



The Institute

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GAMES ENGINEERS PLAY

BY TRUDY E. BELL

WHAT DO THE U.S. ARMY, Hollywood animators, medical schools, and artificial intelligence researchers have in common with gawky teenage boys huddling over their PlayStations or Xboxes?

They are all fascinated by computer games. Indeed, the three-dimensional fantasy worlds and the behavior of the animated characters in them have become so realistic—and computers have become so capable—that games are now being used to train personnel ranging from Army troops to surgeons, as well as to advance the development of artificial intelligence (AI). It's a field becoming known by the oxymoron of "serious games," and it's not just for kids.

Sixty serious engineers met in May to exchange the latest developments at the second IEEE Symposium on Computational Intelligence and Games held at the University of Nevada in Reno.

[Continued on page 22]



This learning program, which runs on the Internet, helps soldiers practice their perceptual attention while on patrol.

E-Cycling Made Easier

BY IVAN BERGER

WE ALL HAVE A STAKE in protecting the environment, and that includes producers, users, and recyclers of electronic equipment. Governments around the world are pressuring both users and producers into environmental virtue through regulations, mandates, and directives. But a new program, based on a new IEEE standard, aims to entice rather than coerce.

IEEE Std. 1680 was announced in May at the IEEE's International Symposium on Electronics and the Environment, an event attended by recyclers and computer manufacturers as well as engineers. The "Standard for Environmental Assessment of Personal Computer Products" is the IEEE's first environmental standard and the first U.S. national standard on computer recycling. The Green Electronics Council (GEC) is listing products that comply with the standard at <http://www.epeat.net>. Compliance is voluntary.

Most provisions of the standard, and the approach of listing environmentally compliant products, are potentially applicable to all areas of electronics. But for now, the standard covers only computers and monitors, which accounted for about 2.79 million tons—out of a total of 236.1 million tons of electronic waste—in the United States alone in 2003, the last year for which the U.S. Environmental Protection Agency (EPA) has complete figures.

As advancing computer designs render fairly young machines obsolete, and multiple-computer households become more common, a greater number of computers—many still functional but obsolescent—will be disposed of. Today, a little more than 10 percent of such dis-



IEEE Std. 1680 will make it easier to recycle the tons of outdated computer equipment that ends up at waste facilities such as this one in Bordeaux, France.

carded hardware is recycled; the rest gets buried in landfills, exported, incinerated, or just left to clutter users' storage space. The new standard aims to extend computers' useful life, and make them easier to recycle, in ways every stakeholder should be able to accept.

TOUGH NUTS TO CRACK Today's computers are not easy to recycle. Many are difficult to take apart. Disassembled, they're a hodgepodge of materials: some valuable, some hazardous, some that can be recycled and some that can't, often mixed together. And recyclers often have no clear indication of which materials are which.

Until recently, computer makers have had little reason to consider such points, and buyers had no way of knowing how "green" their prospective purchases were. Purchasers who most need to know are governments and other institutions, which are the major buyers—and scrappers—of computer gear. According to the EPA, about 10 000 computers owned by the U.S. government alone join the waste stream every week.

"Thirteen federal agencies have signed the EPA's Federal Electronics Challenge, a pledge to buy greener electronic products, reduce the impact of their use, and dispose of obsolete [Continued on page 19]



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BY WILLIE D. JONES

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1 E-Cycling Made Easier

BY IVAN BERGER

With governments around the world pressuring users to reduce, reuse, and recycle their outdated electronic equipment, a new IEEE standard aims to help clean up the digital dump.

1 Games Engineers Play

BY TRUDY E. BELL

Teenage boys are not the only ones interested in computer games. The U.S. Army, Hollywood, and artificial intelligence researchers (to name just a few) are using gaming technology to attain serious results.

PRESIDENT'S COLUMN

7 Fostering a Truly Transnational IEEE

BY MICHAEL R. LIGHTNER

The IEEE is a global organization, but many members outside the United States encounter problems that challenge its transnational nature. Unavailable products and currency issues are just some of obstacles in the way of a truly transnational IEEE.

THE INSTITUTE ONLINE

<http://www.ieee.org/theinstitute>

Look for these articles on 5 September

NEWS Six new publications for 2007 will cover biomedical issues, nanotechnology, and industrial electronics, among other topics.

HISTORY Electromagnets, the LCD, and the first transatlantic telephone cable are named History Milestones.

FEATURED CONFERENCE Learn how telecommunications continues to pervade all aspects of industry, government, and society at IEEE GLOBECOM 2006, to be held 27 November to 1 December in San Francisco.

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NEWS

FROM AROUND THE IEEE & THE WORLD

IEEE Sets 10 Strategic Challenges

AT ITS JUNE MEETING in Minneapolis, the IEEE Board of Directors approved 10 strategic challenges designed to better position the IEEE in a globally competitive environment and to provide direction on how the organization can improve serving its members, the profession, and the public. Among the challenges identified are these five:

- Develop affordable, attractive alternative membership models that maximize membership opportunities, maintain the prestige of membership, protect the IEEE's reputation, and ensure the economic viability of the enterprise.

