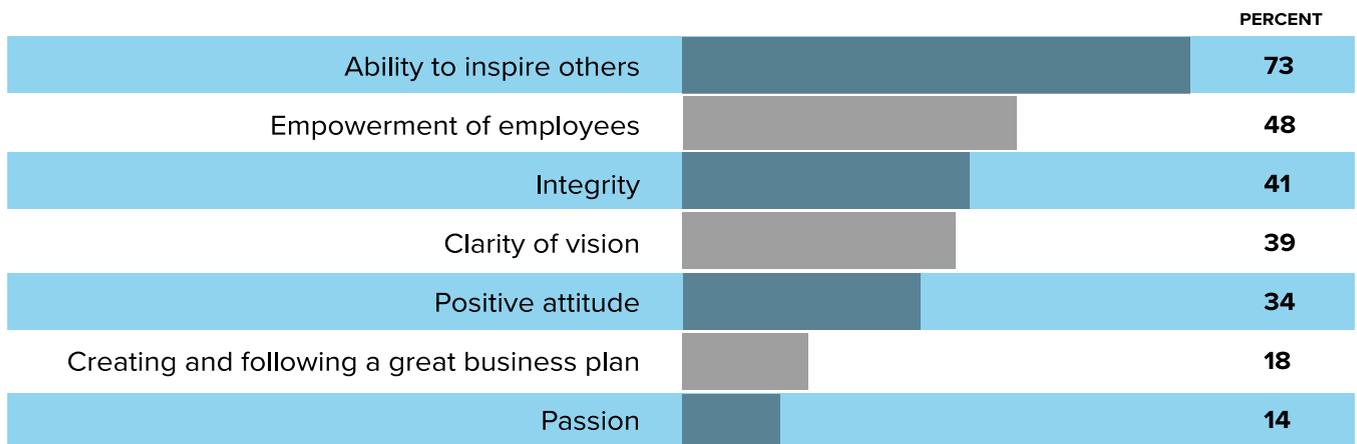
And way down the list were the following: courage, commitment to the company, decisiveness, organization and visiting customers. So there you have it. Now you know what to focus on.

QUESTION 2: How do you see leadership evolving?

Sometimes it's hard to notice change because evolution can be...so...slow. Keep in mind, evolution does not happen at the same pace for every person...you could be far behind the next person, which could make you appear to be an outdated leader. Are you?

The responses to this open-ended question were perhaps the most difficult to categorize of all the responses we got. Answers ranged from "becoming more team-based than single hero-based" to "getting more hands-on" to "better organization and execution of plan" to "much more collaborative, less prescriptive."

The Most Important Traits and Skill Sets of a Great Leader Today



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As a general breakdown, the recurring themes were team building, growing people, and clarity of vision, with a small but respectable number feeling things haven't improved much at all. However, several insightful comments are worth passing along:

- “The good leaders have to focus on identifying subordinates who have the ability to clearly understand the company goals and how to achieve them and then give them the responsibility and freedom to achieve them.”
- “I think great leaders will have to continue to provide positive and timely communication to their employees.”
- “Fundamentally, leadership never changes. Having the clarity of vision and the courage to strive for that vision along with inspiring people to join in on the adventure is a constant. The changing elements are the current means needed to get there, whether that be product technology or market savvy, and the technical tools to deliver the message.”
- “Not sure if the question means ‘evolving’ within the individual or ‘evolving’ in general. If the latter: Leadership skills will continue to be tested as pressure for short term performance clashes with long term stability and growth.”
- “Management experts have been talking for 20+ years on the importance of presence, positive feedback and delegated responsibility. This is continuing and, especially with new generations entering the managerial bodies, less people will accept a workplace with instructive leadership.”
- “The principles of leadership remain unchanged. The challenges arise due to changing societal norms that amplify personal, generational and cultural differences.”

QUESTION 3:

What do you see as the three most important challenges in leading a team?

Leading a team is perhaps one of the most difficult leadership skills to master. This was

another fill-in-the-blanks or short-answer question, so answers varied. There was familiar theme throughout the responses that show most people want to be valued and empowered; however, they also want a clear focus for their company's direction. Let us do our jobs!

	%
Plan/ focus/alignment	69.4
People/personality	72.2
Building teams	30.6
Communication	25.0
Empowerment	22.2
Resource management	22.2
Gaining respect/trust	16.7

QUESTION 4:

What do you see as the most important impact of great leadership in a company?

Higher employee retention/happier employees	40.48%
Improved efficiency of operations	26.19%
Better margin/profitability	14.29%
Other (please specify):	9.52%
Consistency	7.14%
Process control	2.38%

The takeaway here: Great leadership leads to happy employees. Indeed, several comments further emphasized the importance of one's employees: “When you have long term, happy employees, much of the other [choices] happen naturally.” And, “Without good and happy employees the rest becomes so much more difficult to achieve.” And, “A good workforce will generally generate a good profit margin through excellent product quality and minimum scrap/rectification costs.”

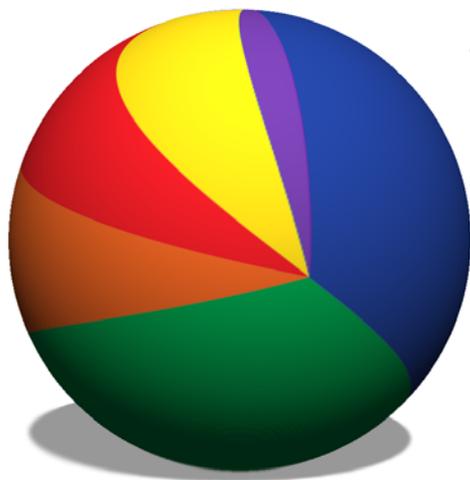
Are you surprised by these results and responses?

QUESTION 5:

Do you feel empowered to make decisions at your job?

Not being empowered can be a miserable feeling... But the good news is that more than

Most Important Impact of Great Leadership



40.5% ● Higher employee retention/happier employees

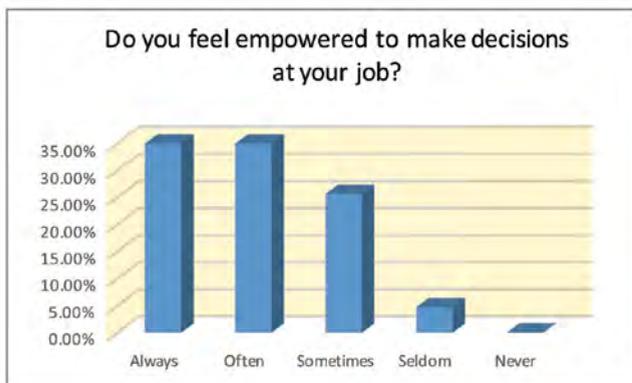
26% ● Improved efficiency of operations

14% ● Better margin/profitability

9.5% ● Other

7% ● Consistency

3% ● Process Control



71% of the respondents feel quite empowered to make decisions, plus another almost 24% felt empowered at least some of the time. Perhaps we should have asked for positions in the company; hopefully, higher level employees will have more decision-making authority. More good news—no one said “never.”

QUESTION 6:

How does your leader motivate you in your job?

This was an open-ended question and we asked for three responses. Keeping in mind that the goal is happy employees...

While many different words were used, several themes emerged. The most frequently used words were support, compliments, recognition, accountability, trust and sense of involvement. Others were empowerment, feedback and new challenges, with the very occasional mention



of money or compensation (though compensation could mean other things also).

Perhaps we should have followed this with a question as to position within the company but we do believe we received a representative cross-section in the responses. And we also believe that level in a company really has little to do with what truly motivates individuals.

QUESTION 7:

Does your company invest in leadership training?

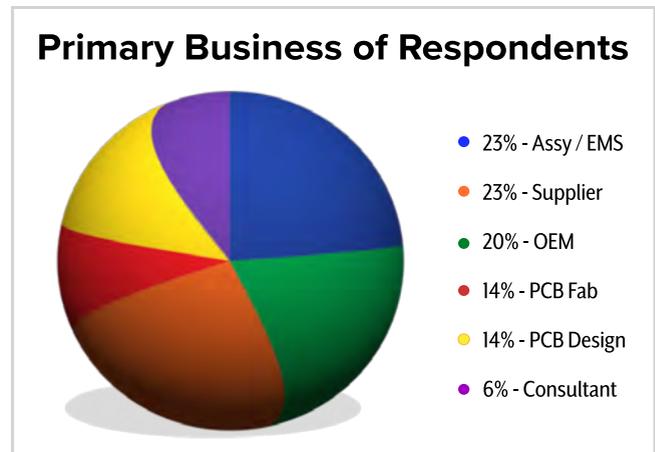
Happily, over 50% of respondents answered yes, while 31% said no, and some 17% were not sure. We asked what type and how often but the answers were rather vague for the most part. Which leaves no doubt that there is plenty of room for improvement, even at those companies that offer training.

QUESTION 8:

Regarding millennials: How do you lead a generation that says it doesn't want to be managed?

Talk about an open-ended question! And the answers were pretty broad also, but a few themes emerged. People wrote things like “show the need for,” “challenge them,” “inspire a shared vision,” “teach team dynamics,” “present clear goals,” “communication,” “don't micromanage, give them all participation trophies.” The last one was noted by the respondent as sarcasm.

Wait a minute; aren't these the things we all want in a job? To wit, millennials is just a catch-phrase; they want the same things the rest of us do but they are perhaps less willing to wait for it—less patient. They also have many more options outside of manufacturing—in fact, manufacturing is for the most part barely recognized as an option. And that is the real problem in our industry. One respondent com-



mented, “Not all young people are archetypal millennials.” Aha!

And another person pretty much summed it all up this way, “The key is to manage someone without them knowing they are being managed. And that is not a trick, that is the essence of good leadership.” How perfectly said on both counts. **PCB**

NASA Develops Satellite Concept to Exploit Rideshare Opportunities

Each time a rocket blasts off to deliver a primary payload into space, it typically does so with room to spare—a reality that got NASA engineer Joe Burt thinking.

Why not exploit that unused capacity and create a sealed, pressurized, thermally controlled capsule that could take advantage of rideshare opportunities while accommodating less-expensive, off-the-shelf instrument components typically used in laboratory-like settings? Several years in the making, Burt and his team at NASA's Goddard Space Flight Center in Greenbelt, Maryland, now are ready to validate portions of such a system.

Called the Capsulation Satellite, or CapSat for short, the system is a hockey puck-shaped structure that measures roughly 40 inches wide and 18 inches tall. Purposely designed as either a stand-alone system or stacked depending on payload needs, each capsule is capable of carrying about 661 pounds of payload into orbit—a microsattel-



lite-class weight not accommodated by the increasingly popular CubeSat platform whose instruments typically weigh two to six pounds.

With funding from NASA's Earth Science Technology Office, or ESTO, Burt and his team will validate CapSat's all-important thermal-control system in a thermal-vacuum chamber test in late September. The system uses

thermostatically controlled fans—much like those used to cool electronic equipment on Earth—to circulate air over hot and cold plates located inside the craft. This maintains a constant temperature where instruments would experience little, if any, thermal degradation while on orbit, Burt said.

Under the ESTO-funded effort, Burt and Goddard detector expert Murzy Jhabvala also are conducting a study to scope out the specifics of flying a next-generation photodetector camera on a CapSat. The idea is that NASA could fly the detector on a constellation of CapSats to gather multiple, simultaneous measurements.

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Lessons in Leadership from my Father

by **Yash Sutariya**

SATURN ELECTRONICS AND SATURN
FLEX SYSTEMS

When I was asked to contribute an article for this issue on leadership, I thought it was an opportune time since my Dad, Nagji Sutariya, had recently passed away. I had spent nearly every daylight hour with him since I started working with him at Saturn in 2001. Along the way, I picked up what drove him as a businessman, a father, and a member of our community. I am proud to share the lessons I gleaned along the way.

Perhaps a brief history is in order here. In 1969, Dad left his arid Indian village for Michigan's Upper Peninsula. In pursuing a Masters in Mechanical Engineering from Michigan Tech, he had basically moved from a desert to a landscape surrounded by water that frequently reached sub-zero temperatures during the winter.

After graduation, he could not find an engineering position, so he took work wherever he could find it. Finally, in 1977, he landed a full-time job at Ford Motor Company's seat design department. Never satisfied and always the entrepreneur, he complemented his daily grind by moonlighting in diamond and art imports while investing in rental homes.

At the advice of friends, he devised a plan and gathered partners to start Saturn Electronics Corporation, in September of 1985. A mixture of hard work, perseverance, and at times good luck propelled the startup to a \$22 million company by 2000. Moreover, his fiscal discipline allowed us to survive the crash of



Figure 1: Nagji Sutariya as a young man at Michigan Tech in 1970.

2001/2002, which enabled us to continue breaking sales records after our recovery throughout the next 15 years.

As we move The Saturn Group forward, his legacy endures through the lessons he taught and the example he set. It is my honor to share my Dad's business leadership tenets with you.

Know Your Business

Dad was a big believer in staying active in every facet of his business. He was quite the opposite of most of the business owners I interacted with during my stint in bankruptcy/turnaround consulting. Often, business owners who found themselves in trouble once knew every detail of their company, but now found themselves focusing more on sales-related activities and relying on others to handle operations, accounting, and engineering. Dad wore multiple hats at our company. He would tell customers that not

only was he the president, but also the CFO, QC manager, and HR manager. And truly he was the official quality manager from Saturn's inception until his first cancer treatment in 2009. So not only would you see him involved in technical aspects such as quality control and product development, but he worked closely with suppliers to immerse himself into the details of chemistries, materials, and machines. Furthermore, he would constantly walk the floor to ensure they were being utilized effectively. I've thrown him out of the factory floor more times than I can count when I found him up ladders or loading panels into a machine. You couldn't keep the man out of trouble, it seemed.



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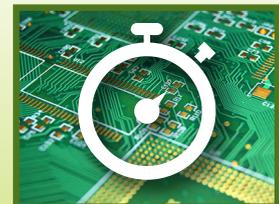
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Figure 2: Dad and I pose for a group photo with the sales reps.

In retrospect, I can see what he was doing. Whenever there was a problem, the research side of it went quick because he knew the processes inside and out and could start the problem resolution closer to the finish line rather than start a massive DOE and burn resources eliminating wrong avenues. Furthermore, it gave us more confidence when making large investments during rough times in the industry.

Know Your Business

1. Walk the floor
2. Work with suppliers
3. Be involved with quality control
4. Have knowledge of machines/equipment

Value Productivity

Walking the floor also provided him the opportunity to monitor employees. His presence ensured a disciplined workforce while he was able to monitor the rate of their production. “Think fast, walk fast,” he used to say. Breeding efficiency through example, Dad was excellent at time management. As a result, he created ‘measurables’—statistical calculations such as: panels per hour; production rate by process; and revenue per man per month. All in all, these measurables allowed him to find the right balance to control the process while inspiring his workforce to match his determination.

Most importantly, he made it a point to share this information with each employee during his weekly department sit-downs. He would explain each person’s results compared to his set standard, and then compare each employee’s results with each other. Anyone performing below median would be charged with learning from higher-performing folks about how to gain efficiency without risking product quality.

