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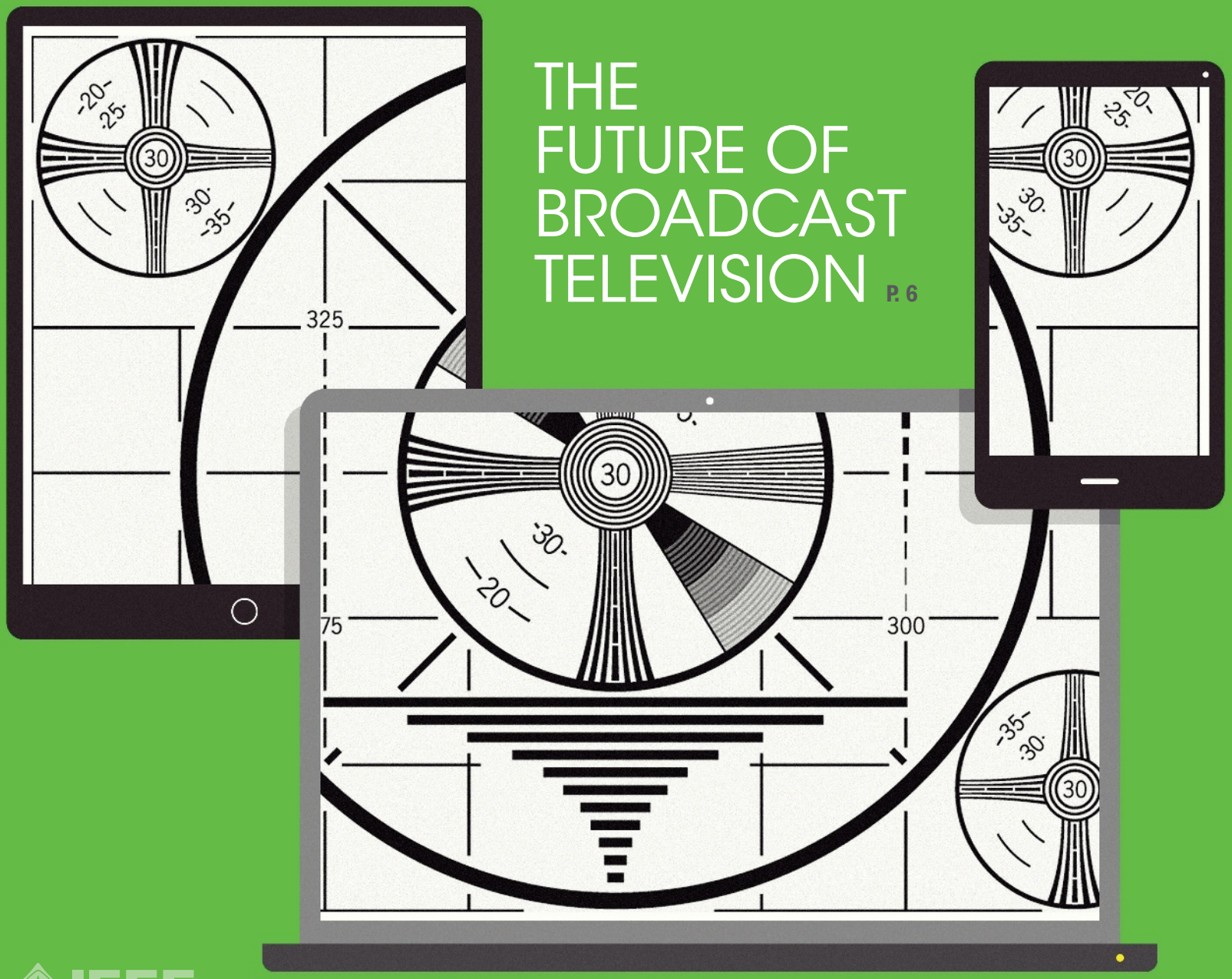


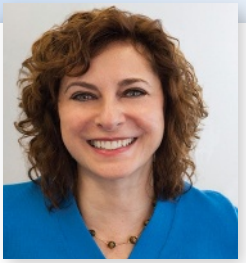
THE FUTURE OF BROADCAST TELEVISION P. 6

IEEE

HOW TECH CAN CHANGE YOUR HABITS | Principles from psychology alter behaviors and beliefs P. 7

THE BIRTH OF SILICON VALLEY | Bay Area engineers revolutionized radio long before computers P. 8

WHAT MILLENNIALS WANT | Three things they value more than a high salary P. 11



EDITOR'S NOTE

AT THE END of a long day, there are few things more relaxing than sitting in front of your television and watching a favorite show. Many of us have newer televisions, with features like high dynamic range. But unless you live in South Korea, if that program is on a broadcast channel, you can't take advantage of the better sound and picture quality and you can't watch it on a mobile device when it first airs.

That's about to change thanks to ATSC 3.0, a new suite of voluntary standards for digital television, featured in our cover story [p. 6], by Assistant Editor Amanda Davis.

A lot of us might have a habit we'd like to break—smoking, for example—or perhaps the goal is to adopt a new habit such as taking a long walk each morning. For extra motivation, we might rely on a wearable device or on a mobile app. In "How Persuasive Technology Can Change Your Habits" [p. 7], Associate Editor Monica Rozenfeld talked to IEEE Senior Member Samir Chatterjee, a persuasive-tech pioneer, about how designers try to alter behavior by having such aids ply you with reminders, triggers, and rewards.

If, like me, you thought Silicon Valley got its start because companies there crafted innovations in computing, you'll learn otherwise from Life Fellow Paul Wesling's article on page 8.

Also in this issue are a selection of responses to three blog entries that stirred many readers to voice their opinions [p. 13]. One blog entry discusses the state of research and where it's headed. Another explores how some employment ads on Facebook discriminate against older workers. The third deals with what millennials expect from their employers.

—Kathy Pretz, editor in chief
@kathypretz

To comment on articles in this issue, visit http://theinstitute.ieee.org/june2018.

REGION NEWS

REGION 1
GLASSBORO, N.J.

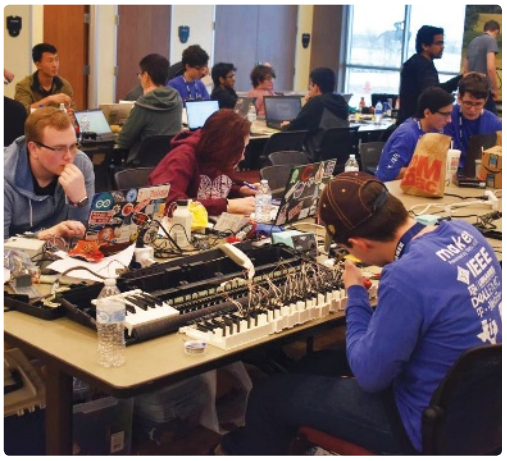
Rowan Student Branch @RowanIEEE
Despite IEEE's triumphant victory in a snowball fight against ASME today, both clubs decided to put aside their differences and build a giant snowman together. #MakeSnowmenNotWar

REGION 2
WASHINGTON, D.C.