- Embrace emerging technologies, broaden technologies already served, and build technical communities as a means of fostering technological innovation.

- Increase the value of technical content and market relevance while continuing to provide well-regarded technical information products and services.

- Establish the IEEE as a leading provider of continuing education and professional development programs.

- Promote public awareness, understanding, and appreciation of engineering and technology.

To view the entire list, visit <http://www.ieee.org/go/strategies>

Dues to Increase for 2007

BASIC IEEE MEMBERSHIP dues for 2007 will rise to US \$123. The \$4 increase over this year's dues is based on the rate of inflation in the United States as measured by the Consumer Price Index.

For U.S. members, the combined assessment for IEEE-USA and ABET will be \$38, an increase of \$1. Of that, \$35 goes to IEEE-USA and \$3 to the accreditation board.

Regional assessments in Regions 1, 2, 4, and 7 have also increased slightly.

Dues for students remain at \$30 in the United States and Canada, and

\$25 in other countries.

The fee for society affiliates, which is set at half the basic IEEE dues and rounded up to the next dollar figure, is increasing to \$62. Affiliates, who may belong to one or more IEEE societies but are not IEEE members, pay the affiliation fee for each IEEE society they join plus the member dues charged by that society.

IEEE members and affiliates don't have to wait for their renewal bill to arrive in the mail. They can renew online beginning in October at <http://www.ieee.org/renewal>.

Fellow Program to Get More Focus

TWO AD HOC COMMITTEES appointed by the IEEE Board of Directors have been charged with increasing awareness of the Fellow program among members and the general public, and exploring ways to improve the program's policies and nominating procedures. The goal of the IEEE Fellow program is to ensure that senior



members who have significantly contributed to the advancement or application of engineering, science, or technology are recognized with the institute's highest membership grade, that of IEEE Fellow. The committees have been asked to present their recommendations to the board at its November meeting.

Time to Vote

THE ANNUAL ELECTION ballot is due to arrive in IEEE members' mailboxes this month. In addition to the two candidates for 2007 IEEE President-Elect, 33 people are running in 14 contests in various IEEE divisions and regions, as well as in the IEEE Standards Association, IEEE Technical Activities, and IEEE-USA.

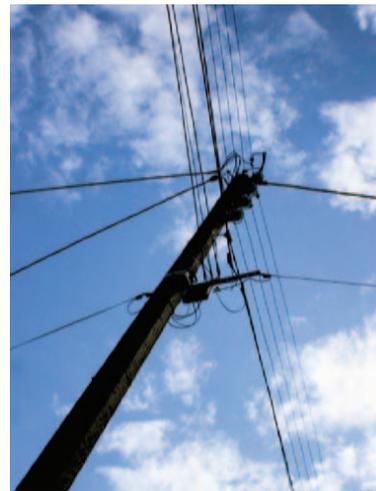
Those on the ballot represent a diverse group of qualified candidates who have the time to devote to their prospective responsibilities and are

dedicated to serving the IEEE membership. Members whose dues are paid in full as of 1 August at member grade or higher are eligible to vote. And for the first time, graduate student members may vote.

Completed ballots must be received by noon U.S. Central Time (18:00 Greenwich Mean Time) on 1 November. Members can also access the ballot and related materials electronically. To learn more, visit the election site at <http://www.ieee.org/elections>.

Funds Approved for New Communications Certification

THE IEEE BOARD of Directors has approved a plan that will provide US \$200 000 to develop and assess the value of a new certification program for technical professionals in communications. The Certificate of Communications Expertise was proposed by the IEEE Communications Society



at the board's June meeting. The society plans to use the money to develop materials describing the communica-

tions areas candidates must master, as well as a set of questions for the certification exam. Industry support will also be solicited. The certification program could be used as a pilot for other IEEE societies that want to develop similar certifications for their technical fields of interest, according to IEEE President-Elect Leah Jamieson, chair of the IEEE's New Initiative Committee, who made the motion.

Electronic Copyright Form Now in Four Languages

THE IEEE INTELLECTUAL Property Rights Office has posted German, French, and Spanish versions of its electronic Copyright Form (eCF) online. The new versions allow some authors for whom English is a second language to better understand the copyright transfer process and identify their rights and privileges as IEEE authors. Chinese, Japanese, Russian, and other languages are to be added by the end of the year.

The translated eCF is available only from journal and conference sites that already let authors submit their manuscripts electronically. An online wizard in the selected language guides the

author through a series of questions to determine the author's copyright status. Once the process is completed, the author is presented with a copy of the entire IEEE Copyright Form in the author's language. The final page, where the author signs the copyright form, will remain in English, however. Authors can sign and submit the form to the IEEE as they upload their manuscript files.

Editors and conference organizers who want to make the eCF and its translated versions available on their manuscript submission Web sites should visit <http://ecopyright.ieee.org/registration/registration.html>.