Value Productivity

- Monitor what people are doing
- Monitor the rate they are doing it at
- Create measurables/statistical calculations
- Determine how many panels per hour
- Know production rate of each process
- Find the right balance

Think Fast, Walk Fast

- Embrace time management
- Breed efficiency
- Set example for others

Push Through Pain

Nobody denied Nagji’s dedication. He would tell me that “the rules do not apply to you” and that there was “no such thing as a sick day.” Nagji never demonstrated this disciplined commitment more than when he was going through chemotherapy. We would plead with him to take the day off and rest. It was nearly impossible to convince him not to go to work. And sometimes, on those rare days where we did convince him, he would show up around



Figure 3: Nagji celebrating his 71st birthday at the office.



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lunchtime demanding productivity reports and preparing for his afternoon QC meetings. Now I'm not recommending that anyone do this, but there needs to be an example set by a leader. Taking the day off or leaving early at the slightest sign of not feeling well sets an example for everyone under you. Lost productivity and continuity can have a tremendous impact on a company's operations and financial performance due to missed deadlines and rocky customer service.

Push Through Pain

- Rules don't apply to you
- No such thing as a sick day

Quality Systems are Much More than a Certification for Marketing and Sales

Nagji's automotive boot camp at Ford had impressed upon him the value of quality standards as a tool to run your company, not just a "shingle" to aid the sales department. We were taught to think of the quality management system as a profit center, as opposed to a cost item on our P&L. Things such as documenting processes, forcing in-process quality checks, drilling down into root cause for rejections and rework, etc., became part of our core business process.

In the 1990s, we were the eighth North American PCB manufacturer to achieve QS9000, which is an automotive quality management system. By 2004, we were completely out of production for the automotive industry when the new TS16949 quality management standard replaced QS9000. Despite not needing this standard, Dad went to the classes the governing body held on building the TS system and within one year we became the first PCB manufacturer in North America to achieve TS16949. Even though we had no use for the cert from a sales perspective, he felt we needed the cert from a systems standpoint. He was impressed by the standard's structure and, most importantly, the requirement for root cause analysis and continuous improvement. These are things that he always pushed for, but that would sometimes fall by the wayside to make room for other projects and situations. Now we meet every other day to discuss new items and follow up on studies aimed at furthering the continuous



Figure 4: Signs adorning the Saturn hallway reflect Nagji's dedication to quality. (Photo by Irina Burcusel)

improvement agenda. And the placards he hung from the ceilings throughout the facility serve as a constant reminder to this emphasis he placed on quality.

Quality Systems Have Value

- Commit to quality systems
- Believe in them: Quality systems are much more than just a cert to promote on your website

Respect Your Suppliers

As I mentioned earlier, Dad immersed himself into the details of the machines, chemicals, and materials we purchased. As a result, he cultivated excellent relationships, and in many cases, friendships with our entire supply base. He even had rules at Saturn regarding suppliers:

1. We have to buy them lunch—they are here to help us.
2. We invite them over for dinner—dinners are a way to build on relationships.
3. We "listen to the supplier...even if you have to admit you are mistaken" as was the case when he was informed that he was "stepping over dollars to pick up pennies" with some of our process decisions.

After years of building relationships with our suppliers, we can really feel that they are coming in with the focus of making our company better—not just to sell us more of their materials.

Respect Your Suppliers

- Value suppliers as part of your team
- Remember: Value, quality, service and then price
- Buy your suppliers lunch; invite them over for dinner
- Listen to your suppliers—even if you have to admit you're mistaken

Cash is King: Company Eats before Family

Dad was adamant when it came to fiscal responsibility—for the company. During the stock market crash of 2000, he was personally invested heavily in technology stocks and saw his portfolio drop by as much as 70%. By the end of the year, he was personally loaded up on debt in the form of margin loans, mortgage, and personal lines of credit. However, he rebuffed any calls from his partners on pulling money out of Saturn. As a result, Saturn went into the PCB market crash of 2001–2003 as a debt-free company with heavy cash reserves. I always say that Saturn eats before the family does and I don't think there's any better example to describe it than this.

He would only invest when it was wise and absolutely necessary. In the same way, keeping cash resources available was equally important as well as not spending money you do not have. Not only would the company not be allowed to take on debt in the form of mortgages, lines of credit, or lease equipment, he was adamant about paying suppliers quickly. In fact, our A/P is always \$0 on the 15th and 30th of every month.

The same discipline was used in our capital investment programs. He was wise with his money, but that did not mean that Saturn never invested. He forced us to think long and hard before making capital equipment investments—even when they were only a few thousand dollars. Not to say that he was being stingy, but rather to instill discipline in us so that we would not flagrantly spend money on items that may not be fully necessary. If he saw an opportunity in an emerging market he would take calculated risks and invest in cutting-edge equipment and even expanding the facility for such equipment. It was amazing how long I had



Figure 5: Nagji receives an award from Corp! Magazine's 2014 Salute to Diversity.

to argue to buy a \$3,000 via-plugging module, but the decision to drop \$1 million on a press system and building took less than 10 minutes. With proper evaluation techniques, making large scale investment decisions is actually an easy thing to do. He was still looking for the best possible return on investment and that's what happened with the "Plating Rack Deal."

In that deal, Dad was negotiating the purchase of all new plating racks. The supplier came in at \$100k. Dad only wanted to pay \$80k. They couldn't come to an agreement because the supplier knew Dad wanted the racks he was making as opposed to the competition's. So Dad made a proposal that they flip a coin. If he won, then the racks would be \$50k. If he lost, the racks would be \$150k. The supplier sweated this one pretty good, and in the end agreed to a straight-up sale at \$80k. I guess having a solid balance sheet also allows having fun and taking risks.

Cash is King: Company Eats before Family

- Keep cash resources
- Pay accounts payable to zero on the 1st and 15th of every month
- Only buy equipment with cash
- No banks; no debts; no leases
- Take calculated risks
- Be wise with your money

Second Chances

Although Dad was a savvy and disciplined businessman he was also capable of great empathy when it came to his employees. “Treat them like family,” he told me. “Because that is what Saturn is: a family.” Though he demanded exceptional performance from his employees he was never one to turn his back on them. When I was younger, one employee was battling alcoholism. One Saturday morning, Dad and I pulled up to work and saw him in the backseat of a police car. There had been a huge argument between the employee and my dad’s two partners. It was so bad that the police needed to be involved. After being briefed on what had occurred, Dad sat down at his desk and the phone began ringing. It was the recently-apprehended employee. He needed someone to bail him out. Dad told him no and hung up the phone. As I watched him over the next half-hour I saw his incredulous face melt and become pensive. He got up and with nothing more than “I need to take care of something,” he walked out the front door. Dad had bailed the troubled employee out of jail and given him his job back. When I asked him why he bailed the man out, Dad told me that this employee had no one else that he could call and that he was a good man suffering from a disease.

However, this compassion was not only extended to Saturn employees; in fact, it was also evident when a rival, as impertinent as the troubled employee, turned to him for help. I say impertinent because they had also previously wronged us yet had no shame when they needed a favor. And this goes beyond helping a troubled employee. This was a competitor who, when we asked them for help, allowed a Saturn employee to wait in their lobby all day like Bud Fox waiting for Gordon Gekko before finally telling him that they did not want to help us.

So when they called us, Dad was sure to give them all the help they needed and then some. For three weeks they used our facility at night to make their boards. When their facility was finally running the rival owner thanked my father and asked what the total charges would be. Dad said no charge. Shocked, the owner asked why. Dad then asked him to remember how they mistreated us years back and said

that the reason he wouldn’t charge was because he wanted to embarrass the owner of the rival company. Anyone can get upset and yell. But calling them out on their hypocrisy through action when they failed is far more memorable.

Second Chances

Respect Your Employees

- Treat them like family—at the end of the day this is what your company is

Being boss does not mean you aren’t human

- Second chances: It’s okay to make a mistake as long as you only do it once

True Root Cause

- Put in controls to avoid repetition

Feuding with Competition

- Forgive but never forget

There must be hundreds of lessons I’ve learned from Dad over the past 25+ years working with him at Saturn. However, these seem to ring the loudest when I sit back and think about it. It has been a fortunate privilege to have had the opportunity to work with someone like my dad for so long and I can only hope to do my best to make him proud as we soldier on without him. Hopefully these lessons can help you out as they continue to help me. Thanks for reading this. **PCB**



Figure 6: Yash, Nagji and family at DBusiness’ 2013 Champions of the Economy reception where Yash received an award.



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Supply Lines Highlights



Laser Pointers: Laser Processing and Telecentricity

Since Mike and I often receive questions on topics that are relevant to a broader audience, we've decided to start using this column to share those questions and answers with our readers. We'll periodically devote the space in this column to address questions that we receive that are especially timely or topical, or address a topic that affects a wider range of readers.

The Story Behind the News: Ventec's IMS Manufacturing Capabilities in China Doubled

In this interview conducted at Ventec Europe's headquarters in Leamington Spa, UK, Ventec Europe & USA COO Mark Goodwin sat down with I-Connect007 Technical Editor Pete Starkey to share the details of Ventec International Group's \$2 million equipment investment. With this injection of new equipment, Ventec doubles its IMS material manufacturing capacity in China.

Frontline Announces InStack Design

Frontline PCB Solutions, an Orbotech-Mentor Graphics company, today announced the launch of InStack Design, an industry-proven solution for designing complex stackups in minutes, taking all fabrication and SI constraints into account and enabling seamless electronic collaboration with board fabricators.

It's Only Common Sense: Respect the Customer, no Matter What!

Customers are much more demanding and insistent that we do things their way. And the irony is that they want less direct communication with us than ever before. They want to do everything online, and they won't pick up the phone if you call them. And heaven forbid if you try to visit them in person...they want no part of that.

Amphenol Invotec Tamworth Facility Adds Machinery From Viking Test

Amphenol Invotec, Europe's leading manufacturer of time-critical, high-technology PCBs has

commissioned a new Pluritec Inspecta Combo HPL X-Ray drill with complete automation, from Viking Test for its facility in Tamworth.

AISMALIBAR North America to Exhibit at Ford Advanced Lighting Innovation Expo

AISMALIBAR is happy to announce their exhibit and presentation at the Ford Advanced Lighting Innovation Expo (ALIE) show in Dearborn, Michigan, on October 5-6.

Amphenol Invotec Adds Nordson ProVIA Plasma System

Amphenol Invotec, Europe's leading manufacturer of time-critical, high-technology PCBs has commissioned a Nordson ProVIA Plasma System, from Adeon Technologies for its facility in Tamworth.

Anaheim Tech Center Showcases Pluritec, Ecospray & Limata Equipment

This West Coast addition augments Pluritec's North American headquarters in Bohemia, New York, making it more convenient for customers in the West to see the equipment in operation.

Pluritec Hires Sousa as New VP-Sales/Marketing

Pluritec recently announced the appointment of Lino Sousa as vice president of sales and business development. In this role, Sousa will be responsible for all direct sales and reseller functions for North America. He has also been entrusted to grow strategic customer accounts and partner relationships that tactically meld with Pluritec's core business objectives.

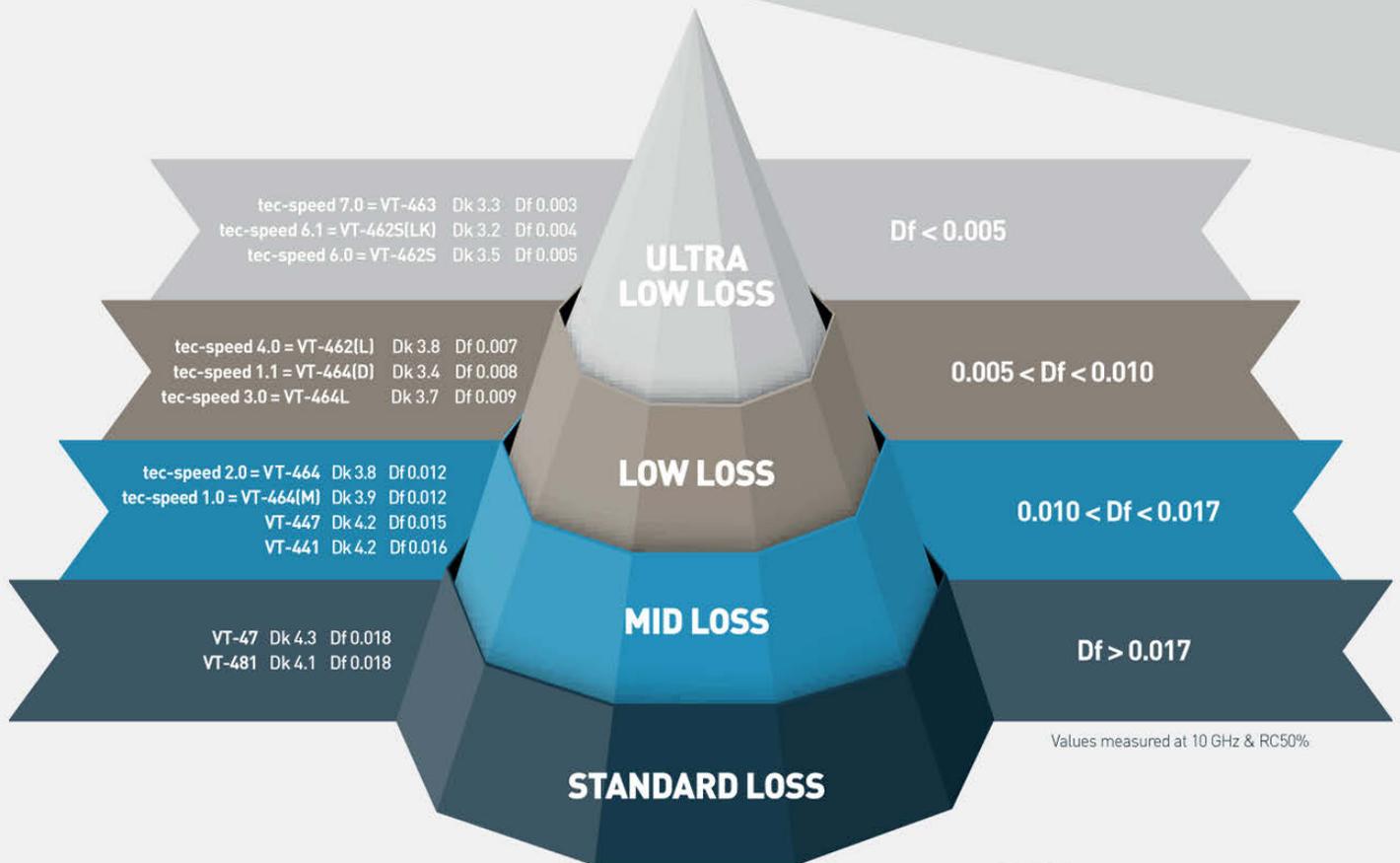
Ventec International Doubles IMS Material Manufacturing Capacity with \$2M Equipment Investment

Ventec International Group has doubled its B-series Insulated Metal Substrate (IMS) materials production capacity at its Jiangyin, China facility. The company has invested USD 2 million in leading edge production equipment that boost IMS materials production capacity 100% above prior levels.

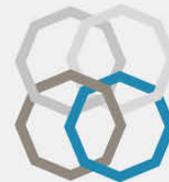
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BizBrain IQ Test:

by David Dibble
DIBBLE LEADERS

With an introduction by Barry Matties, publisher, I-Connect007

Introduction

When David Dibble was only 24 years old, with just \$5,000, he started a PCB company—in a garage. He built it to a profitable \$10 million in sales and 200 employees making printed circuit boards.