Middle schoolers Vinay Ayala [below, left] and Nikhil Kuntipuram present their team's smart city design at the 2018 Future City Competition Finals, held in February during U.S. Engineers Week. The team, from Edlin School, in Reston, Va., won the competition and also took home the IEEE-USA Most Advanced Smart Grid prize.

REGION 5
COLLEGE STATION, TEXAS

The IEEE student branch at **Texas A&M University** held a 24-hour hardware hackathon in February. Students built an automatic bartending machine, a music synthesizer for an electronic keyboard, and a voice-activated home automation system.



REGION 6
HONOLULU

Iolani Palace March 23, 2018
Today, Iolani Palace and King Kalakaua were honored with an IEEE Milestone for lighting the way for the Kingdom of Hawaii to be illuminated with electric lights. This is an honor we know the king would have been proud to receive. Mahalo, IEEE.

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COVER: EDMON DE HARO; THIS PAGE, CLOCKWISE FROM TOP LEFT: RANDI KLETT; ROWAN IEEE; TAMU IEEE; FRIENDS OF IOLANI PALACE; KRR PHOTOGRAPHY

REGION 7

HAMILTON, ONT.

IEEE Canadian Foundation
@IEEE_Canadian_F
At the newly renovated McMaster McNaughton Center, students applied a new grant from the IEEE Canadian Foundation to purchase Arduinos, Raspberry Pis, breadboards, monitors, safety glasses, soldering irons, and sensors. Congratulations to the @ieeemcmaster team.

REGION 8

FARAYA, LEBANON

Students from all majors gathered in Faraya for one amazing weekend getaway! Late nights, early mornings, fun, and memories made. Thank you for everyone who joined us in our first IEEE Snow Camp, and we look forward to many more to come.

GENEVA

Moira Patterson @Patterson_MS
Past president of @IEEEorg @karenbartleson addressed the #WSIS forum and stressed the need for inclusiveness in the development of #AI technologies to bring maximum benefit to humanity globally. #Ethical design must be priority.

TURKEY

In March, five student branches in Turkey met to perform science experiments at five village schools. We would like to thank the engineers for this fun and educational experience.

REGION 9

ASUNCIÓN, PARAGUAY

IEEE Women in Engineering members in March at the IEEE Region 9 meeting.

REGION 10

BEIJING

Zappy
@zappysquirrel
I really enjoyed my visit to Beijing. My good friend Shuang Yu took some photos of me by the Forbidden City.

CLOCKWISE FROM TOP RIGHT: JUAN JOSÉ ENCINA; SHUANG YU (2); ASIM KÖROĞLU; IEEE AUB

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IEEE
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*Where available

IEEE volunteers and staff members celebrate the launch of the Foundation campaign at the Board of Directors meeting in Lake Buena Vista, Fla.

Help the Foundation Meet Its Fund-raising Goal

THE IEEE FOUNDATION, the organization's philanthropic arm, launched its first public fund-raising campaign during the February IEEE Board of Directors meeting. The Foundation's goal is to raise US $30 million by October 2020. More than 50 percent of the total had already been committed at press time—that's nearly $15.5 million raised.

The campaign is seeking donations from IEEE members and nonmembers as well as academic institutions, companies, and other organizations that want to address global challenges and support IEEE's mission of advancing technology for humanity.

Funds generated by the campaign will help drive new levels of technological access, innovation, and engagement through a variety of far-reaching global initiatives designed to transform lives through the power of technology and education.

There are several ways to support the campaign and help the Foundation meet its fund-raising goal. You can donate online (http://www.ieeefoundation.org/donate) and designate a specific program or let the Foundation determine where the need is greatest. Or you can donate by mail, over the phone, or through your company's matching gift program. You can also contact the Foundation directly through its website, http://www.ieeefoundation.org.

—Amanda Davis

Three Vie for President-Elect

IEEE LIFE FELLOW Toshio Fukuda was successful in getting nominated by petition as a candidate for 2019 president-elect. His name will appear on this year's ballot along with the two Board-nominated candidates, Fellow Vincenzo Piuri and Life Fellow Jacek M. Zurada. The candidate chosen in this year's annual election will serve as IEEE president in 2020. *—A.D.*

Toshio Fukuda

Vincenzo Piuri

Jacek M. Zurada

Annual Election Begins in August

LOOK FOR YOUR annual election ballot package to arrive in August via first-class mail with a postage-paid reply envelope. You'll also receive instructions by email explaining how you may access and return your ballot electronically.

Those eligible to vote include new members as of 30 June and students elevated to member or graduate student member grades on or before that date. Associate members are not eligible to vote.

To be eligible, student members graduating this year between 1 January and 30 June must update their education information online to be elevated to member or graduate student member grade.

To become an IEEE member, you must be regularly employed in an IEEE-designated field and have a combination of education and work experience totaling at least six years. To apply for transfer to member grade, complete the online form at https://www.ieee.org/membership_services/membership/grade_elevation.html.

Log in to your IEEE account (http://www.ieee.org/profile) by 30 June and confirm or update your contact information, your communication preferences, and education information. That will help guarantee you receive your ballot package.

ELECTION DEADLINES

15 AUGUST
IEEE annual election ballots are mailed to voting members and electronic ballots are accessible.

1 OCTOBER
Last day that members' marked ballots will be accepted by IEEE, by noon CDT USA/17:00 UTC.

15 OCTOBER
Election results are announced by the IEEE Tellers Committee.

18–19 NOVEMBER
IEEE Board of Directors acts to accept the report of the Tellers Committee. Election results are made official.

Calendar *of Events*

JUNE

3–6
IEEE Vehicular Technology Conference, Porto, Portugal

20–25
IEEE Meeting Series, New Brunswick, N.J.

25–29
IEEE Conference on Network Softwarization, Montreal

JULY

8–13
IEEE World Congress on Computational Intelligence, Rio de Janeiro

9–11
IEEE 5G World Forum, Santa Clara, Calif.

30 July–3 August
IEEE International Conference on Blockchain, Halifax, N.S., Canada

AUGUST

10–12
IEEE Women in Engineering International Leadership Summit, Hammamet, Tunisia

15
IEEE Milestone ceremonies honoring Moore's Law and the birthplace of Silicon Valley, Mountain View, Calif.

15–17
IEEE Games, Entertainment, and Media Conference, Galway, Ireland

CLOCKWISE FROM TOP RIGHT: ISTOCKPHOTO (2); WIKIMEDIA COMMONS; JACEK M. ZURADA; VINCENZO PIURI; TOSHIO FUKUDA; IEEE FOUNDATION