Focusing upon the work of W. Edwards Deming, Peter Senge, Buckminster Fuller, Ilya Prigogine, and John S. Bell, David became an expert in workplace systems improvement. Since 1990, he has been training and consulting using his *Four New Agreements for Leaders and Managers* as a proven model for sustainable organizational transformation, with remarkable results. Today, he is the president of Dibble Leaders.

I-Connect007 worked with David to formulate the *Biz Brain IQ Test*, which we offered to readers during the last several months within I-Connect007 publications. Below are the combined responses from the 170 people who completed the quiz, representing a cross-section of disciplines from our industry.

The highest possible score for the Biz Brain IQ Test is 200. The average result was 120, while the highest score we saw was 167.

Discussion of Results and Answers

1. The culture of a company is most shaped by:

The mindset of top management	32%
Values	25%
Company policies	15%
Vision	15%
Mission	13%

This question is probably a bit too easy in that there is more than one best answer. The culture of a company is most shaped by *the mindset*

of top management. Having said that, we see that values and vision are part of the mindset of top management. *Mission* also falls in there somewhere. We can even make a case that *company policies* many times come from the mindset of top management.

2. The most important aspect of being a good manager is:

Setting people up to be successful	50%
Immediately acting to solve problems	19%
Being a systems thinker	13%
Holding people accountable	8%
Controlling people's actions	4%
Being good to people	4%
Pushing people to reach goals	2%

This question starts to get to the heart of what it means to be a great manager. The best answer is *being a systems thinker*. Notice only 13% of responders picked this answer while 50% picked *setting people up to be successful*. Interestingly, it's very difficult to set people up to be successful unless the systems in which they work have been optimized in a systems-based manner. *Taking immediate action to solve problems* is usually a bad choice in that the “don't just stand there—do something” tenet driving most managers is seldom the best option. Doing something before understanding the problem (system) often makes things worse. How can we *hold people accountable*, if we haven't optimized the systems in which they work? Remember, approximately 94% of the results are a function of the systems in which people work, not the efforts of people. Most of the time when we measure results we attribute to people, we are measuring results produced by the systems.

The Surprising Results

3. When a new employee is hired, the most important training should be:

Vision, mission, values of the company	38.6%
Specific job training by a superior	18.6%
Sexual harassment	11.4%
Policies and procedures	10.7%
Systems thinking and tools	10.7%
Informal get-togethers to meet peers	6.4%
Merit review process	3.6%

This question tests the responder in a couple of ways. First, it gets to the heart of systems thinking and if the responder is a systems thinker. The best answer is *systems thinking and tools*. Only 10.71% of responders chose this best answer while 38.57% chose *vision, mission and values*. If vision, mission and values do not include systems thinking and tools, it is very difficult to set people or the company up to be successful—or at least optimally successful. Second, although a widely accepted practice, *specific job training by a superior* is simply wrong. It adds variation to systems making them less efficient over time. While *sexual harassment* training is important, sexual harassment itself in the workplace is a cultural problem that must be addressed at that higher level before training itself will be effective. *Policies and procedures* are useful, but usually only in disciplining employees. Instead, build policies and procedures around optimized systems.

4. Do you consider yourself to be a systems thinker?

Most of the time	36.4%
Sometimes	23.6%
Absolutely	18.6%
I'm not familiar with systems thinking	18.6%
Occasionally	0.0%

This question looks at the responder's understanding of systems thinking. There is only one best answer to this question and that is *absolutely*. You either are a systems thinker or not. If you are a systems thinker, you know it absolutely. If you're not a systems thinker or only on your way to becoming a systems thinker, you will have responded something other than absolutely. Systems thinking is much like learning a foreign language. At first we translate the foreign language back into our native thinking to make sense of it. As we progress, we are able to translate more and more back into our native thinking. One day, with ongoing practice, we reach a point where we don't have to translate back. We simply *think* in the foreign language. At that point we are fluent. Systems thinking can be a curse in that, when you think in systems, it's often difficult to believe the workplace works at all with all the non-systematic thinking entrenched within the vast majority of leaders and managers.

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5. How do you prioritize your work or projects?

I put things in proper sequence	37%
I work on my top 20% important issues	22%
I work on whatever is most pressing	20%
I do what I think best	12%
I don't formally prioritize very much	5%
I mostly work on the things I like to do	3.6%

This question looks at systems thinking and tools. One of the most useful and powerful systems optimization tools is the 80/20 rule. This Pareto principle tells us that usually 20% of the variables create 80% of the outputs. If you look in your closet, you'll see that 80% of the time you wear 20% of the clothes in your closet. It's the same for most systems. If you want to get the most out of your systems, identify the critical 20% of the variables. In fact, as a leader or manager, you want your people working only on the critical 20% of their systems/projects.

The best answer here is *I work on only my top 20% of important issues*. A close second is I put things in proper sequence. However, note that you can't put things in proper sequence unless you have first identified the critical 20%. *I work on whatever is most pressing* is wrong unless one has done the systems work to know what's most pressing and specifically the critical 20%. *I do what I think is best* is mostly wrong. Unless data indicates that what you think is best is really best, you'll usually be working on the wrong issues or symptoms of root causes.

6. What do you think the most important goal for leaders should be?

Providing value to customers	29.3%
Optimizing systems/growing employees	28.6%
Setting people up to be successful	15%
Making money	6%
Optimizing our systems	6%
Growing employees	5%
Hitting our numbers	2%
Growing the business	0%

The best answer here is *optimizing systems and growing employees*. If a leader focuses on optimizing systems and growing employees, both the employees and customers will feel valued and taken care of. *Setting people up to be successful* is second in that it entails optimizing systems and growing people. *Optimizing systems* is third and *growing employees* is fourth. *Providing value to customers* garnered nearly 30% of the vote but this is the wrong place to focus. Customer satisfaction and value received is much more a function of happy, systems-literate employees, management and leadership than anything else. In fact, some studies suggest that customers will feel that same about the company as employees over time.

7. What do you think is the best way to deal with problems?

Looking to systems as source of problem	32%
Putting our best people on the problem	29%
Getting people to behave differently	11%
Cracking the whip	11%
Telling people how to fix the problem	10%
Holding people accountable	6%

Looking to the systems as source of the problem is easily the best answer here. If 94% of the problem is systems-related, why would you look anywhere else? From a systems thinking perspective, there are no other good answers here. While *putting our best people on the problem* is a traditional approach, it is badly flawed. Unless the "best people" take a systems-based approach, problem solving will be a firefighting exercise and solutions will not be sustainable. The remainder of the answers to the question are also flawed and, in some cases, make things worse. Taking any action without knowledge of the systems is simply tampering, which adds variation to already stressed systems.



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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



8. What do you think is the best way to optimize the performance of a company?

Rally the people through teambuilding	29%
Fix or optimize a few key systems	27%
Implement latest information technology	10%
Increase profit-margin goals	10%
Bring in new people in key areas	10%
Increase revenue growth rate goals	6%
Reduce real costs	4%
Cut expenses across the board	4%

The best answer here is *fix or optimize a few key systems*. In most cases, nothing improves performance like optimizing the few key systems that are holding the company back. Because all systems are connected, optimization in key areas creates synergies throughout the organization and even to customers and suppliers. The second best answer is to reduce real costs. Systems optimization naturally reduces real costs, usually significantly. In certain circumstances, people really are the issue and require us to *bring in new people in key areas*. Remember, however, that bringing in new people will not change results unless systems are optimized. Like bringing in new people, in some cases we must *implement the latest information technology*. Be aware that, even when absolutely necessary, implementing new technology will take longer and be more expensive than even the highest estimates. *Rally the people through teambuilding* may give a short-term boost to the company but it won't last without systems work. The other answer options will usually make performance worse, not better.

9. In making decisions in a business, what do you think most influences those decisions?

80% logic / 20% emotion	47%
50% logic / 50% emotion	17%
100% logic	16.5%
20% logic / 80% emotion	12%
100% emotion	6.5%

The answer to this question will likely surprise many. The best answer is *100% emotion*.

In fact, every decision that the human mind makes is driven by emotional energy and only later backed up with logic. It doesn't matter if we're running numbers in a spreadsheet, picking out a dress or ordering dessert, the mechanics are the same—emotion before logic. Think how this may affect your decision-making. Notice most leaders and managers believe that logic drives emotion rather than vice versa. The further you get away from 100% emotion as the driver, the worse your answer. For those who are not convinced, we have an exercise we do with skeptical executives which proves the point.

10. What causes the most frustration for people in the workplace?

Poor leadership	24%
Poor direct management	21%
No passion for the job	19%
Poor systems	11%
Not enough private life	10%
Poor business planning	9%
Not enough money	4%
Too far from work	2%

This question is really a look in the mirror for leaders and managers. Without doubt, the root causes of most frustration in the workplace is *poor leadership*, *poor direct management* and *poor systems* where people cannot feel successful in their jobs. The mind of top management shapes the culture of the company. Poor or faulty thinking by leadership equals a troubled culture. Poor direct management impinges on every aspect of the workplace experience for most employees. Poor systems imprison an employee in a no-win situation. Is it any wonder that 70% of the U.S. workforce is disengaged in the workplace? If I could wish any single improvement to leadership and management worldwide, it is systems thinking. No matter how poor leadership or management may be, systems thinking will create a dramatic improvement.

Bonus Question

I have one final bonus question for those of you who are interested in the costs of bringing sustainable systems optimization to your company and people:

What is the average ROI for doing in-depth, sustainable, systems optimization work in conjunction with systems-based staff training?

- A. 300%–1000%
- B. 100%–300%
- C. 50%–100%
- D. 47%
- E. 28%
- F. 10-25%

The answer to this question can be found after the scoring summary below.

The Biz Brain IQ Test is designed to introduce you to the power of systems thinking and the roles of leadership and management in harnessing that power. The test challenges many of the old beliefs about leadership and management that now go unexamined. It is also an opportunity for you to get a feel for where you stand in relation to other leaders and managers as relates to systems thinking and the use of systems optimization tools as your best bet for resolving problems and significantly improving the performance of your company.

Check out your score and, if you have questions, feel free to contact me anytime.

Scoring

150–200—You are a genius leader or manager. You're probably in the top 1–2% of all leaders or managers. Your business will likely dramatically outperform those of your competitors. You are probably being recognized as a leader in your industry and business in general.

130–149—Congratulations! You are for the most part a good leader or manager. Your business is probably doing well in relation to

your competitors. You may be seen as a leader in your industry.

110–129—You are about average and probably a somewhat effective leader or manager. Your business is probably performing about the same of your competitors. Your company could be doing significantly better.

90–109—You are below average in your knowledge of systems and growing your people. Your business is probably struggling at times and needs work in both systems optimization and growing people.

89 or less—You may have difficulty sustainably solving problems, motivating people or growing the business. Your business will often be filled with drama and expensive firefights. You may well be feeling somewhat overwhelmed or exhausted.

Bonus Question Answer

The answer is A: 300%–1000%. Because ROIs like this are very rare in most businesses, for most leaders and managers this is a hard number to fathom. Yet, throughout a 25-year period of doing this type of work, 300–1000% first year ROIs are where the returns on the vast majority of implementations fell. The point of this question is to get leaders and managers thinking about what they might do to raise their game and most benefit their people and companies. **PCB**

References

1. [Biz Brain IQ Test](#) by Dibble Leaders.



David Dibble is a keynote speaker, trainer, consultant, executive coach, and systems thinker. For more than 25 years he has consulted and trained in the workplace, with a focus on his systems-based book [The New Agreements in the Workplace](#). To reach Dibble, [click here](#).

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Six Leadership Lessons from 20 Years in the Electronics Industry

by **John Mitchell**

IPC—ASSOCIATION CONNECTING
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The orchestra conductor is an apt metaphor for the successful leader.

Effective leadership often boils down to the ability to inspire others (the symphony) to their best work, while keeping and driving the overall vision of the organization (the musical score).

Freed from the minutiae of day-to-day operations, leaders are called upon to consider the “big picture” and then make the tough strategic decisions that could make or break their team’s work.

I’ve spent more than 20 years in the electronics industry, beginning as an engineer for General Electric in upstate New York.

For the last four years, I have served as president and CEO of IPC, a global trade association for the electronics industry. In this role, I have been exposed to all types of problems faced by the CEOs of our more than 3,700 member companies worldwide. In addition, I have witnessed innovative management and leadership techniques employed across dozens of different cultures.

It would be impossible for me to capture all of the qualities exhibited by the most successful executives of the world’s largest electronics manufacturers in this short space. I can, howev-

er, highlight the themes I’ve observed and the lessons I’ve learned in my own career.

1. Integrity trumps all.

It’s trite to say that the world is small, but it’s true.

Customers, suppliers, and manufacturers all talk to each other. Those who have the best reputations and longest tenures in this industry are honest to a fault. In addition, to succeed in the most demanding jobs, you have to be able to sleep well at night.

The lesson here? Always, always do the right thing. The dividends will follow.

2. Stretch.

Do not be satisfied with the status quo. Understand and consistently seek to learn how things might be better and what resources are required to get there. Then, build a plan and start executing and refining until you get there.

The moment you become complacent is the moment you begin to lose market share to your competitors.

3. It is all about the people.

There’s an adage in HR circles that “people don’t quit companies, they quit managers.”

Regardless of your business, at a certain level you’re only as good as your team. Thus, the utmost care must be taken to identify, recruit,

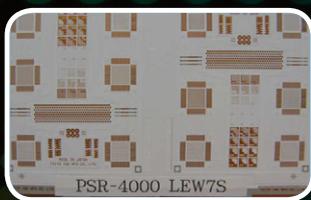
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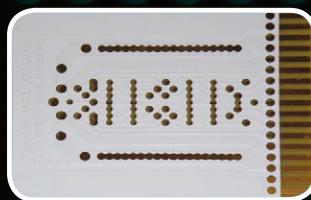
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- Take care of your staff. Ensure that they are a diverse group and not just clones of you. Mix it up a bit (incorporating different personalities, experience levels, backgrounds, etc.) to craft the best team.

Most importantly, encourage and enable an open culture where constructive feedback and different opinions are embraced and encouraged. By embracing a positive and safe corporate culture, ideas can be hashed out on their merits, allowing the best to emerge.

4. Remove the bad apples.

This is a team, not a family.

With your family you have to deal with your sister-in-law because she married your brother—there's no other option.

In contrast, teams are carefully assembled by owners and managers. As in sports, if a player is no longer good for the team (either by choice or by capability), it's time for a trade.

Further, trades are often best for the poor teammates in the long run. People deserve to work where they will flourish into their best selves—so leaders should not shy away from tough decisions when some are not in the right place or not living up to their potential.

5. Tackle the hard things first.

It's critical for leaders to recognize and understand their most critical tasks of the moment and focus on them. The key word here is focus—to avoid the distraction of the million other things that are easier, more interesting, more fun, more whatever. Then grind away at that most important thing.

The results? You finish the most important thing. You discover your other tasks, if still relevant, are easier to do once you've accomplished that first thing. And you find that day in, day out, week after week and month after month, your best efforts have been spent on the areas most valuable to you and your organization.

6. Take care of yourself.

If you are not eating well, sleeping enough, or exercising with regularity, your performance—and that of your team—will suffer. You owe it to yourself, your team, and your stakeholders to perform at your best. So ensure you are appropriately balancing your work and health—emotional as well as physical.

While far from an exhaustive list, these six keys have helped me grow in my career in the fast-changing field of the electronics industry. I hope they are of value to you as well. **PCB**



John Mitchell is president and CEO of IPC—Association Connecting Electronics Industries.