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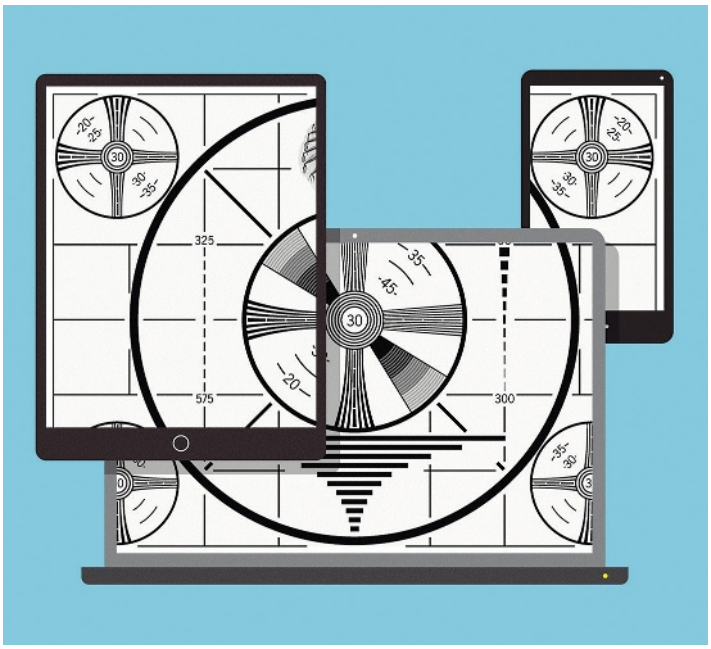


The Future of Broadcast Television

New standard promises immersive audio, interactivity, and hyperlocal emergency alerts BY **AMANDA DAVIS**

INSTEAD OF RUSHING home to catch the finale of your favorite cable TV show, you soon might be able to tune in on your laptop, tablet, or smartphone. Thanks to a new suite of standards, broadcasters will be able to provide access to live programming anytime and anywhere, and on multiple devices. They also will offer interactivity as well as better sound and picture quality.

Those are some of the features made possible by ATSC 3.0, a suite of standards for digital terrestrial broadcasting, authorized for the United States in November by the Federal Communications Commission. The suite incorporates the first IP-based broadcast standard, allowing broadcasting companies to simultaneously transmit content over the airwaves and the Internet.

ATSC stands for Advanced Television Systems Committee, a nonprofit in Washington, D.C., that develops voluntary technical standards for digital television.

"When we started developing these standards, we decided to start from scratch instead of simply adding on to the previous version," says IEEE Senior Member Mark Richer, president of the ATSC. "The result is a suite of 20 standards that incorporate several new technologies. These standards are flexible enough to accommodate applications that haven't even been developed yet."

South Korea has already adopted the standards, taking advantage of many of their features during this year's Winter Olympics in Pyeongchang, where there are already ATSC 3.0–compatible televisions and receivers. In the United States, televisions do not yet comply with the standards, but converters—gateway devices that can be incorporated in existing home-entertainment systems to receive ATSC 3.0 broadcasts—are expected to be available soon.

HAVE IT YOUR WAY

The standards offer broadcasters the sort of flexibility that viewers have grown accustomed to with streaming services including Amazon Prime and Netflix. Soon, for example, viewers will be able to catch a major sports event by tuning in on their tablet while, say, traveling on a train.

Because the standard is IP-based, broadcasters could offer apps to go along with TV shows, making the experience more interactive. Certain programs might come with an app that launches a trivia game about characters in a sitcom, for example, or provides in-depth information about the subject of a documentary.

IEEE Fellow Rich Chernock, chair of the ATSC's Technology Standards Group, TG3, notes that the standards also expand the potential for hyperlocal advertising. Broadcasters could deliver commercials about stores and events in viewers' immediate area if the viewers allow the broadcaster to detect their location.

Having access to viewers' locations also would allow broadcasters to issue an emergency alert for a small area, says IEEE Life Fellow James O'Neal, editor of *IEEE Broadcast Technology* and a member of *The Institute*'s editorial advisory board.

"Let's say you're at home during a severe storm and a tornado is about to touch down near your neighborhood," O'Neal says. "Your ATSC 3.0 television would automatically 'wake up' and play an audio alert and show a map detailing the areas in the tornado's path and let you know what to do next."

TRUE TO LIFE

TV picture and sound quality has advanced by leaps and bounds in the past decade. Until ATSC 3.0, however, broadcasters have been unable to transmit programs that take advantage of all the advances.

Many modern televisions have a high dynamic range (HDR), which extends the number of shades of black, white, and gray that can be transmitted and displayed, as well as improves the contrast ratio (how bright or dark the images can appear). HDR also offers extended colors, allowing a much broader palette to be transmitted.

Until the ATSC 3.0 standards were approved, companies were unable to broadcast in HDR.

The standards also will let broadcasters offer immersive audio—another feature that can make content seem truer to life. "If you have a surround-sound system, and you're watching a live broadcast of a fireworks display, the sound of the fireworks will emanate from above the TV," O'Neal says.

"It's a vast improvement over traditional channel-based audio, in which sound is directed at different quadrants of the room," Chernock says. "Now you can have object-based audio, in which sound comes from different elements on the screen. For example, if you're watching a football game, you can choose to listen to either the announcer from the home team or the away team—or you can tune them out entirely and just listen to the sound of the crowd."

ON THE HORIZON

Chernock, Richer, and O'Neal agree that it will take time for TV manufacturers to catch up with the new standards, especially because they're voluntary. That is in contrast to the 2009 transition from analog to digital television—in which U.S. broadcasters were ordered to stop transmitting analog signals by a specific date.

"Once U.S. broadcasters begin putting ATSC 3.0–compatible programming on the air and show what it can do, the consumer electronics industry will soon follow," Chernock says. This year more than two dozen U.S. broadcast companies plan to test compatible content. Companies in Canada and Mexico are also getting on board, Chernock says.

"By next year's Consumer Electronics Show, I think we'll start to see numerous ATSC 3.0 TVs and receivers on the showroom floor," Richer predicts.

In the meantime, the ATSC, IEEE, and other organizations are working to educate consumers and broadcasters about the standards. IEEE Educational Activities, for example, is partnering with the Society of Motion Picture and Television Engineers on a series of online courses. They're scheduled to be available this month. ◆

EDMON DE HARO

HOW PERSUASIVE TECHNOLOGY CAN CHANGE YOUR HABITS

Principles from psychology alter behaviors and beliefs

BY MONICA ROZENFELD

IF YOU'RE LOOKING to break a habit such as smoking or start a new one such as saving more money, you might need a nudge from your digital device.

Persuasive technology—a term coined by Stanford researcher B.J. Fogg—involves incorporating insights from psychology into the design of mobile apps, wearables, and other products. The goal is to modify people's habits and beliefs.

Behavioral science—the study of human (and animal) actions—is playing an increasing role in software design, whether to keep users coming back to the same website or encouraging them to play the next level of a video game when they're ready to quit. The same techniques also can be applied to help people improve their lives.

"The Holy Grail of behavioral change is helping someone take small steps to accomplish a goal until it becomes a permanent habit," says IEEE Senior Member Samir Chatterjee, a persuasive-technology pioneer. But designing technology to help people form or break a habit—also known as *behavioral engineering*—is not easy.

HACKING MOTIVATION

If people want to change a behavior or belief on their own, they first need motivation. If they're not motivated, though, persuasive technologies might be able to alter their attitude or behavior without coercion or deception, Chatterjee says. He founded the Innovation Design and Empowerment Applications (IDEA) Lab at Claremont Graduate University, in California, where his students develop persuasive tech applications.