Secure Passwords Can Be Sent Through Your Body, Instead of Air

Sending a password or secret code over airborne radio waves like WiFi or Bluetooth means anyone can eavesdrop, making those transmissions vulnerable to hackers who can attempt to break the encrypted code.



Now, University of Washington computer scientists and electrical engineers have devised a way to send secure passwords through the human

body—using benign, low-frequency transmissions generated by fingerprint sensors and touchpads.

“We’ve now shown that fingerprint sensors can be re-purposed to send out information that is confined to the body,” said senior author Shyam Gollakota, UW assistant professor of computer science and engineering.

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Leadership Lessons from the Rio Olympics 2016

by Renato Peres
CIRCUIBRAS

This month's column is not about PCB technical stuff; instead, it's about some valuable lessons I have learned this summer during that most fantastic of events, the Olympics. What I have learned can now be applied to PCBs and how we can transform a glass-reinforced laminate or any other bare material into an incredibly useful product that will make the difference in every single life of this planet.

The 2016 Summer Olympic Games in Rio de Janeiro finished about two months ago and there are many things we can learn from the athletes, coaches and supporters.

It was the first time Brazil held such an event, and it started quite well with the opening presentation. If you haven't seen it, I strongly advise you to do so. It was outstanding.

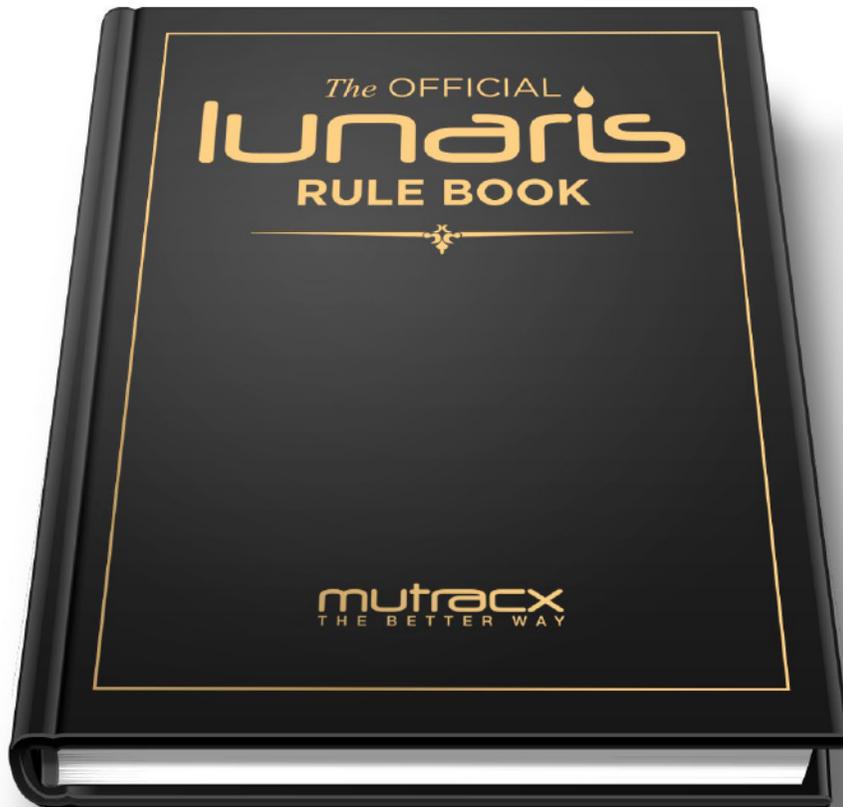
Of course there were pros and cons before and during the games, but as a whole, the Olympics were quite good. Thomas Bach, president of the International Olympic Committee, said, "These were marvelous Olympic Games in the marvelous city."

Every time I watch a game, TV show or movie I subconsciously start linking what I am watching with what I live daily. It is amazing the number of things we watch that can influence our way of leading, either for worse or better.

With the last Olympics and Paralympic Olympics it was not different. For this reason, I would like to share some leadership thoughts I have learned from Brazilian athletes and coaches in the last couple of months.



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Rafaela Silva



**Rafaela Silva—Gold Medal at Rio 2016—
Judo, Women’s 57Kg**

I could cite Confucius or some other great philosopher, but as we are talking about sports, movies and fighters, I see no better quote for Rafaela than one from Rocky Balboa, Sylvester Stallone’s character from the Rocky movies:

“You, me, or nobody is gonna hit as hard as life. But it ain’t about how hard you hit. It’s about how hard you can get hit and keep moving forward. How much you can take and keep moving forward. THAT’S HOW WINNING IS DONE!”

In Rafaela’s case, this is the truest quotation I could ever imagine. She was born in the biggest favela of Rio de Janeiro, nicknamed City of God, facing poverty and criminality. She could have made many excuses for not becoming a champion or a successful woman, but she decided to take another direction.

Rafaela started training at the age of five under the guidance of her parents who wanted to keep her and her sister away from the streets.

She showed a high skill level and was invited by her coach to keep training permanently. The tipping point came in London 2012 when she was disqualified for grabbing the leg of her opponent, which has been illegal since 2010.

Claiming she made a mistake, and that she was not trying to cheat, Silva faced racism, criticism, depression and serious struggles to get back to the sport.

In 2013, a year after the Olympics, she won the world championship and in 2016 she became the only Brazilian woman to ever win both the world championship and an Olympic gold medal.

What have I learned from Rafaela Silva?

1. There is no excuse. Many times people try to find excuses for their weak results, lack of success or personal achievements, in order to avoid facing reality. Rafaela is an example for leaders who try to hide behind their adversities of daily life, and who blame the others for their own failures.

2. Being a leader requires a huge effort to face the truth, no matter what. In fact, one of the greatest moral virtues a leader can embrace is honesty in recognizing what is going well and what is not. We tend to put our best foot forward, and there is no reason not to do so. But we cannot stop there, even when everything else is okay.

3. In winning or failing, and in being successful or not, there are consequences. Getting stuck is a decision.

Questions to consider:

- What are the decisions I am going to make?
- What are the excuses I need to face?

**Thiago Braz da Silva—Gold Medal at
Rio 2016—Pole Vault**

This was one of the most controversial gold medals in Rio 2016. The Brazilian supporters played a key role on Thiago’s victory, not in the way Silver medalist Renaud Lavillenie, lost the competition, but on how Thiago Braz won it. The Brazilians motivated him, and he was able to turn the supporters’ pressure, that once was his greatest fear, into his greatest weapon.

Thiago has been trained by one of the most well-known pole vault coaches, the Ukrainian Vitaly Petrov, who trained two world record holding athletes. He also won the World Junior Championship in 2012, and was qualified 4th in the World Indoor Championship in 2014. Additionally, he held the South American record for pole vault. He had never achieved the mark of six meters, but he was ready for it.



Thiago Braz da Silva

Thiago admitted one of his greatest battles was with his own mind. The fear of failure was constantly invading his thoughts.

What have I learned from Thiago?

1. A leader must believe he can. A leader must believe he is able to succeed, because nobody will do it for him.

*"You can do as much as you think you can,
But you'll never accomplish more;
If you're afraid of yourself, young man,
There's little for you in store.
For failure comes from the inside first,
It's there, if we only knew it,
And you can win, though you face the worst,
If you feel that you're going to do it."*

—Edgar A. Guest

2. Preparation comes first. As with Thiago's career until the Olympic record, a leader's career is not built in the blink of an eye, because nobody ascends to a leadership position, and keeps it, preparing occasionally. Preparation has

no end in the life of a leader; there is no comfort zone for a leader.

3. Take risk. Taking risk means you have studied pros and cons of further steps, analyzed the risk and move forward. Acting without thinking is not taking risk, it is irresponsibility.

4. Humility. Having the humility to recognize what changes are necessary to be made and work to get it done is of paramount importance. But humility in leadership has another connotation. Leaders are those who serve the others, taking the bricks out of the way, not building walls with it.

Questions to consider:

- What do I know about leadership or my field of work that I didn't know last week or month?
- What are my failures and fears that I should start facing?
- Who will I choose to walk with?
- What are my plans for leading better, or for being a better professional, next week?



Robson Conceição—Gold medal at Rio 2016—Boxing, Men’s Light 60Kg

“Never, never, never give up.”—Winston Churchill

Robson Conceição grew up in a poor neighborhood in Salvador, in the state of Bahia. Since childhood, he needed to work to help his mom and grandmother. He hardly slept because of work and boxing training, and his first goal was to be as good a street fighter as his uncle. After realizing he was heading nowhere with his goal, he decided to become a professional boxer.

He had no financial incentives, and lost his two first fights in previous Olympics, but never gave up on his dream.

He was the first boxer to win a gold medal in Olympic games, and is considered the second best in the world in his category.

What have I learned from Robson?

Robson is an example of determination: no money, no time, no incentives, no father, yet a dream to follow. His goal was to make history in Brazilian boxing, and he did that by becoming the first Brazilian man ever to win at an Olympic Games.

Furthermore, he went through the process of defining what was important and what was nec-

essary. He knew it was important to him to train boxing, but it was necessary to work to get food.

When a leader has a well-defined goal it is easier to set a path and drive the effort to achieve results.

Questions to consider:

- What is my goal?
- Do I have a plan?
- What is important and what is necessary in my life?
- Am I focusing on what is important or just being led by what is necessary?

There are plenty of other leadership teachings we can learn, and I am sure you have a lot to share. Having said that, join my LinkedIn forum “Olympics and Leadership” and share your thoughts.

In my next article, I will examine the importance of the coach. **PCB**



Renato Peres is an industrial engineer and production coordinator with Circuibras Circuitos Impressos Profissionais.



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Electronics Industry News

Market Highlights



Steve Williams Receives Prestigious John Maxwell International Certification

Steve Williams, president of The Right Approach Consulting (TRAc), received certification from the John Maxwell Team as an Independent Certified Coach, Teacher & Speaker. The 5th anniversary weeklong event was held at the Marriott World Convention Center and hosted candidates from more than 30 countries.

For First Time, Carbon Nanotube Transistors Outperform Silicon

For decades, scientists have tried to harness the unique properties of carbon nanotubes to create high-performance electronics that are faster or consume less power—resulting in longer battery life, faster wireless communication and faster processing speeds for devices like smartphones and laptops.

DRAM Contract Prices to Rise Over 10% Sequentially in Fourth Quarter as Memory Demand Stays Hot

Prices of both DRAM and NAND Flash are projected to rise in the fourth quarter, and DRAM contract prices in particular will post another sequential increase of over 10%.

A Conscious Coupling of Magnetic and Electric Materials

New multiferroic material by Berkeley Lab and Cornell researchers is a big step in march toward ultra-low power electronics.

Memory for Future Wearable Electronics

In collaboration with Sungkyunkwan University, researchers from the Center for Integrated Nanostructure Physics within the Institute for Basic Science (IBS), have devised a new memory device inspired by the neuron connections of the human brain.

Global Flexible Electronics Market 2016—Forecasts to 2020

According to the report, capacity expansion plans is a key driver aiding to the growth of this market. As the innovation continues to churn out developments in the flexible display market, major com-

panies such as Samsung and LG have started expanding their manufacturing capacity and required investment in their APAC manufacturing plants.

Domestic Service Robots on the Rise

The domestic service robot market is forecast to grow at a compound annual growth rate of 17%, from five million units shipped in 2015 to more than 12 million units in 2020, according to IHS Markit, a world leader in critical information, analytics and solutions.

Researchers Find Vulnerabilities in Cars Connected to Smartphones

In what is believed to be the first comprehensive security analysis of its kind, Damon McCoy, an assistant professor of computer science and engineering at the NYU Tandon School of Engineering, and a group of students at George Mason University found vulnerabilities in MirrorLink, a system of rules that allow vehicles to communicate with smartphones.

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My Leadership Journey

by Steve Williams

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Introduction

I have been in leadership positions for the majority of my 40-year career, but it has not always been a smooth and natural relationship. With the following three stories, I will attempt to share the lessons learned on my journey as a lifelong student in pursuit of the art of leadership.

Lesson One: Work Ethic

I believe the foundation of leadership is formed by a person's work ethic; their belief in the moral benefit and importance of work and its inherent ability to strengthen character. The traits of a strong work ethic are the very same traits of a strong leader: professionalism, respectfulness, dependability, dedication, determination, accountability, and humility. A great leader embodies each of these traits and encourages others to embrace them as part of the continual development process.

I am so very lucky to have such positive role models in my parents, which is where my work ethic foundation was formed at an early age. Our family owned a PCB manufacturing shop, and before I was old enough to work there full-time, I would spend afternoons after work taking out garbage and cleaning toilets. Remember the humility trait? Well, nothing is more humbling and character building than cleaning toilets every afternoon. Of course, working in the business would become my first full-time job after escaping high school. This is where I learned my first lesson. What I have found is that people in this position, children of the owners, have two paths they can take. The first path is where they embrace the privileged role of being the owner's kid and all of the perks that come along with that. Or the second path, the one I chose, is to work harder than everyone else so that there was no doubt which path I had chosen. The collateral benefit from this work ethic





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is the respect that gets earned. I also believe that great leadership comes from having been there and done the work.

Lesson Two: A Manager is not a Leader

While researching my latest book, *Notorious: Business Lessons from History's Most Ruthless Leaders*, I was struck by a quote from Sonny Barger. Sonny has been the leader of the Hells Angels Motorcycle Club for the past 50 years, and Sonny said, "A great leader knows he doesn't have all the answers." This was a particular lesson that took me quite a few years to learn. I had been fortunate enough to have gained a significant amount of technical skill very early in my career, and this was probably part of the reason I had developed a very autocratic management style. My way, or the highway; I thought I did have all the answers.

I learned my second lesson while working in a PCB shop in the Midwest, running the mechanical processes (drilling, routing and programming). I'll never forget my department lead—a woman named Ruby, who was a tough-as-nails gal that had worked there for 25 years and happened to be one of the best drillers I had ever worked with. I don't remember the specifics, but I had given Ruby a list of a number of jobs that needed to get done one day, and when I came back later to check on them, not a single one had been completed. When questioning Ruby, she told me some unexpected hot jobs had come into the department and she reprioritized my list.

Of course she was right, but my ego felt my authority was being questioned, and I said, "Ruby, you just need to learn to follow directions." Ruby looked me straight in the eye and said "Steve, maybe you need to listen to us more often." It didn't sink in at the time, and I think my reply was, "Yeah, yeah, whatever, just follow my list." But years later Ruby's words would play a major role in my development. An autocratic style can work in the short-term, with direct reports, but not so much as I moved up in management and needed to get the cooperation of others outside my control. I knew I needed to make changes, but really didn't know which ones or how. You see, I had become a

good manager, but was nowhere near being a leader.

Lesson Three: My Ah-Ha Moment

Years later I was interviewing for an executive position with another PCB shop, and the CEO of the mothership would be performing the interview, as this position reported directly to him. This was an impressive businessman; he held a PhD and an MBA, and he was the leader of one of the largest multi-divisional companies in Wisconsin. As I was guided into his impressively large office for introductions, I stuck my hand out and said, "I truly appreciate this opportunity Dr. Sterner, I am...", and he stopped me right there and said "Steve, please call me Frank. Titles don't mean a whole lot around here, results do." I sat down in front of his massive desk, and he said, "Why don't we go over here and chat?" and led me over to a small, round table with two chairs, and we talked for an hour. I left that meeting reflecting on the fact that this important businessman took the time to make sure I knew he valued my time as much as his, and that at least for that hour, we were equals (even though we clearly weren't).