One way to get people to alter their behavior is to simply remind them with a mobile app that, for example, dings when it's time to drink a glass of water or to get up and walk. But for someone with little desire to change a habit, alarms alone likely won't do the trick. Therefore, persuasive technology designers consider the interaction of three factors: motivation, ability, and triggers.

If, for example, people are physically able to exercise but lack motivation, triggers can help. Triggers come in many forms. They can include upcoming events—like a wedding or an annual health checkup—as well as close friends who have achieved a similar goal. Such triggers can be built into systems to motivate people, Chatterjee says.

An app can send you an alert that, for example, your sister's wedding is three months away, which could remind you that you have a suit or dress you need to fit into. Or, syncing the app with social media or an online forum can be a great way to encourage an individual by finding a community that shares the same goals.

The app QuitNow, designed for people who want to stop smoking, for example, offers an online community where smokers share their progress and check up on one another. More than 2 million people using QuitNow have successfully stopped smoking, according to its developer, Fewlaps, a software company in Girona, Spain. The app incorporates a financial trigger as well, tracking daily cigarette usage and the money saved by reducing the number smoked.

Making an announcement through an app or social media helps keep people accountable to others, Chatterjee says. Informing friends and family on Facebook that you plan to run a marathon or write a book will hold your feet to the fire, as opposed to keeping your goal a secret, he says. "It's harder to change behavior of those who feel alone in their goal."

REACHING THE GOAL

If triggers are not working, another option is to focus on a person's ability to accomplish a goal. That might involve setting more attainable milestones, such as saving 2 percent of each paycheck instead of 5 percent. Another aid is simplifying the process of logging information into the app by offering voice activation.

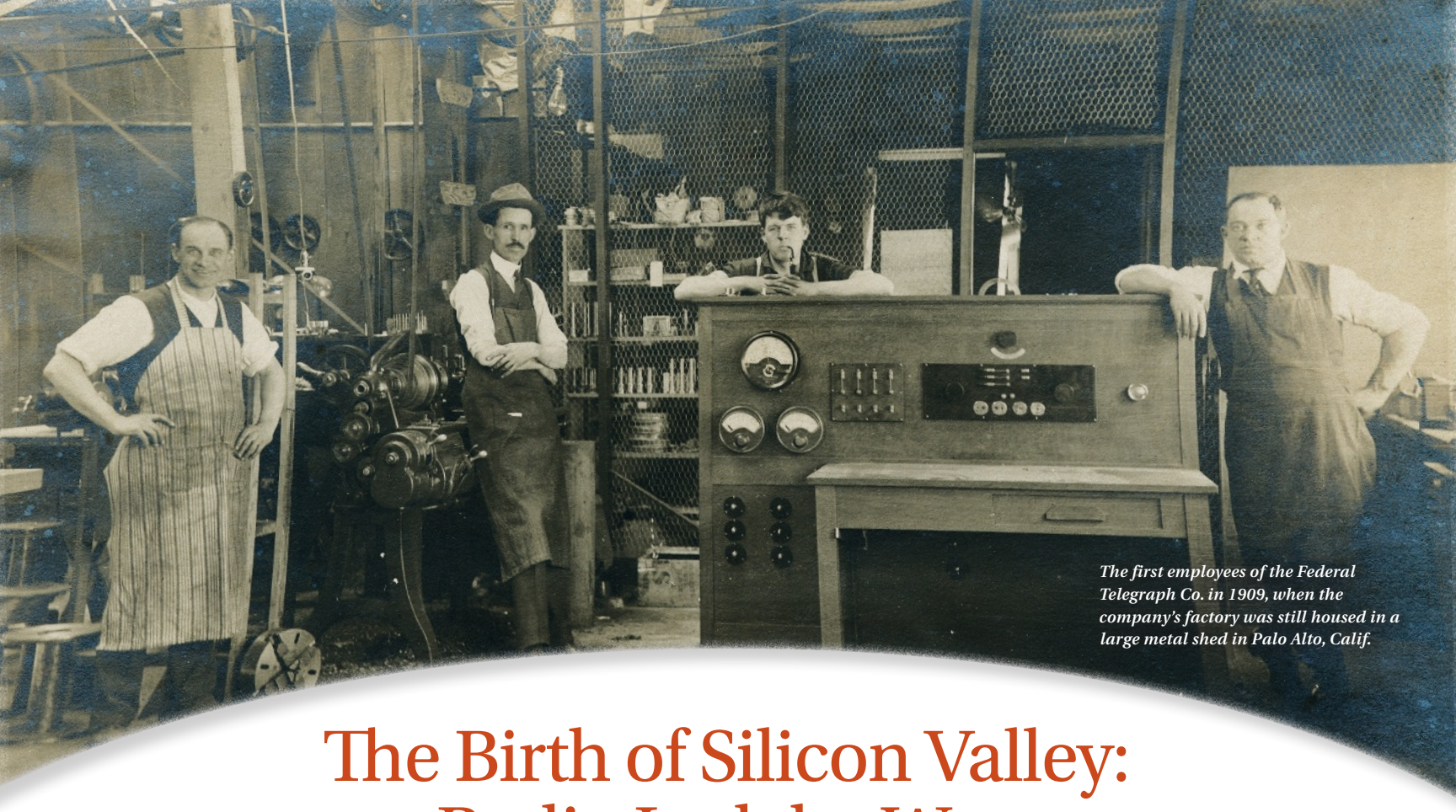
Designers also consider offering a reward system for good behavior. It might include earning a badge when a milestone is reached, or "gamifying" the experience by collecting points that can be applied toward unlocking, say, a new feature of the app.

Such rewards are even more important when users are about to quit on their goal. To guard against that, developers can build their software to sense inactivity and then contrive to inspire users to continue.

The field of persuasive technology requires input from many disciplines—including data analysis, behavioral science, and game theory—to better understand users and keep them coming back. Or, Chatterjee says, to get them to use the app in the first place.

Data can help inform how people are using an app and when they are most and least active with it. Behavioral scientists can provide insights into why people quit when they do, and suggest how to motivate them to stay on track. And game theorists can build in rewards or gaming experiences to encourage people to keep going. ◆

EDMON DE HARO



The first employees of the Federal Telegraph Co. in 1909, when the company's factory was still housed in a large metal shed in Palo Alto, Calif.

PERHAM COLLECTION OF EARLY ELECTRONICS

The Birth of Silicon Valley: Radio Led the Way

Long before computing, engineers and hobbyists were transforming communications BY **PAUL WESLING**

SILICON VALLEY—an area that encompasses San Francisco and its extended suburbs to the south, including San Jose—is commonly known as the tech capital of the world. When most people think of the valley, they probably think of semiconductors, personal computers, and software. But it was a hub for innovation long before the rise of personal computing.