Frank's values of empowerment, teamwork, and mutual respect permeated that company, and as Ruby's words came back to me, became the beginning of my transition from manager to leader. As my fellow author and friend Warren Bennis once said, "A manager does things right, a leader does the right thing."

I recently went through a yearlong training program with the world's foremost leadership experts, the John Maxwell Team. The lessons learned were far too many to cover in even a year's worth of articles, but the overriding lesson I learned is that the more you learn, the more you find out how much you don't know. The journey continues... **PCB**



Steve Williams is the president of The Right Approach Consulting LLC. To read past columns, or to contact Williams, [click here](#).

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Are You a Leader or a Manager?

by Todd Kolmodin

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The question can be asked, are you a manager or a leader? Can you be both? Is there even a difference? The answer to this latter question is, yes. In a successful organization there are many people performing different tasks all in harmony to make the business successful. Some individuals can be phenomenal leaders while others can be excellent managers. Some can actually be both. How do we define a leader from a manager?

In a text written by Warren Bennis, *On Becoming a Leader*[1] some key differences are outlined, drawing some boundaries around leaders versus managers. One of his key observations that rings true is that leaders innovate while managers administer. By his definition, the leader comes up with new ideas and moves

the group into a forward thinking mindset. The leader constantly keeps their focus on the horizon and develops new tactics and strategies. The leader needs to be abreast of current trends, technologies and tactics. In his book, Bennis quotes Gene Wade, the CEO and founder of UniversityNow:

“You got people who are just going to work instead of thinking about why they’re doing what they are doing, and then you have the leaders.”

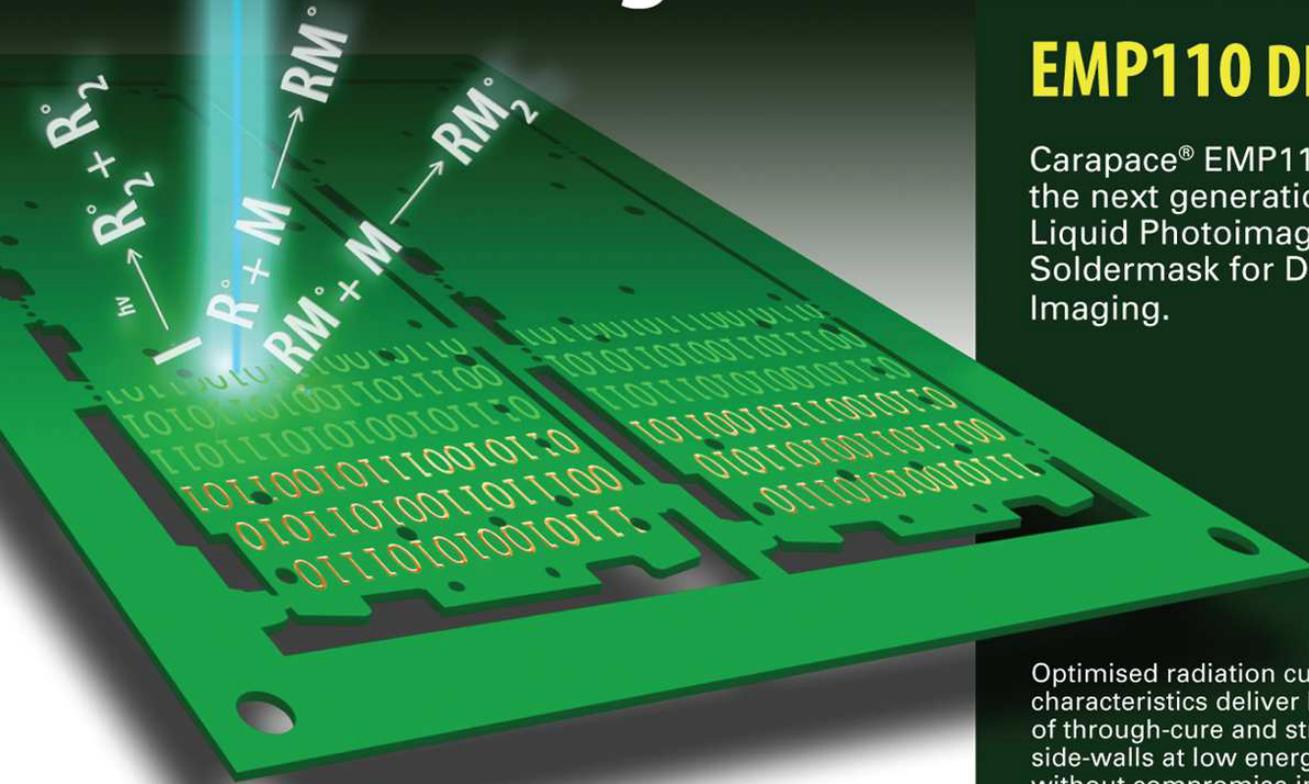
Bennis goes on to say that, conversely, you have the manager who maintains what has already been established. This person keeps an eye on the bottom line and maintains control. The manager maintains order within the company. Wade goes on to say, “The leader inspires





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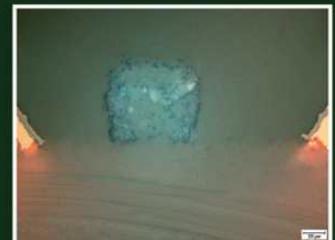
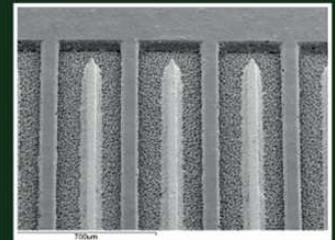
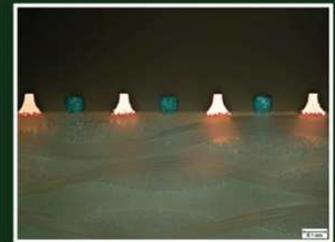


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trust whereas the manager relies on control.” The leader inspires other people to be the best they can be while setting the tempo and pace for the team. “Leadership is not what you do—it’s what others do in response to you. If no one shows up at your march, then you’re not really a leader,” Wade says. If your team does accept your inspiration you have created a bond of trust within your organization and this is essential especially if the business is rapidly changing and needs individuals who believe in its mission.

“Leadership is not what you do—it’s what others do in response to you. If no one shows up at your march, then you’re not really a leader.”

In the same book, management expert Peter Drucker comments, “As for managers, their job is to maintain control over people by helping them develop their own assets and bringing out their greatest talents. To do this effectively, you have to know the people you are working with and understand their interests and passions.” The manager then “creates a team from their people, through decisions on pay, placement, promotion and through their communication with the team.”

Wade goes on to add, “Managing a project is one thing, empowering others is another thing.”

What I found interesting is some of the insights Bennis, Wade, and Drucker shined on the differences between managers and leaders. Leaders ask the questions “what” and “why” while managers ask “when” and “how.” To ask the questions “what” and “why,” you have to be able to understand why certain actions are occurring. Sometimes this involves challenging authority. The successful leader needs to stand up to management when they think something

else needs to be done for the success of the company as a whole.

Wade goes on to say that if the company experiences a failure it is the leader’s job to come in and say, “What did we learn from this?” and “How do we use this information to clarify our goals or get better at it?” Instead, managers don’t actually think about what the failure means. Their job is to ask “how and “when” and make sure they execute the plan accordingly. Peter Drucker added that “managers accept the status quo and are more like soldiers in the military. They know that orders and plans are crucial and their job is to keep their vision on the company’s current goals.”

Concluding, Wade states that, “Although the two roles may be similar, the best managers are also leaders. I think you can do both but you have to take the time to cultivate it.”

So are you a leader? Or a manager? Combining the traits required for both is a one-two punch in success. Manage the goals and personnel while also thinking outside the box and asking the “why” and “what” questions. Lee Iacocca, the well-known automobile icon, encouraged the question of authority. Any of his team of thousands of employees were told on their assembly lines if something is not right, you pull that chain and stop the line. Employees felt pride in their empowerment and that they made a difference. There is an example of a “manaleader.” **PCB**

References

1. Bennis, W. (1989), “On Becoming a Leader.”

Additional Reading

1. Giang, V. (2012), “3 Things That Separate Leaders from Managers.”
2. Murray, A. (2010), “The Wall Street Journal Essential Guide to Management.”



Todd Kolmodin is the vice president of quality for Gardien Services USA, and an expert in electrical test and reliability issues. To read past columns, or to contact Kolmodin, [click here.](#)

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Three Keys to Successful Leadership

by Sam Sangani
PNC INC.

It is often easy to lose sight, particularly in the manufacturing sector, of 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 of those things in the positive.

It is not that upper management has a blatant disregard for the people working for them; but when you are in the business of making things it is easy to forget the people that actually make them.

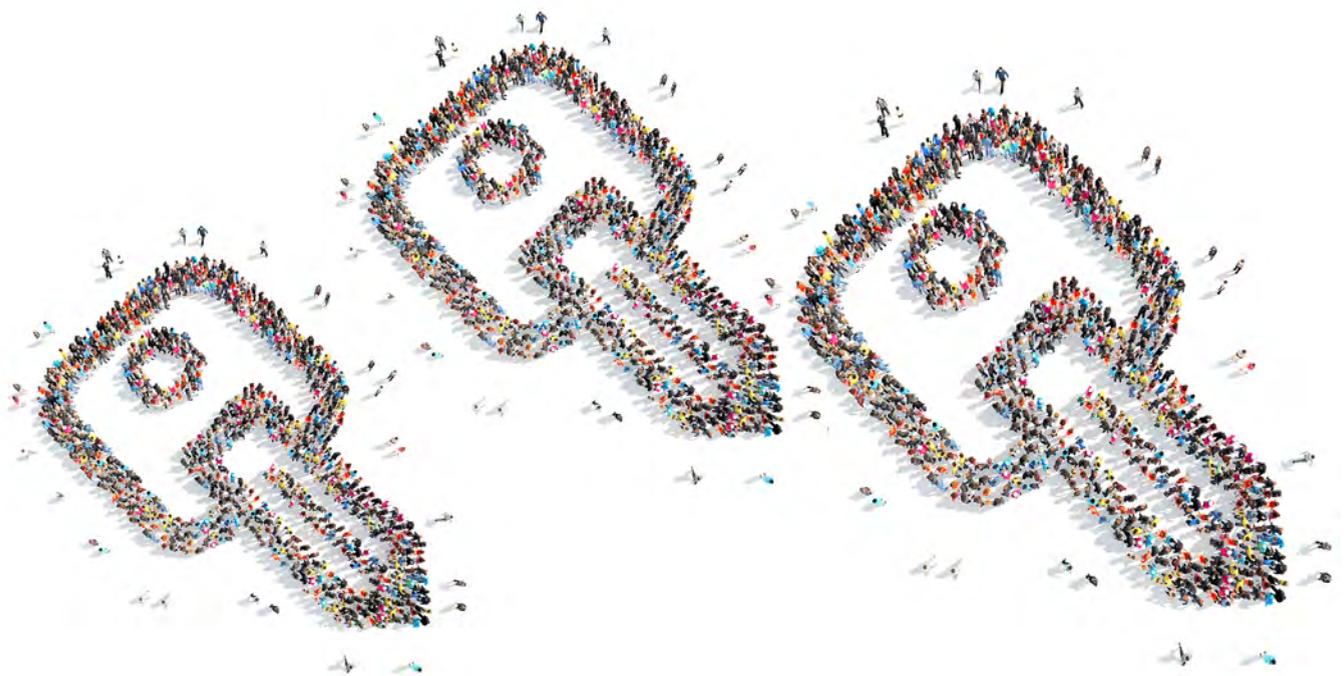
Good leadership and management will always hinge upon the value of three things:

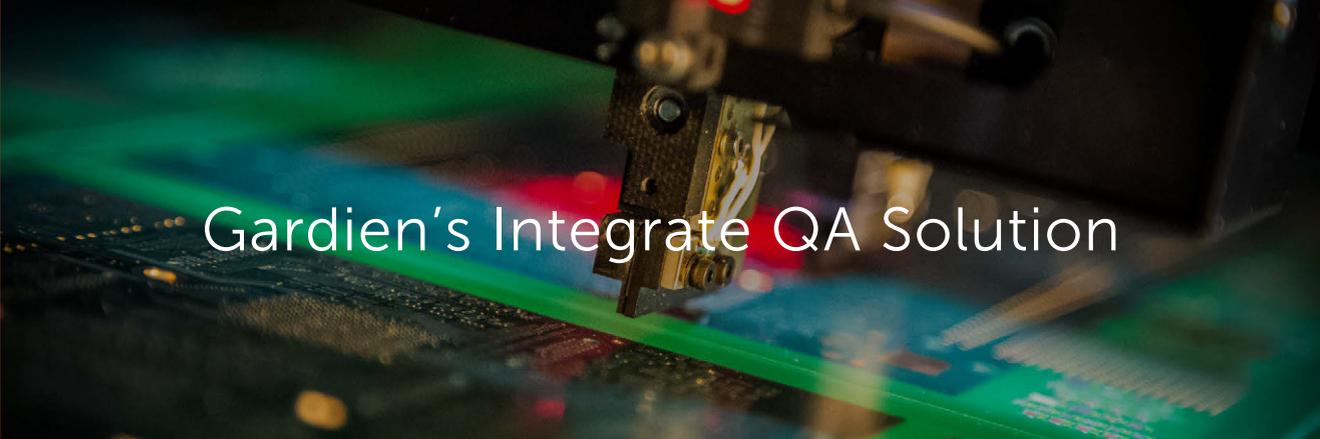
1. What the employee perceives their value to the company to be.

The most common way to measure this value is by compensation. However, it is not al-

ways the most accurate. We all see examples of over- and under-paid people all the time. There are other ways to manage what level of contribution someone thinks they are giving to a company. For example, you would be surprised how far verbal acknowledgment can go. You'd be even more surprised how much further it goes when it is done with others listening. This serves the double purpose of not only recognizing one employee's efforts but also incentivizing those listening to improve their level of performance in the hopes of receiving similar treatment.

Regulating this perception inside your employee's mind is undoubtedly one of the most important traits of a good leader. You need them to feel important but you never want them to feel irreplaceable either. No matter how honest and full of integrity they are, letting them feel overly important will breed mental lethargy and a lack of focus.





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2. What you (the employer) perceive their value to be.

This part requires a bit of introspection. Do you honestly think he/she is being fairly compensated? If not, can you afford to give them a raise? If the answer to that question is no, is there another way to show them they are important to your company such as the ones mentioned above? These are all questions that, when answered honestly and applied accurately, will allow you to leverage value into profit.

3. The company's value to you.

In the manufacturing world, leaders generally have so much at stake, usually large amounts of equity, that this generally isn't an issue. However, for the purposes of leadership in general (and the outliers) this truth still holds. If you don't care about the company, you will not be a very good leader/manager. Regardless of whether or not you have equity, you have to care. At the end of the day, everybody is in this to make money; therefore, everybody is essentially selling something—tangible or intangible. If you don't have faith in whatever it is you're selling, you won't be profitable.

Although the volatility of the manufacturing sector, especially for PC boards, is relatively low, we all know the market can turn on you any second—especially when you get too comfortable. Being overly comfortable can lead you to taking things for granted—especially your workforce. Leaders tend to rely a bit too much on the adage “everyone is replaceable.”