Some consider IEEE Fellow William Shockley's silicon transistor company, Shockley Semiconductor Laboratory, in Mountain View, to be the start of Silicon Valley's story. Shockley, a Nobel laureate who had grown up in Palo Alto, left Bell Labs in 1956 to establish the laboratory. The following year, several Shockley employees, known as the *traitorous eight*, left to form Fairchild Semiconductor, a company in Palo Alto that would revolutionize the semiconductor industry. But the seeds for what became Silicon Valley were actually sown 50 years earlier.

FRUITFUL BEGINNINGS

In the late 1800s, California's Santa Clara Valley, 80 kilometers south of San Francisco and anchored by San Jose, was known as the Valley of Heart's Delight. The region got the nickname because of its blossoming fruit trees and abundance of agriculture. Shipments of its apricots, cherries, and prunes to the Midwest and East Coast—along with the gold still being mined in the Sierra foothills—brought wealth to the region. Steamships from the Hawaiian Islands and Asia headed for San Francisco's seaport.

But San Francisco was relatively unknown compared with other U.S. cities such as Boston, Chicago, and New York.

That began to change in 1909, when Stanford engineering graduate Cyril Elwell sought a better design to replace the noisy radio transmitters of the day. He licensed the Poulsen arc design for transmitters from Denmark. It could send not only Morse code but also voice and music, a big advantage over transmitters of the time. With what we'd now call *angel funding* from Stanford's president, David Starr Jordan, and several professors and friends, Elwell formed the Federal Telegraph Co., in Palo Alto.

He built more powerful versions of his original transmitter and by 1912 was able to send messages to Honolulu and receive them as well.

The sinking of the RMS *Titanic* in 1912 brought focus to radio as a potential life-saving technology. Although the radio operator on the ship sent out emergency messages that night, the operator on the nearby SS *Californian* had left his station and gone to bed. Later that year, U.S. federal laws were changed to require shipping companies to have operators monitor radio signals around the clock.

The U.S. Navy liked the technology developed by Federal Telegraph for ship-to-ship and ship-to-shore communications and installed the radio system on its vessels.

By the end of World War I, Federal Telegraph had installed million-watt systems in Panama, the Philippines, and Spain, as well as Arlington, Va., Los Angeles, and Portland, Ore., to support U.S. Navy and commercial shipping companies. Federal Telegraph continued to increase the size and power of its transmitters, and its revenue grew.

RADIO ENTERTAINMENT

Another Stanford engineering student, Charles "Doc" Herrold, started a small radio company in San Francisco, but it was destroyed in the 1906 earthquake. He moved to San Jose and in 1909 founded the College of Wireless and Engineering to teach radio arts to aspiring hobbyists and operators. His Wednesday evening "San Jose Calling" program, launched that year, was the first regularly scheduled radio broadcast in the United States.

Herrold's wife, Sybil, would play music and broadcast it over the station, which eventually grew into San Francisco's KCBS. ◆

Life Fellow Paul Wesling is an IEEE Distinguished Speaker. He is also a member of the IEEE Silicon Valley Technology History Committee.

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What to Expect When Moving Up to Management

Insights from the IEEE Technology and Engineering Management Society BY MONICA ROZENFELD

IF YOU'RE AN ENGINEER looking to move into a management role, here are a few things to know about what managing requires.

With the right skills, any engineer who aspires to be a manager can become one, according to Life Senior Member Oliver Yu, chair of the IEEE Technology and Engineering Management Society (TEMS) innovation and entrepreneurship committee. He has had a long career as a manager in California, including at the Electric Power Research Institute in Palo Alto and at the research nonprofit SRI International in Menlo Park. He is now president and CEO of the Stars Group, an online gaming company in Los Altos.

The Institute interviewed Yu and Senior Member Michael Condry, president of IEEE TEMS, who began in management at Bell Labs, in Holmdel, N.J. He went on to become director of Sun Microsystems in Santa Clara, Calif., and then CTO of Intel's Global Ecosystem Development Division before retiring in 2015.

Here is what they say you can expect once you become a manager.

BRING OUT THE BEST IN OTHERS

As manager, you are the bridge between your own manager and your team—you're expected to deliver on the objectives of your project and troubleshoot problems that arise, Condry says. "Your focus shifts from you as an individual engineer to you as a leader. As manager, it's all about teamwork."

With that, you give up stardom, Yu says: "The recognition goes to your team—even if you help it leap over multiple hurdles. You will become the star only if your team members are stars."

Therefore, he says, it's key to be a mentor to your engineers. "Instead of you being the smartest person in the room," he says, "leverage their expertise to help the team deliver outstanding results. You will be rewarded for it."

And once you're recognized by your employer, be sure to share that recognition with your team, Condry says. Companies tend to spotlight some employees over others—which dissuades people from doing their best work and reduces the overall effectiveness of the team, he adds.

Also, create an environment in which people *want* to work for you. Condry suggests welcoming their feedback and demonstrating that you care about them and respect them as professionals.

But that doesn't mean being easy on them. "Good managers know how to draw out the best in their team," Condry says.

COMMUNICATION IS KEY

One of the biggest tasks a manager has is to see the big picture and execute on it. That might entail communicating the deliverables from your manager to your team or relaying feedback from customers to top leadership. Whether it's one project or several, a whole division or an entire company, managers must have a wide-angle lens, Yu says, whereas engineers take a narrower view.

"It is critical that managers speak two different languages: detailed for engineers and high-level for executives," Yu says.

Managers must learn to communicate concisely with the company's top leaders about business decisions. "If you can't say it with three bullets on one slide, you won't hold their attention," Condry says. "If they ask for more details, you've done a good job at getting your message across."

Being succinct is often difficult for engineers who move into a management position, Condry says. "If they come from academia, engineers think the more volume, the more effective the message," he says. "But in industry, you need to make your points fast and crisp."

It's important for managers to understand the technology their teams are working on. "If managers don't know how the technology works, they'll struggle to lead their teams," Condry says.

As manager, you have to see how all the pieces work and fit together, including the supply chain and the marketing process. Even if you oversee only one piece of the pipeline, you're still responsible for moving everything along to meet deadlines, Condry says.

And if you find that your team lacks the expertise needed to complete your project, it's important to communicate that as well, Condry advises. While at Intel, he says, he saved the company US $1.2 billion when he asked a power electronics engineer from another department for help on his project—expertise he did not have. Together they came up with a patch for a circuit system instead of a complete redesign.

TO GET THROUGH THE DOOR

Before applying for a management position, it would be helpful to take classes in team management, communication skills, business strategy, and similar subjects, Condry says. Courses might be available through your employer; if not, check with colleges, universities, and engineering and business associations.

IEEE TEMS, for example, offers Engineering Management 101 and Understanding an Industry Technical Staff Pipeline, each available for $11 for members or $15 for nonmembers. Check out its website for these and other resources.

Yu also recommends asking to shadow managers at your company to see what their day looks like.

If there is no time for classes when you find a newly posted management position, emphasize related experience on your résumé, in your cover letter, and in interviews, Yu suggests. That could include having led a project or organized a conference, as well as tasks that demonstrate your ability to work with a budget and lead a team. Explain the kind of project it was, how many people were involved, and the type of communications required to execute and complete it, Yu says.

"Emphasize any creativity you've implemented in managing a project or leading a team," he adds. In interviews, be attentive and be prepared to answer questions effectively. "It's obvious during interviews whether the applicant is a good communicator—which is a must," he says.

Yu warns that managers have more responsibilities and—more importantly—deal with all types of people. If you cannot work well with people in various roles, he says, becoming a manager might not be the right move for you. ◆

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THREE THINGS MILLENNIALS VALUE MORE THAN A HIGH SALARY

Why the generation job-hops and what could persuade them to stick around BY AMANDA DAVIS

ISTOCKPHOTO

MILLENNIALS OFTEN are categorized as impulsive and driven by instant gratification, with a tendency to job-hop. Many stay at a company for two years at the most before moving on. A recent study by strategy firm Department26 reveals what motivates millennials to stay in one spot—as well as what drives them away.

Workers ages 21 to 35 are influenced by a number of factors, according to the study, which surveyed 1,000 millennials in the United States. As part of the study, Department26 conducted more than two dozen in-depth interviews. The researchers assessed concerns about finances and the future as well as what millennials are looking for from employers.

It turns out high wages are not necessarily their top priority, despite the fact that many entering the workforce are saddled with student loans.

Here are three ways to make millennials more invested in your organization.

SHOW THEM A CLEAR PATH

Millennials are making significant contributions, especially to technology, but many are restless in their current role. According to the survey, more than half of respondents expect to be promoted within the first two years of being hired. Many say they plan to leave the company if that doesn't happen.

To help manage employees' expectations, recruiters and managers should be prepared to explain what's required to move up the ranks, the report says. Managers should provide regular feedback to help them see the bigger picture and fully understand what's expected in order to advance. Annual reviews aren't enough, according to the report. With well-established goals and better communication with supervisors, millennials can manage their own expectations.

OFFER FLEXIBLE HOURS

When asked what's important, many of the respondents mentioned freedom. When millennials are productive, they expect flexibility with their schedule in return. One respondent, an IT manager for a large bank, said she resented the fact that, despite her hard work and excellent standing at the company, she wasn't granted permission to leave work early on a Friday.

For millennials, productivity is more important than adhering to a 9-to-5 schedule. That might mean working a few hours in the evening or over the weekend with the option to take a few hours off during the workweek to attend to personal matters.

Another option is to allow employees to work remotely. An article by the Society for Human Resource Management noted that many millennials ask about telecommuting options during job interviews. Communication tools such as Google Hangouts, Slack, and Skype have enabled a number of companies to let their employees work from home. And a study by the Stanford Graduate School of Business suggests that telecommuters are actually more productive than colleagues who regularly commute to the office.

LET THEM LEAD

A joint study by research firms Virtuali and WorkplaceTrends revealed that 91 percent of millennials aspire to be leaders. And many of them already have traits that could make them effective leaders, a *Forbes* article says, such as the desire for open communication and transparency, a tendency to challenge the status quo, and an unwillingness to compromise core values.

Although the instincts might be there, though, it could take years of experience to become an effective leader. Continuing education is essential. According to a *Forbes* op-ed, on-the-job training should help employees build skills they've expressed interest in strengthening, such as project management.

And because they tend to be more focused on short-term goals, according to the Department26 survey, millennials want training that lets them learn quickly so they can apply their new skills immediately.

That might include a weeklong boot camp to master new software, a seminar on time management, or a workshop on how to handle interpersonal conflicts. When an employer invests resources in millennials' careers, they in turn feel more invested in the company. ◆

Read comments about this article on page 14.

PRESIDENT'S COLUMN

Open the Doors of IEEE

To grow in size and stature, we must broaden our thinking on new possibilities

JIM JEFFERIES IEEE PRESIDENT AND CEO

WHEN WE OPEN the doors *externally*, we connect the public to the impact that IEEE and our members have on technology. We can open those doors wider to cultivate partnerships that can leverage the best IEEE has to offer. When we open the doors *internally*, we embolden cooperation and inclusiveness across our full field of interests.

We should open the doors to innovation in our own thinking and approaches to new models. Open the doors and ease the path to deeper engagement opportunities and broader participation from our valued members, including showing students a wide-open portal to a career.

IEEE is unique in that our members create so much of the organization's value. Whether they are writing papers, editing journals, organizing conferences and meetings, developing standards, promoting education, or meeting policymakers in capitals around the world—IEEE members do it all.

However, members and volunteers cannot succeed in all we try to accomplish without IEEE's professional staff. A large part of our success lies in our being a strong volunteer-led, membership-based organization with a well-supported staff. With the doors open, we must work continuously to encourage and empower our valued volunteer-staff collaboration to yield the full potential in meeting IEEE's mission.

This also includes creating a unified front that embraces our individual society, section, chapter, and region initiatives and outreach. IEEE is more than a collection of autonomous, independent units. While societies, for example, are technologically specialized, they share common needs, challenges, and ambitions. We must leverage IEEE's resources across all its elements to generate a critical mass of interest with the end goal of cooperative workshops, standardization efforts, and interactions with industry, government, and other organizations if we're to demonstrate the broader value that IEEE brings.

To tell the story of IEEE is to share the impact our members are having around the globe. There is a rich opportunity to grow our public visibility and increase the public's understanding of the contributions to society made by countless members seeking to advance technology to benefit humanity.

By projecting our global public policy voice, we can position IEEE as the world's trusted source for information and insights on emerging technology and trends in the marketplace. By celebrating the pride and prestige of our professions, we can demonstrate how engineers, scientists, and technologists contribute to our global community, helping to build today's technologically advanced world. By increasing our organization's publicity, renown, and interests, we can entice potential members to join and existing volunteers to lead, as well as encourage the next generation to explore the possibility of engineering and science careers.

THE VALUE OF MEMBERSHIP

Our members include those studying, teaching, practicing, inventing, and advocating for technology. To engage these diverse audiences in meaningful ways, we must develop membership value propositions and be open to alternative membership models tailored to differing needs. We must ask the important questions: Why did you join IEEE? Why would you stay a member?

It is interesting to note that in the global population, there are more millennials than the baby boomers they will replace. As markets and trends change by generation, so do members' expectations. Many young professionals hold a different perspective regarding the value of membership and how they want to participate in a membership organization. IEEE must engage them on their terms and allow them to take on roles and responsibilities that matter to them. The energy, innovation, and fresh perspectives they offer are essential in these changing times. There is a place for them in IEEE's top leadership. An open perspective will also enhance our humanitarian and philanthropic expansion.

Because the world's most important and pressing issues lie at the convergence of technologies, their solutions require teams from multiple disciplines working together, whether that's big data driving medicine and agriculture or cloud computing integrating the data, education, and entertainment streams of daily life.

We can create a culture of open inquiry at IEEE in which our varied members bring together their diverse experiences, viewpoints, and interests to yield extraordinary accomplishments. That is what unites us in a truly global community as engineering professionals and as IEEE members defined by a commitment to advancing technology to benefit humanity through our work. It is already embodied in our mission and values. Opening the doors wider will only help to maintain IEEE's position as the world's leading technical professional organization.