Although it's true, some people are less replaceable than others. Your department supervisor who has been there for 20 years and doesn't need to be told anything to do his job properly needs adequate upward movement in his/her compensation and position in order to maintain a semblance of self-worth and dignity.

At the end of it all, leadership comes down to balance: a balance between delegation and micromanagement, over- or underpaid, overly attached or undervalued. As leaders, to remain apathetic—to a degree—is one of our most important characteristics. In enables us to make rational decisions free of emotional influence. Pragmatism will always be your best friend.

Last—but certainly not least—be open to suggestions. Colin Powell once said, “The day the soldiers stop bringing you their problems is the day you stopped leading them. They have either lost confidence that you can help them or concluded that you do not care. Either case is a failure of leadership.” Although it is impossible to equate our brave servicemen and women with civilian employees, the underlying principle about leadership still remains. **PCB**

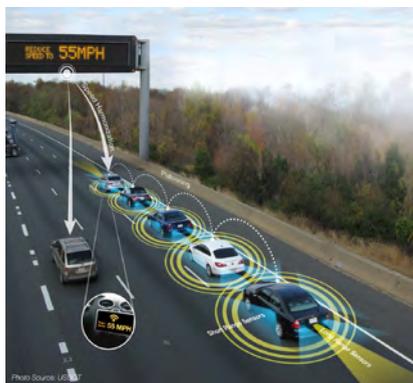


Sam Sangani is president and CEO of PNC Inc.

Connected Cars to Introduce a New Era of Smart Mobility

The production of new automobiles equipped with data connectivity, either through a built-in communications module or by a tether to a mobile device, is forecast to reach 12.4 million in 2016 and increase to 61 million in 2020, according to Garner Inc.

“The connected vehicle is the foundation for fundamen-



tal opportunities and disruptions in the automotive industry and many other vertical industries,” said Research Director James Hines. “Connected vehicles will continue to generate new product and service innovations, create new companies, enable new value propositions and business models, and introduce the new era of smart mobility.”

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10-Step Business Plan Process

by Happy Holden

It takes more than just a good idea to exploit that brainstorm of yours. Hewlett Packard's "10-Step Business Plan Process" is the format to present an idea or product in a fashion that will answer most questions that management may have about a product or idea. It is how ideas and products come to reality. While it is designed primarily for developing strategic business plans, it has also been used for planning in administrative support functions. The process efficiently captures external knowledge and internal expertise in an iterative, self-validating methodology. It might be as short as 10 paragraphs or as long as 10 chapters. What is important is answering the question that each step asks.

Introduction

Three elements highlight the primary characteristics of the 10 Step Business Plan. Its logic is driven from segmentation:

1. Customers and channels, competition
2. Necessary products/services, development
3. Purchase plans and financial analysis

These are conducted sequentially at the segment level. Valid understandings are derived from a segment disaggregation of markets.

The foundation of the 10-Step Plan is user needs; in fact, the only valid segmentation is based on user needs. Imaginative understandings of user needs lead to competitive advantage. As users ultimately determine product and service success, user needs provide the best basis for business decisions.

The application of the 10-Step Plan is multi-functional. By incorporating analyses from R&D, manufacturing, QA, sales, marketing, finance, and personnel, all functions contribute to the formulation of an action plan as opposed to a shelf plan.

The 10 Steps

The content of each of the 10 planning steps are briefly described here.

Step 1—Statement of Purpose

A concise statement of purpose for the business strategy in the context of decision criteria for use across related entities. It identifies



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1) user needs segments, and 2) sources of your competitive advantage to answer the question “where do we focus and how do we win?”

Step 2—Specific Objectives to Achieve Over a Five Year Period

The specific objectives translate the statement of purpose into achievable milestones for each function. These milestones represent the basis for formulating specific action plans by function. It answers the question of which functions own which critical commitments?

Step 3—Description of Customers and Channels of Distribution

A description of user segmentation and a ranking of priorities with respect to target segments. Fundamental to this section is a rigorous, fact-based analysis of end-user, customer, and channel needs, and a detailed understanding of the purchasing process.

At its simplest level, a user needs segment represents the intersection of an industry and an application. Although you may be most efficient in providing only part of the end-user solution, all parts of the solution must be evaluated in determining your positioning for maximum competitive advantage. The end product of this section is an understanding of how to differentiate your products and services in key target segments based upon user needs.

The most difficult part of the process is segmentation. All possible segmentation variables are useful for driving imaginative solutions. Segmentation continues until your idea emerges as the segment leader or has a competitive advantage to become the segment leader.

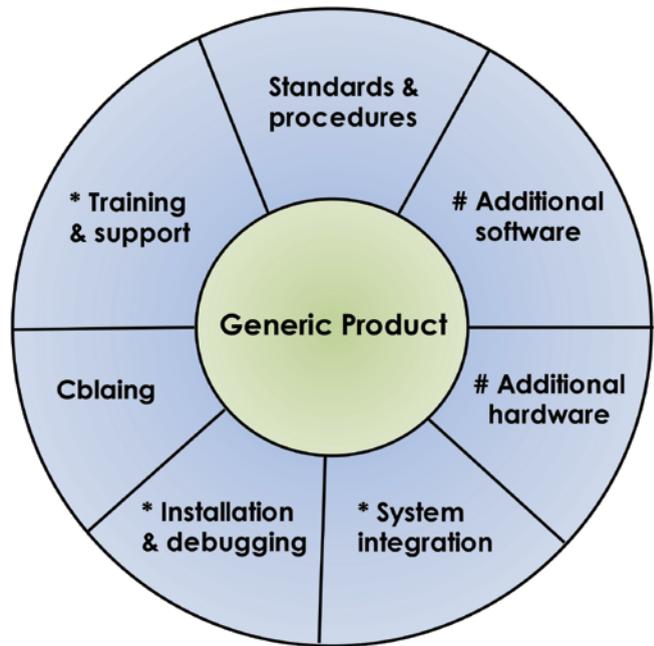
Step 4—Description of Competition

The competitive analysis includes 1) an identification of competitors selling to (or planning to sell to) the target customer segments; 2) measurement of competitor presence by segment over time; 3) an assessment of your and competitors’ capabilities for addressing the needs of the segments; and 4) a determination of capability gaps for you to overcome in gaining a competitive advantage.

Changes in competitive position must be understood on a segment basis. Competitive

WHOLE PRODUCT
The complete solution is everything it takes to enable the customer to immediately begin to get return on their investment.

But whole product expectations vary throughout the adoption life cycle.



* Locally delivered services
May need to be provisioned locally
Source: *Crossing the Chasm* by Geoffrey Moore

Figure 1: Eighty percent of the effort in proposing a product is the research into competitors and differentiating user needs and your competitive advantage, by applications. (Source: HP 10-Step Process, internal document)

strategies must be understood on a segment level. If your idea leads a segment, barrier points must be established. If your idea is pursuing a segment, entry points must be discovered. Size and growth of segments determine the nature of investments; competitive advantage determines your ability to recover investments.

Note: Steps 3 and 4 tend to be iterative since the plan must provide a segmentation that is internally consistent and provides criteria that permits your idea to win (Figure 1).

Step 5—Description of Necessary Products and Services

Description of the products and services the business unit must provide (either on its own

or through affiliations with outside entities) for your idea to successfully compete and lead in the chosen segments. When determining the requirements for a specific product or system, this step articulates and documents those requirements (Figure 2).

Step 6—Plan for Development or Purchase and Introduction of Products and Services

Detailed descriptions of how each function contributes to fulfilling Step 5. The plans show milestones by date and assign responsibility. It defines both your and partner solution contributions and answers the question, how can we

leverage our resources through partners? Recommendations for affiliating with outside entities to fill the capability gaps identified in Step 4 are also made here. The recommendations include:

- Reasoning for using outside rather than internal resources
- Type of affiliation required (e.g., joint marketing agreement, joint venture, acquisition, etc.)
- Parameters for assessing candidate firms for the affiliation
- A list of candidate firms

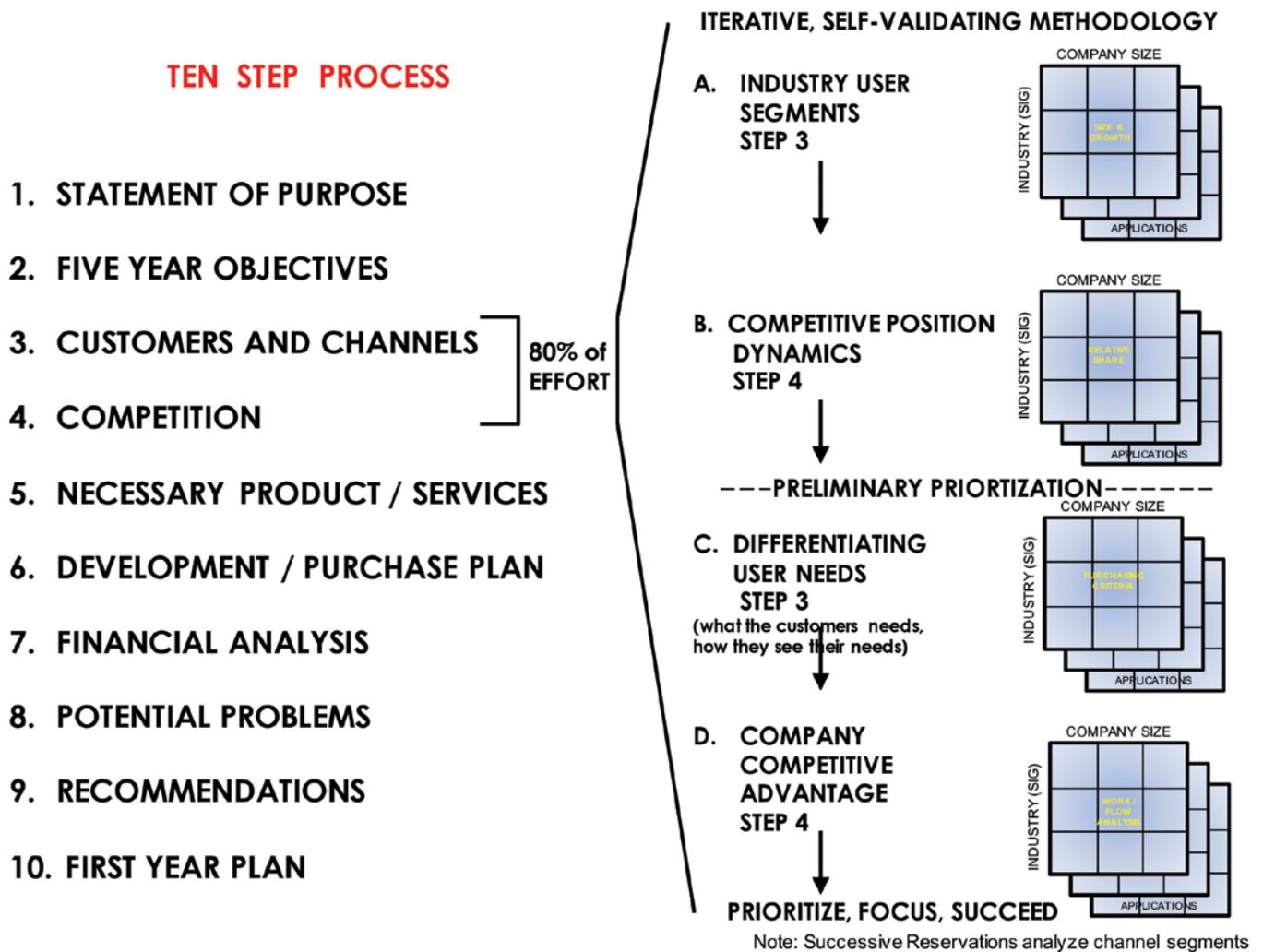


Figure 2: User needs are redefined and focused on finalizing action plans to support the business in achieving competitive leadership in its targeted segments. (Source: Crossing the Chasm by Geoffrey Moore)

If progress has been made on selecting and approaching some of the candidate firms, a status report (including an assessment from Corporate Development if the affiliation is to involve an equity investment) is included.

Step 7—Financial Analysis of Costs and Returns

A set of financial scenarios projecting key financial variables, including expected revenues, line item costs, cost per order dollar (CPOD), operating profits, and return on assets (for both market segments and products). The scenarios describe expected results assuming different levels of effectiveness in your strategy implementation and varying favorability in the economic/business environment.

Financial analysis of costs and returns evaluates the merits of the investment commitments indicated by functional plans. It determines competitive advantage investments and return on assets (ROA) by user needs segments.

Step 8—Potential Problem Analysis

A contingency analysis identifying potential competitor, environment and implementation problems that would force re-examination of the plan:

- Assigning probabilities to the occurrence of each
- Outlining appropriate countermeasures

Potential problem analysis simply states explicitly any major events that would necessitate reformulation of the plan. These are usually competitive/financial assumptions elaborated via risk/sensitivity analyses.

Step 9—Recommendations

Recommendations to other similar entities concerning the level and type of interactions for sector, group, or division support required to effectively implement the strategy. It explicitly states the interrelationships that must work if the plan is to work.

Step 10—First Year Tactical Plan

A link to the first year tactical plans and implementation planning is essential. In this step, the planning organization either outlines the major tactical and strategic objectives, or includes the full set of implementation plans.

Summary

The Business Plan is the recognized procedure to inform and alert management to new ideas or products. These 10 steps (or 10 questions) are an efficient way to execute a business plan and determine if the idea is feasible. **PCB**

References

1. "10-Step Business Plan Process," Hewlett Packard, internal document.
2. "Crossing the Chasm" by Geoffrey Moore, 1991 HarperCollins.



Happy Holden has worked in printed circuit technology since 1970 with Hewlett-Packard, NanYa/Westwood, Merix, Foxconn and Gentex. Currently, he is the co-editor, with Clyde Coombs, of the Printed Circuit Handbook, 7th Ed. To view past columns or to contact Holden, [click here](#).

What's Stoking Growth Opportunities for Interoperable Tech in US Unmanned Aircraft Systems?

The U.S. Air Force is looking to minimize training requirements by channeling funds toward platform upgrades and changing spending trends in the unmanned aerial systems (UAS) segment. By deploying an open architecture, ensuring standards-based modularity to enable plug and play

sensors and implementing quick hardware and software upgrades, the USAF is making a case for a new MQ-X to replace the MQ-1/9 fleet. It is focusing on the less expensive sensors and platforms such as those in the MQ-9 extended range aircraft.

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MilAero007 Highlights



Summit Interconnect Subsidiary KCA Electronics Recognized at Lockheed Martin Small Business Awards Event

Summit Interconnect, Inc. subsidiary KCA Electronics was recently recognized by Lockheed Martin Corporation at their Small Business Awards Event. An award for KCA's outstanding product quality, service and support was presented to Shane Whiteside, President and CEO of Summit Interconnect and Eva Alcantar, Inside Sales Manager for KCA Electronics.

The European Space Agency on Reliability

Stan Heltzel is a materials engineer working for the European Space Agency, and he is tasked with the job of procuring and qualifying PCBs that end up in satellites. I met with Stan at EIPC's Summer Conference to discuss his presentation on qualifying a fabricator, his role at the ESA, and updating of space standards.

Ventec VT-901 Reliability Validated by Key Israeli Customers' HATS Testing

Ventec International is proud to announce that the reliability of its VT-901 polyimide laminates, prepregs and low-flow prepregs has been conclusively demonstrated by Highly Accelerated Thermal Stress (HATS) testing by two leading PCB manufacturers in Israel.