Please share your thoughts with me at president@ieee.org. ◆

DAVID SUTPHIN

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Sparking Conversation

Several of our blog posts inspired comments from readers

TRACI DABERKO

The State of Research: Where Are We Headed?

EEE FELLOW CHAI K. TOH WROTE in his blog post that both industry and academia have become shortsighted in their research efforts: "Industry as a whole is now focused on short-term research, often called *D&D*—design and development—which results in marketable products within a two- to three-year time frame. Research takes time, and most breakthroughs come only after a good number of years." Toh is a professor of electrical engineering and computer science at National Tsing Hua University, in Hsinchu, Taiwan.

Those in academia are also strapped for time, he noted. They are tasked with many roles, including teaching, supervising students, seeking research funding, and publishing, so they typically conduct research only on a part-time basis.

"Who is now doing the long-term fundamental research that will disrupt the market and drastically improve quality of life, and what role will or should IEEE play in terms of advancing research?" Toh asked. "Progress in human civilization is everyone's responsibility. It is time for us to unite and act."

As a researcher, I am always struggling with starting a project. It's not just coming up with an idea—it's also looking for a sponsor to fund the research. If I want the government to finance my research, I have to prove that the outcome will have a positive economic impact in the next three years. But it's difficult to predict that from the beginning.

If I want my company to sponsor me, then that means I have to make my case to a manager whose priority is to maintain the company's financial well-being. Usually the first question is about the return on investment, and explaining that the idea is "really cool" is not the answer that person is looking for.

—Günter Grossmann

I've worked in corporate research for almost 20 years, and I can attest that there is no smooth pipeline between basic research and innovative product development. In almost all cases the innovative product requires multiple breakthroughs across seemingly unrelated fields. For example, the iPhone was introduced in 2007 and had required innovation in displays, software, and digital communications.

—RF Austin

Professor Toh is right: The level of fundamental research is much diminished from the era when the Internet and GPS were developed. Many of today's great technologies have their roots in government funding, often from the military. Only these agencies seem to have the foresight to keep funding risky research that leads to genuine breakthroughs. The U.S. government has been generous with funding in the past, but perhaps an international coalition of government-funded research should be promoted for the good of all.

—William Webb

Continues on next page

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Job Ads on Facebook Discriminate Against Older Workers

DOZENS OF LEADING EMPLOYERS in the United States—including Amazon, Target, and Verizon—are placing recruitment advertisements on Facebook that target job hunters younger than 40. This finding is based on an investigation conducted by *The New York Times* and the nonprofit journalism organization ProPublica.

Employers can select criteria about prospective workers, such as profession, location, interests, and age range, and then Facebook uses its extensive data collected about users to direct the ads to the target audience.

A class-action complaint alleging age discrimination was filed in federal court in San Francisco on behalf of the members of the Communications Workers of America. The union is suing several American employers and employment agencies that exclude older workers from receiving employment and recruitment ads on Facebook.

Rob Goldman, Facebook's vice president of advertising, defended the company, saying, "Used responsibly, age-based targeting for employment purposes is an accepted industry practice, and for good reason: It helps employers recruit, and people of all ages find work."

In our blog post, we asked readers whether they had faced age discrimination in the hiring process, on Facebook, or elsewhere.

I am against age-based advertising, because it discriminates against persons not in the specified age range and because it also ignores the fact that age is very seldom a reliable indicator of ability to do the work needed.

—Prof Stewart

We "graybeards" bring a lot more to the table than just what's on our résumés. We've been in the workforce for more than a generation, so we've lived through the changes. We've seen the march of technology and all its good and evil, and we don't flinch (well, not much) at economic or social turmoil. Plus, we carry the institutional memory of multiple companies in our hearts and minds. These are just a few of the reasons to hire people like us, and why almost all cultures revere their elders.

—Jim Strohm

Age should not be seen as a negative: An older person with more experience can give good advice and save the younger people from going over the same ground twice. However, I recognize that newer technology understood by and available to younger people now makes stuff possible that I couldn't do many years ago. The old and the young should work in the same place to their mutual benefit and to the benefit of their employer.

—Brian Butters

The greatest value in building an effective team is to hire as much experience as you can afford and mix it up with younger workers who can bring a fresh perspective. The real problem is that too few people in our industry understand this and, generally, they lack the knowledge of how to build stellar engineering teams. This has not changed all that much in my 35 years in the field.

—Ben Rolfe

Employers should be free to hire whomever they want. It is their company, after all. If us older engineers truly bring added value to the table, then other companies will quickly figure that out, and hire us to beat the competition. It is also possible that we don't bring as much to the table as we think we do.

—Merrill

Ads targeting certain age groups save a lot of time. If you get to an interview and they see you are older than they want for the job, they just won't offer it to you. Good luck trying to argue that you didn't get the job because of your age in those circumstances.

—Brian Hudson

TRACI DABERKO

These discussions are ongoing. To weigh in, visit http://theinstitute.ieee.org/june18responses.

Three Things Millennials Value More Than a High Salary

A RECENT STUDY by strategy firm Department26 found that what motivates millennial workers (ages 21 to 35) to stay with one company are leadership opportunities and a clear path to advancement, as well as flexible hours. (Read the full article on page 11.)

Why in the world would new employees be loyal to a company? Even with zero job experience, they have all heard the stories from their parents about companies dumping loyal employees after 35 years of dedicated service. So if the grass looks even a tiny bit greener on the other side, they are hopping over the fence. And how can you blame them?

—Steve Gilbert

If millennials want to be leaders, IEEE should offer them more opportunities to do so. Let them become a volunteer and work on various projects. This would give them the chance to learn from IEEE leaders and provide a path to a leadership position.

—Victor Skowronski

The problem with millennials is that they are incapable of receiving criticism. I teach several university seminars, and I've noticed a profound difference between this generation and the previous one. Perhaps the elementary schools and high schools are discouraging competition and promulgating an "everyone is a winner" mind-set, but I find them to be very fragile emotionally. A leader cannot have this quality.

—JB Wilson

The goal should be to expand everyone's understanding of leadership. It is not a position; it is an attitude. Can I help someone? If I do, I am a leader because I led by example. Does someone need support? I give it to them because this is what leaders do. I believe the more successful firms will find ways for all their professionals to be leaders.

—John W.

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The Newest IEEE Resources

BY KATHY PRETZ

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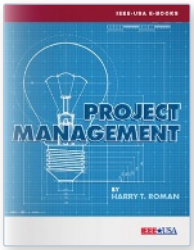
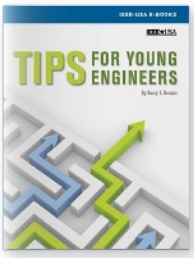


BASICS OF PROJECT MANAGEMENT

Efficiently managing projects is one of the most important leadership skills an engineer can learn. So says IEEE-USA's *Project Management*, an e-book written by Harry T. Roman, an IEEE life senior member. Roman gives practical advice on what it takes to lead a project, how to sell an idea to top management, and how to select members of a team. The e-book sells for US $3.99, but for IEEE members it's only $1.99.