Let's Talk Testing: Does your Product have a Military Application?

Just like any other industry segment within the circuit board world, the military sector has its own share of documents...and likely many more than most! These documents have been developed over the years to guide, shape, and test anything and everything that might go into a jet fighter, a radar system, a warship, a weapons system, etc.

Mil/Aero Markets: F-35 Declared Combat-Ready

Electronic subsystems are an integral part of all modern military fighter jets, with a substantial portion of the electronics supporting intelligence, surveillance and reconnaissance (ISR) sys-

tems, electro-optical/infrared (EO/IR), avionics, munitions and radar related subassemblies. This equates to a very high content of PCBs and SMT assembly requirements.

Testing Todd: Testing Military/Aerospace—Houston, We Have a Solution

This month we will dive into the testing of aerospace and military product. These designs require special processing in many cases above and beyond the IPC standards. The main specifications used when testing military product are MIL-PRF-55110, MIL-PRF-50884 and MIL-PRF-31032.

The Blackfox Advanced Manufacturing Program for Military Veterans

You might be wondering why you should hire a military veteran, especially if your company has nothing to do with the military. But hiring veterans can bring a wealth of benefits, and this article highlights them. It also focuses on the Blackfox Veteran's Training Program, the first program of its kind to provide veterans with little to no industry experience with the skills to grow their careers in the electronic assembly industry.

Firan Technology Group Announces Organizational Changes

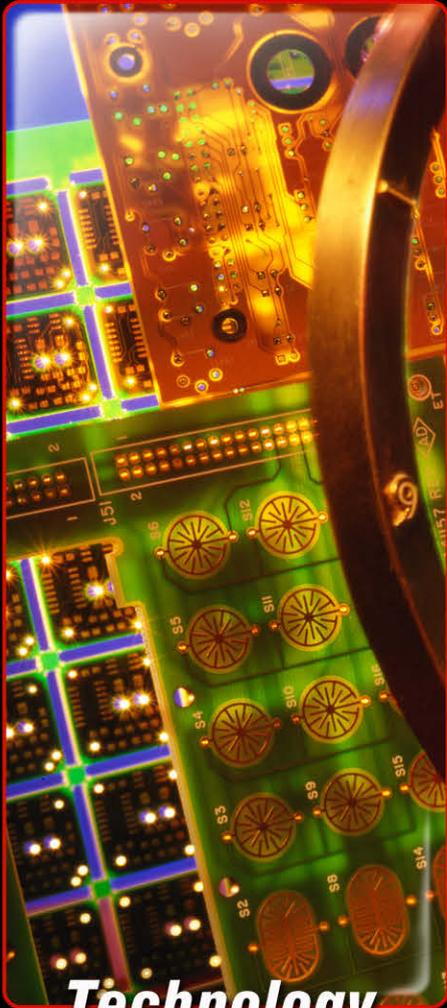
Firan Technology Group Corporation announced today the retirement of Joseph R. Ricci, vice president and CFO. Joe will remain with FTG in an advisory role to ensure an orderly leadership transition to the new CFO over the next number of months.

L-3 Selected by All Nippon Airways to Supply Airbus A320 Full Flight Simulator

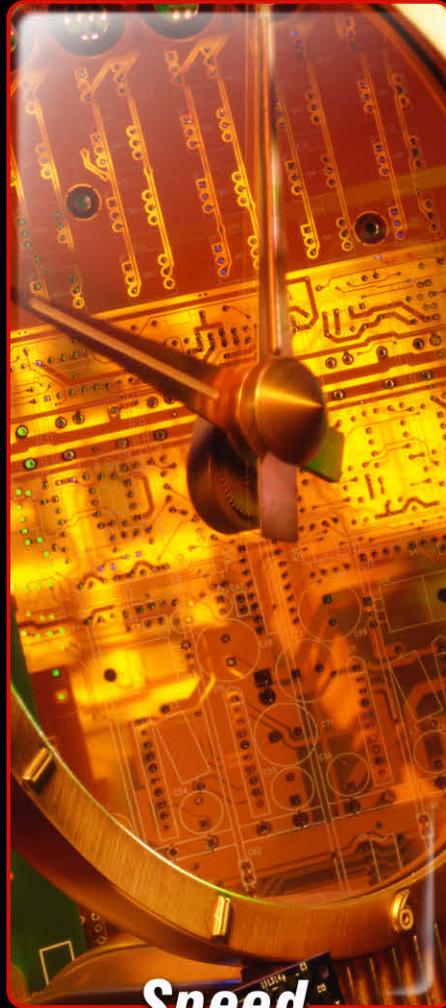
L-3 Communications announced today that its Commercial Training Solutions (L-3 CTS) business has been awarded a contract by All Nippon Airways (ANA) to build and deliver an Airbus A320 Full Flight Simulator (FFS). Based on L-3's RealitySeven flight training simulation solution, the device will be installed at ANA's flight training facility in Tokyo, Japan, and ready to deliver training in September 2017.

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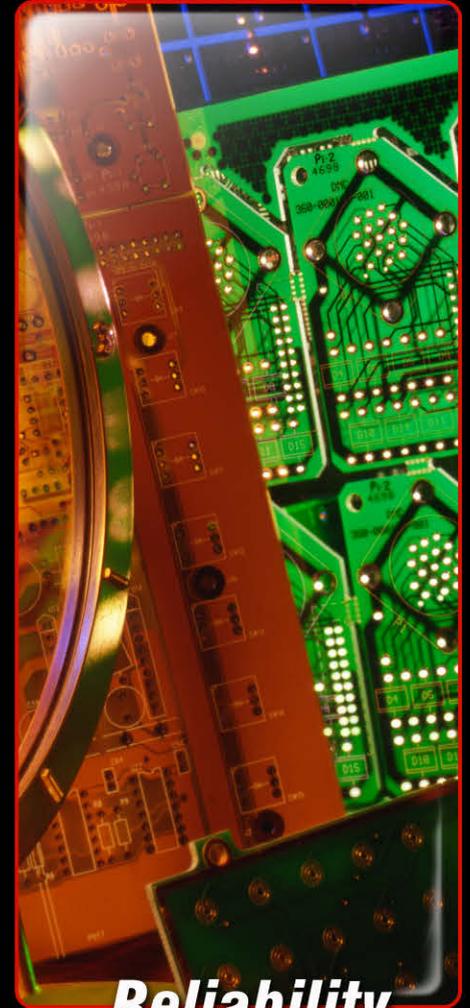
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Case Study: Plating Nodules—Where Did These Come From?

by Michael Carano

RBP CHEMICAL TECHNOLOGY

Introduction

Sometimes the problems can really get pretty ugly. One would assume these uglies would be easy to correct. But most often, solving such a problem requires a much deeper dig into the process. In this column this principle will be illustrated with a real-life case study. In this real-life troubleshooting exercise, plating anomalies were detected on the PWBs plated in two different plating cells. This study points out that the root of the defects is rooted in two different causes. One is related to addition agent control, the other to solution filtration and anode maintenance. The study digs into plating roughness and multiple causes and corrective actions.

Severe Plating Roughness/Nodules

In previous columns, this author has presented many possibilities for copper plating nodules. However, what occurred with one PWB fabricator was on the extreme (Figure 1).

In Figure 2, a somewhat different type of nodule appeared on circuits at the same fabricator. Only this defect occurred on circuit boards plated in a different cell.

Basically this fabricator was seeing two different types of nodules/roughness. The nodules depicted in Figure 1 clearly show “normal” copper grain structure (fine-grained equiaxed). However, in Figure 2, the grain is quite large. In addition, the nodule/roughness shown in Figure 1 can be traced to what looks like debris that has been essentially plated up and around.

So what does the troubleshooting exercise look like?

Again, two different issues are evident. Yes, both are nodules/roughness related. However, the origins of the roughness/nodules appear to be different. Thus the troubleshooting approach needs to take on a much wider view. Several steps are needed immediately. First obtain an analysis of all of the chemical processes



Figure 1: Severe plating nodules. (Source IPC-9121 Process Effects Handbook)

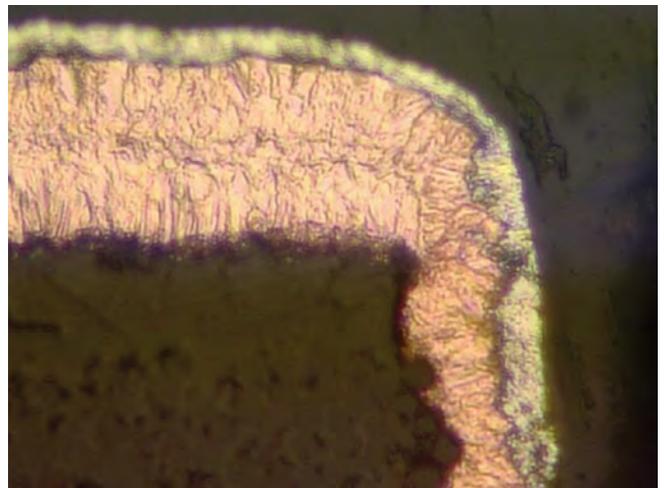


Figure 2: Severe nodules—but copper is crystalline in nature. (Source IPC photo archive, Bannockburn, Illinois)

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in the line. Check the quality of the plating solution. And *walk the line!*

This last step provided some additional information that must not be discounted. Upon first inspection of the plating cell, one noted that the plating rack on this particular cell did not seat properly in the contact saddle. One could see the space in the contact area. That is certainly not optimal with respect to achieving electrical conductivity through the plating cell, plating racks and to the circuit board. The greater the resistance in the plating cell, the less current flows to the circuit board. And from there one can surmise that the plating thickness and distribution will not be ideal. Poor electrical contact within the plating cell leads to high resistance which in turn affects plating quality. One of these symptoms manifests itself as “burned” or rough plating as shown in Figure 2.

It is also prudent to inspect the electrical cables and their respective connections leading from the rectifier to the plating cell. Are the cables of sufficient size to carry the current necessary to effect optimum plating distribution? Or are the cables in such poor condition

“Inspect for the not so obvious! You will save yourself headaches and heartaches later.”

that some current is lost before the current can reach the circuit board? Inspect for the not so obvious! You will save yourself headaches and heartaches later.

Secondly, analysis of the plating solutions told another story that needed to be addressed. This part of the story relates to the control of the plating additives in the acid copper plating cell. In the plating cell showing the copper with the enlarged grain (Figure 2), the troubleshooter found that two key additives required

for the proper functioning of the acid copper process (organic addition agents and the chloride ion) were extremely low. Indeed, analysis showed both to be well below the minimum required for optimum plating quality.

There are myriad of addition agents commercially available. The function of these additives is to provide a mechanism whereby the copper deposit is plated in a level and ductile condition. Typically, the addition agent package consists of grain refiners, leveling agents and suppressors. For purposes of this discussion, the grain refiner is used interchangeably with the term “brightener.” The chloride ion plays a synergistic role with organic additives in the brightening and leveling mechanism, and also promotes even anode corrosion. (In a future column the author will present more details on plating additives.) For now, one needs to focus on the problem at hand.

The plating cell in question was set up to have the additives added manually after analysis. However, it was discovered that a timely analysis of the plating additives was not completed for over 36 hours because the operator thought the panels looked good! Organic addition agents and other chemical additives such as the chloride ion have a major effect on plating quality. Upon analysis using CVS (cyclic voltammetric stripping analysis) and the traditional Hull cell, it was clearly determined that the plating solution was severely low in the additive. When the low organic agent concentration and low chloride ion situation was corrected, the plating condition shown in Figure 2 was eliminated. For good measure, the plating saddles were adjusted to improve the contact between the plating rack and the plating cell.

Now, while the defective condition seen on boards plated in cell #2 was related to the plating additives, cell #1 (Figure 1) displayed a defect of a different origin. Clearly the defect in Figure 1 can be traced to particulate or insoluble material in the plating solution or on the surface of the printed circuit board. Again inspection of the plating cell showed that there was indeed particulate matter that was not being properly filtered from the plating solution. While that was understood, the

source of the particulate material was not evident. It is a known fact that anode sludge (forming on the copper anodes during plating) can enter the plating solution and cause roughness. The question is how? It was suggested that the anode bags themselves (anode bags cover the anodes and are designed to prevent material from entering into the solution) be inspected. It was noted that several of the anode bags had worn out significantly to the point of developing tears in the bags themselves. As a corrective action the anode bags were replaced with new ones. In addition, improvements were made in the plating cell filtration. In this case, the 25-micron filters were replaced with 5-micron filters. And the solution filtration rate was held steady at three solution turnovers per hour. The result was a major improvement in the quality of the plating coming out of cell #1.

Summary

This actual case study points out again the complicated nature of solving printed circuit board defects. In this case the defects were external and could be readily seen after acid copper plating. However, the root cause analysis pointed out that the origin of the defects was from two different sources. And the troubleshooting exercise dealt with each appropriately. **PCB**

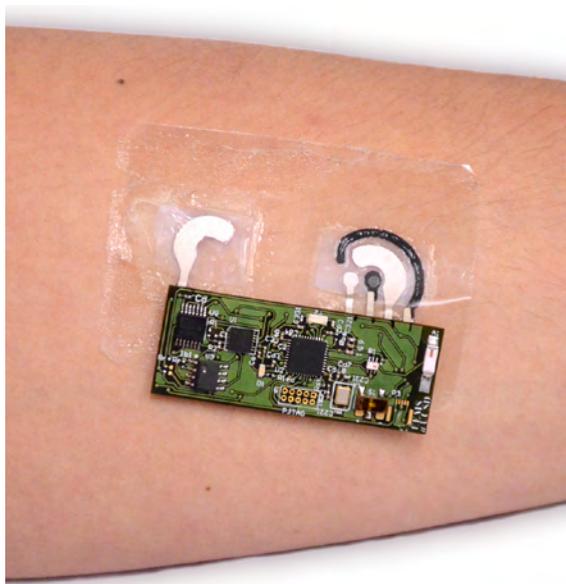


Michael Carano is VP of technology and business development at RBP Chemical Technology. To read past columns or to contact Carano, [click here](#).

Detecting Blood Alcohol Content with an Electronic Skin Patch

To help imbibers easily and quickly know when they've had enough, scientists have developed a flexible, wearable patch that can detect a person's blood-alcohol level from his or her sweat. The monitor, reported in the journal ACS Sensors ("Noninvasive Alcohol Monitoring Using a Wearable Tattoo-Based Iontophoretic-Biosensing System"), works quickly and can send results wirelessly to a smartphone or other device.

Currently, ignition interlock devices are being marketed as a way to prevent drunk drivers from starting a car engine. But these are based on breath analysis, which can be affected by a number of factors including humidity, temperature and whether someone has used mouthwash. Recent research has demonstrated that sweat can be a more reliable real-time indi-



cator of blood alcohol content.

At least two transdermal sensors have been developed to measure alcohol levels in sweat, but users have to wait up to two hours for results. Joseph Wang, Patrick Mercier and colleagues at the University of California, San Diego, set out to make a more practical version.

With temporary-tattoo paper, a patch that tests BAC non-invasively in three rapid steps. It induces sweat by delivering a small amount of the drug pilocarpine across the skin. An enzymatic reaction leads to the electrochemical detection of the alcohol content. And a flexible electronic circuit board transmits the data via a Bluetooth connection to a mobile device or laptop. The steps take less than eight minutes from start to finish.