ON SUCCEEDING IN THE WORKPLACE

Another IEEE-USA e-book from Roman, *Tips for Young Engineers* advises readers to document their progress with what he calls a *career history file*. Today's workers switch companies so often that, he says, it helps to keep an updated file of significant accomplishments and work activities. He also recommends taking notes at conferences and off-site meetings to help you understand on further reflection how your company might use the technology. And to gain name recognition, he says, you should submit technical articles to conferences. The e-book costs $7.99; IEEE members get a $2 discount.

IEEE-USA (2); ISTOCKPHOTO

STANDARDS

RATING THE TRUSTWORTHINESS OF NEWS SITES

Reputable news outlets and social media platforms are looking for ways to stem the spread of false and misleading news, or at least label it as such. The "IEEE P7011 Standard for the Process of Identifying and Rating the Trustworthiness of News Sources" is trying to help readers detect fake content.

The standard will score a representative sample of articles from each publication by analyzing such factors as the headline, the organization's use of retractions, bias, factual accuracy, and whether it labels so-called native advertising—paid content written to look like a journalistic piece. Each news outlet will receive a letter grade—from A to F—indicating how trustworthy the source is.

MAKING AUTONOMOUS SYSTEMS ETHICAL AND SAFER

Three projects have been added to the IEEE P7000 standards family, which supports a principal IEEE goal of prioritizing human well-being in the development of standards that cover the design of autonomous and intelligent technologies.

IEEE P7008, the "Standard for Ethically Driven Nudging for Robotic, Intelligent, and Autonomous Systems," addresses those overt or hidden suggestions known as a robot's *nudges*, designed to influence human behavior or emotions.

IEEE P7009, the "Standard for Fail-Safe Design of Autonomous and Semi-Autonomous Systems" provides a basis for developers to design robust and transparent fail-safe mechanisms for increased accountability.

IEEE P7009 also establishes procedures for measuring, testing, and certifying a system's ability to fail safely, along with instructions for improving system performance.

Those developing products and services must consider how to improve human well-being based on more than economic growth and productivity. IEEE P7010, "Well-being Metrics Standard for Ethical Artificial Intelligence and Autonomous Systems," establishes a baseline for aligning objective and subjective metrics from global well-being indices with design methods applied by AI programmers.

DESIGNING INTELLIGENT SYSTEMS

This is an updated version of "Ethically Aligned Design: A Vision for Prioritizing Human Well-being with Autonomous and Intelligent Systems." More than 200 global thought leaders helped create the 263-page document, leading the IEEE Standards Association to call it the most comprehensive crowdsourced global treatise on the ethics of such systems.

The new version adds five sections—on affective computing, classical ethics in autonomous and intelligent systems, mixed reality, policy, and well-being—and contains updated content from the eight committees that created the earlier version.

TERMINOLOGY FOR QUANTUM COMPUTING

Quantum computers are expected to be exponentially faster than today's supercomputers, able to process complex algorithms and massive amounts of data at incredibly high speeds. But the field's terminology is inconsistent.

That's why the IEEE Standards Association Quantum Computing Working Group is setting definitions. Without standard terminology, it's difficult to get software and hardware engineers on the same page. And it's challenging to train new engineers working in quantum computing if terms and concepts have multiple definitions.

To learn more about the resources on this page, visit http://theinstitute.ieee.org/june18prodserv.

Member Achievements

ANTHONY AGNELLO

IEEE Senior Member Anthony Agnello [above, left] and Richard Factor were honored with a Lifetime Achievement Technical Grammy Award by the Recording Academy for their influence on the record-making process in the music industry.

They work at Eventide, an audio-effects hardware manufacturer in Little Ferry, N.J. The company, cofounded by Factor, revolutionized the industry with the H910 Harmonizer effects processor, developed by Agnello in the early 1970s. The H910 forms the basis of today's pitch-shifting and pitch-correction devices.

Agnello, president of the company's audio division, is a member of the IEEE Signal Processing Society.

RORY COOPER

Fellow Rory Cooper was named one of *O, the Oprah Magazine*'s Health Heroes for this year. He was

profiled in the January issue.

Cooper is director of the Human Engineering Research Laboratories (HERL), a joint effort of the University of Pittsburgh and the U.S. Department of Veterans Affairs. In 1980, while serving as a U.S. Army sergeant in Worms, Germany, he sustained a spinal-cord injury in a bicycle accident that left him partially paralyzed.

He and other HERL researchers recently developed the Mobility Enhancement Robotic wheelchair (MEBot), which can handle rugged terrain yet is narrow enough to cruise through doorways. The researchers were challenged to build the chair by the U.S. Marine Corps Wounded Warrior Regiment.

Cooper also invented the PARA (patient assist robotic arm), and he is working with RE2 Robotics, a Pittsburgh startup, to bring it to market.

He is a member of the IEEE Control Systems and IEEE Engineering in Medicine and Biology societies.

JOHN HENNESSY, DAVID PATTERSON

Life Fellows John Hennessy [below, left] and David Patterson received the Association for Computing Machinery's Turing Award. They created a systematic and quantitative approach to designing faster, low-power RISC (reduced-instruction-set computer) microprocessors.

Hennessy recently was named executive chairman of Google's parent company, Alphabet. Patterson is a professor emeritus of computer science at the University of California, Berkeley.

The award includes a US $1 million stipend from Google. Hennessy and Patterson, both IEEE Computer Society members, are scheduled to receive

the award at a banquet on 23 June in in San Francisco.

LEAH JAMIESON

Purdue University's College of Engineering, in West Lafayette, Ind., has named its Women in Engineering program after Life Fellow Leah Jamieson, the 2007 IEEE president. The program is the first in the nation dedicated to women in the field.

Jamieson told *Inside Indiana Business* that the opportunity to have a lasting impact on women studying engineering at Purdue touches her heart. She is a professor of electrical and computer engineering and a dean emerita of engineering at Purdue.

She is a member of the IEEE Education and Signal Processing societies, the IEEE Society on Social Implications of Technology, and IEEE Women in Engineering. She is also a former president of the IEEE Foundation.

LONNIE PARKER

Member Lonnie Parker was named a Modern Day Technology Leader by *U.S. Black Engineer Information Technology* magazine. The award honors high-achieving, mid-career professionals who are engineering the future through R&D.

Parker is an electrical engineer at the U.S. Naval Undersea Warfare Center in Newport, R.I. He serves as principal investigator for the imaging portion of the center's Submarine Advanced Development Processing project.

He is a member of the IEEE Robotics and Automation Society and IEEE Young Professionals.

AGNELLO/FACTOR: EVENTIDE; COOPER: UNIVERSITY OF PITTSBURGH; HENNESSY: STANFORD; PATTERSON: UC BERKELEY; JAMIESON: PURDUE UNIVERSITY; PARKER: GEORGIA TECH

Nominations Needed for IEEE Technical Field Awards

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SPONSOR: IEEE Control Systems Society

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For an outstanding contribution to the advancement of speech and/or audio signal processing.
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