Don't Reinvent the Wheel— Find an Expert!

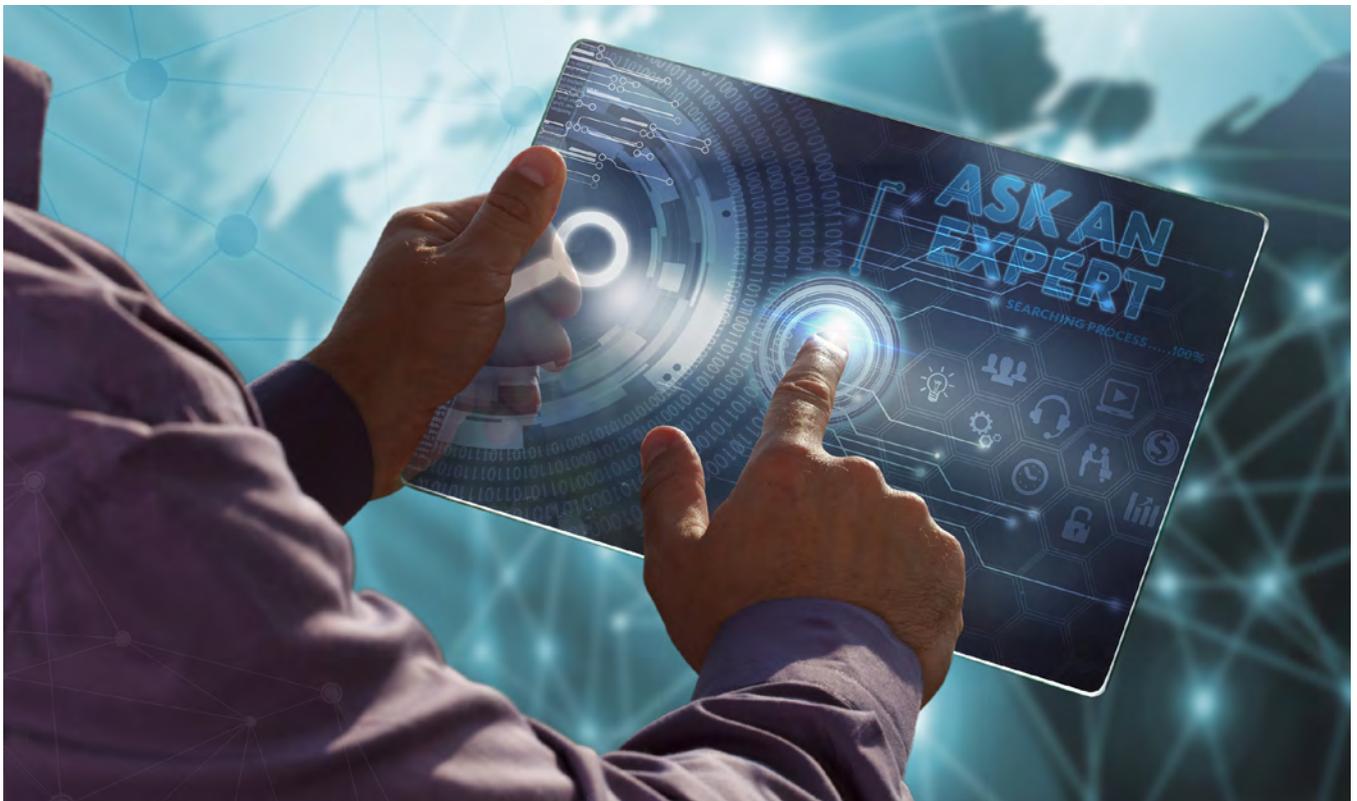
by Keith M. Sellers
NTS-BALTIMORE

Back in the day when I was an engineer fresh out of college, I quickly learned that experience is the solution to many problems. Now that being said, experience comes in many forms...it could be knowledge learned from a textbook, it could be an observatory comment jotted down in a notebook, it could be a conversation with a co-worker or colleague, or it could be an Internet search that finds a scholarly technical article, etc. My point is that "experience" is all around you if you're eager and willing to look for it, and when problems or issues arise, tapping into that experience is invaluable.

Expanding on that idea, it's likely, unless you're working in a cutting-edge, R&D-driven field, that someone out there in the world has dealt with a similar (or possibly the same exact)

issue/problem that you are currently facing. My advice to you today is to seek out that information and utilize the knowledge and experiences of others before you as best you can. As an example, the Internet is an almost bottomless pit of information and when used appropriately can likely get you the information that you need or, at the least, get you headed in the right direction.

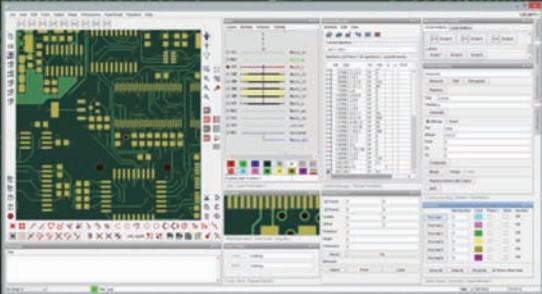
Technical knowledge and experience can be found in many places and in some cases, a good bit of the hard work in finding those places may have already been done by others, so why not make your life easier by learning from their experiences? Focusing in specifically on the printed circuit board/assembly world, a good place to start is with IPC. For those not familiar with



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IPC, it is an organization that has been around for nearly 60 years, focused on the advancement of all sectors of the printed circuit board world—design, manufacturing, assembly, and test. With respect to our topic today, this organization's membership is heavily populated with true experts in the printed circuit board

“IPC has a couple of specific areas that can be used for your benefit. Various conferences and meetings throughout the year are held around the world.”

field and if a problem arises in your day-to-day travels, it's very likely that someone within IPC can help you solve it, as they have probably dealt with it before.

IPC has a couple of specific areas that can be used for your benefit. Various conferences and meetings throughout the year are held around the world. These events typically contain technical sessions, where someone can learn about a variety of topics pertinent to the printed circuit board world, as well as meetings in which various sectors of the industry are discussed at the highest levels. Of specific interest to many would be the standards development meetings that occur twice per year. These meetings focus on the many test methods and test specifications that IPC issues for the industry and the sessions are organized into various topics. A tremendous amount of experience can be found in any of the meeting rooms and much information can be gleaned just by attending and listening. The chairpersons and co-chairpersons of the various committees and task groups are all experts in their fields and the attendance in a single meeting will likely span all four of the sectors mentioned above: design, manufacturing, assembly, and test.

In addition to the conferences and meetings, IPC also has a Validation Services division. This

group is tasked with qualifying companies to a variety of lists, depending on their specific role in the industry. Specifically, there is a Qualified Products List (QPL), a Qualified Manufacturers List (QML), and a Qualified Test Laboratories list. From these lists, you can search for companies and contacts that can likely help you directly with the issue you are dealing with. For example, if there is a widget that you are looking to obtain to help with your issue, it's possible it already exists and the QPL could help you find a source. At the same time, if you're in a time or resource crunch and you need help with your production process, using the QML might be a good resource. And, lastly, if some form of testing is of interest, the Qualified Test Laboratories list could be a good place to start.

Similar to IPC, the Defense Logistics Agency (DLA), which is a supporting agency of the Department of Defense, also has QPL and QML lists in the military arena...along with a certified list of test laboratories that are suitable for testing PCB-related items for military-based applications. Once again, these various lists are stacked with knowledgeable colleagues and companies that can surely help you with the issue you are currently dealing with.

While there is certainly merit in the notion of solving a problem completely and totally on your own, that never really happens if you think about it, as you're utilizing someone else's experience in some way or another whether you realize it or not. Even a “problem” as simple as being asked to draw a line on a piece of paper is “solved” by understanding Euclid's geometric principals. It's his “experience” that allows you to solve the problem, whether you know who Euclid is or not!

So when a problem or issue arises, don't be afraid to ask around and get some help. Experts (and information) in all varieties of fields are everywhere if you're willing and able to search them out. **PCB**



Keith M. Sellers is operations manager with NTS in Baltimore, Maryland.

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Trade Shows: The Unstoppable Force

by Barry Lee Cohen

LAUNCH COMMUNICATIONS



Editor's Note: This column was originally published as a blog on the Launch Communications website and is reprinted here with permission of the author.

Trade show mania...it's still here. We complain, criticize, and whine (yep...that's me!) about the financial and human expense, while feeling an odd, inner excitement and anticipation as the date of the big event approaches. Yet to quote the ever put-upon George Costanza, this "unstoppable force" seemingly has a life of its own.

Some companies have reduced or in some cases completely eliminated trade shows from their marcomm plans, whereas many others find it difficult to right-size their participation with a requirement to meet defined, measurable

objectives. Decisions to participate at a given show are sometimes made without the collaboration of marketing, industry and communications teams that should be key stakeholders and driving the decision process, with deliverables that include a launch program, benchmarking, and pre/post-event monitoring.

Although trade shows are perceived as a dinosaur by some and a necessary evil by others (e.g., "our competitors will be there, so..."), this veteran of the media mix is often deemed guilty without conclusive data that reflects a well thought-out plan. It's astonishing that given trade shows are one of the largest budgeted areas of the marcomm pie, it is commonly overlooked when it comes to measuring ROI. Poor old guy...you're not evil, just misunderstood.



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SEO and SEM, coupled with a company's digital arsenal of websites, blogs, and e-blasts are often anointed as the better, low-cost options. However, this delightful digital dynasty is all too often detached from the initial event planning and treated exclusively as an embellished bolt-on during the show. Measuring these results is easier than using traditional media, no doubt. However, measuring these tactics in a separate silo is about as effective as buying peanut butter because it was on sale, but forgetting to spread it on your sandwich with the jam when you're craving that combination of the sweet and chunky (yep...me again!).

Digital vs. trade show: Which is better? Neither is perfect and one does not replace the other. Each should be evaluated and selectively deployed as strategic initiatives within an inte-

grated program launch. Carefully executed, you will elevate your company's brand, establish thought leadership and grow customer mindshare.

There's so much more to be said about the good, bad, and absurd of trade show practices and comparisons to digital, but it's time for that PB&J. **PCB**



Barry Lee Cohen is president and managing director of Launch Communications. To read past columns or to contact Cohen, [click here](#).

These Smart Threads Could Save Lives

Smart clothing consists of fabrics with new technologies such as digital components and electronics embedded and developed to provide added value to the wearer. They are, according to Wikipedia, the Pratt Institute states that "what makes smart fabrics revolutionary is that they have the ability to do many things that traditional fabrics cannot, including communicate, transform, conduct energy and even grow".

Engineers are joining forces with designers, scientists and doctors at Drexel University to produce new biomedical textiles, and the resulting smart clothes are not only fashionably functional, but could also be life savers.

With support from the National Science Foundation (NSF), electrical and computer engineer Kapil Dandekar, industrial and fashion designer Genevieve Dion, and OB-GYN Owen Montgomery are incorporating RFID technology into their "belly



bands" for women with high-risk pregnancies. The band continuously tracks data and alerts the doctor's office via the Internet should the woman start contractions. A smaller version is being created for babies at risk for sleep apnea.

Developed at the intersection of engineering, medicine and design, these examples of new human-centered service technology show vast potential to improve healthcare.

NSF has invested approximately \$34 million in such systems in the last three years, supporting innovative new partnership projects to create service systems that are smart and human-centric.

The research in this episode was supported by award #1430212, Wearable Smart Textiles Based on Programmable and Automated Knitting Technology for Biomedical and Sensor Actuation Applications, under the Partnerships for Innovation: Building Innovation Capacity (PFI:BIC) program.

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TOP TEN



Recent Highlights from PCB007

1 Weiner's World

People in the printed circuit and electronic packaging industries often ask me about re-shoring. My response generally is that re-shoring is a myth. It seems that whenever I try to contact someone by email I get an automated response stating, "I am currently in China and will return to my office on..."



2 Happy's Essential Skills: Computer-Aided-Manufacturing, Part 1—Automation Protocols

I have addressed automation planning previously in this series, so I hope by now you realize the difference between automation and mechanization. In printed circuit fabrication and assembly, most of what is advertised is mechanization. But when you get to assembly test, then you begin to see true automated solutions.



3 All About Flex: FAQs on RoHS for Flex Circuits

In 2003, the European Union (EU) adopted RoHS, which restricts the use of certain materials in electronic products and electronic equipment. The intent is to reduce the environmental impact of known hazardous materials and has driven changes in manufacturing processes and materials used to manufacture a wide array of electronic products.



4 EPTE Newsletter: Sony Sells Battery Division to Murata

Large electronics companies in Japan continue to lose market share in the global arena. This erosion of market share has had a ripple effect on Japanese printed circuit manufacturers that supplied these electronic companies; when they sneeze, printed circuit manufacturers catch cold.



5 Happy's Essential Skills: CIM and Automation Planning, Part 1

There is a lot of talk and information about automation, but I find that there is very little available on automation planning. This is one of my specialties. I started by getting a master's in EE in control theory. This went well with my B.S. in chemical engineering as I specialized in process control and IC manufacturing.



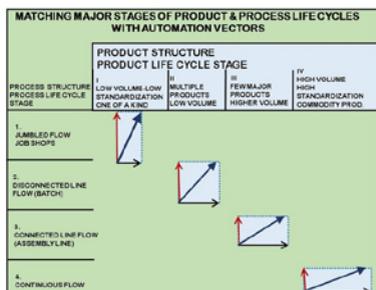
6 Printed Circuits, Inc. Hires Ed Andrews as Director of Quality Systems

Rigid-flex circuit board manufacturer Printed Circuits Inc. has hired Ed Andrews as their director of quality systems.



7 Happy's Essential Skills: CIM and Automation Planning, Part 2—Six Principles of Automation

In Part 1 of this column, I discussed the foundation of CIM and the principles of automation planning. In Part 2, we will assume that all the necessary preparations in strategy and tactics have been completed. How does it all fit together for



successful implementation? This problem affects large, wealthy companies as well as the smallest job shop.

8 Standard of Excellence: Communication Breeds Success

We all need to talk to one another. You need to work closely with your customers. And we all need to work with the new generation of PCB designers and design engineers, many of whom have never set foot in a board shop. Fortunately, they make up for their lack of DFM knowledge with their hunger for information.



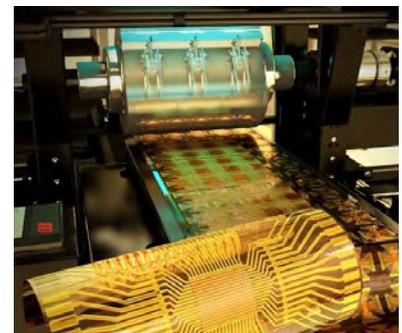
9 Sunstone Circuits Announces RF/Microwave Capabilities

Sunstone Circuits has announced the addition of RF/microwave materials (high speed/low loss) for 1- and 2-layer boards.



10 Continuous Roll-process Technology for Transferring and Packaging Flexible Large-scale Integrated Circuits

A research team led by Professor Keon Jae Lee from KAIST and by Dr. Jae-Hyun Kim from KIMM has jointly developed a continuous roll-processing technology that transfers and packages flexible large-scale integrated circuits.



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The PCB Magazine® is published by BR Publishing, Inc., PO Box 50, Seaside, OR 97138

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October 2016, Volume 6, Number10 • The PCB Magazine© is published monthly, by BR Publishing, Inc.

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