—Compiled by Kathy Kowalenko & Jason Laday



Internet Censorship

Google's chief executive recently said the company will not lobby to change China's Internet censorship laws. Earlier, the company's management endured criticism because Google's China site blocks searches on subjects such as democracy or Tibet, topics restricted by the government. What do you think of Google's stance?

No Lobbying, Please!

I agree totally with Google's stance. I do not believe that it is appropriate for any company to lobby a political body. If the employees of companies want to do so as individuals, that is their right, but I think we are ill served by companies acting in the capacity of individual citizens.

DON DRUMTRA
Manchaca, Texas

Do the Right Thing

I can certainly see Google's point of view. For the world's largest emerging market, any information distribution is better than none. It would be sensible to prevent a Chinese-equivalent site from getting a foothold. However, I do not think that Google should participate in censorship. In the end, integrity and credibility are all that any organization or person has. It is sometimes painful to do the right thing.

SUD DeLAND
Torrance, Calif.

Singled Out

An article appearing in the 9 March *New York Times Magazine* gave Google a very fair assessment and concludes that Google is a far more responsible and moral corporate citizen than Yahoo, Cisco, and Microsoft in its behavior in China. Yet the media seems to have singled out Google for bad behavior.

Y.C. LARRY HO
Princeton, N.J.

Google Pox

For living in a democracy, Google sure does not practice what it has learned in

that democracy. Google has agreed to this undemocratic practice and will be the first to scream if the U.S. government attempts to control it. It's a shame that Google has no corporate backbone. A pox on its name! What will the Chinese government demand next in order to suppress its masses?

JOHN D. BOWEN
Silver Spring, Md.

When in China...

Google is a company that wants to do business in the world's fastest (and potentially largest) market. China's government has several policies that work against human rights. If Google wants to do business in China, it has to comply with the law. I do not think it has another choice.

On the other hand, governments that can influence China in many ways should try to convince the Chinese government, and even ordinary Chinese citizens, of the need to protect human rights and remove laws that restrict them.

DANILO MANSTRETTA
Pavia, Italy

Take What You Can Get

This question is like many of those questions where you often get a worse outcome when you take the moral high ground. I think the Chinese people are better off with a crippled Google than no Google at all.

Knowledge, even if biased, is better than no knowledge at all. That the Chinese people have access to the Internet at all is wonderful, and it will only be a

matter of time until the people demand the demise of censorship. I think that that time would only be postponed if Google weren't there at all.

Google made a tough choice, and I think it made the right one.

BILL WOHLER
Menlo Park, Calif.

Shill for China

Google ought to be ashamed of itself for cowardly abetting Chinese government censorship. To paraphrase an old saying, all that is required for evil to triumph is for good men to do nothing.

Google has in fact done worse than nothing. By cowering to the communist government, it has willfully helped to restrict the very free speech upon which its business depends. I am sure that China's citizens do not appreciate that.

What's next? New restriction lists every month? Government propaganda sites with top page rankings?

Who in China (or elsewhere) can trust Google anymore? Having missed this chance to take a stand for free speech, it is now just a shill for the Chinese government.

KEN SHERMAN
Rockville, Md.

A Spoonful of Capitalism

My thoughts are varied on Google's stance. On one hand, it is a company bowing to the desires of a semi-closed society. On the other, it is a company pursuing its right to attract business through growing any way it feels is reasonable. In the end, it is capitalism working through restrictions, and Google feels that making these concessions to grow its presence and business in that market is worth the effort.

In the end, I'm for it. Any capitalistic influences, even slightly filtered, will be good for China—and the world—in the long run.

NICK FOWLER
Brown Deer, Wis.

Ex-Fans

I was a big fan of Google Earth and Picasa, a digital photography company owned by Google. Both have been removed from my computers, and now I have made Google a forbidden URL on my network.

It appears that Google has no problem appeasing the Chinese government, all the while lambasting and stonewalling our own. This and other

Correction

In "Video Game Pioneer Plays On" [June, p. 12], the name of the company that now owns Sanders Associates—where video game pioneer Ralph Baer worked—is incorrect. Lockheed Martin sold Sanders to BAE Systems in 2000.

THIS MONTH'S QUESTION

Borrowed Rules

In May, William Swanson, chief executive of Raytheon, in Waltham, Mass., publicly apologized and was docked approximately US \$1 million in pay by the company after it was revealed that he had plagiarized sections of his popular 2004 book, *Swanson's Unwritten Rules of Management*.

It seems that 16 of Swanson's 33 rules were lifted word for word from W.J. King's *Unwritten Laws of Engineering*, published in 1944 by the American Society of Mechanical Engineering.

Was Swanson's punishment appropriate, too severe, or not severe enough?

RESPOND TO THIS QUESTION by e-mail or regular mail. Space may not permit publication of all responses, but we'll try to draw a representative sample. Suggestions for questions are welcome. Responses will appear in the December issue of The Institute and are subject to editing for brevity.

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company decisions have irritated many at my workplace, and it is affecting the way we do our computing.

JERRY NOBLES
Mobile, Ala.

Reality Check

When Google went public, I read that its statement of intent to the U.S. Securities and Exchange Commission included something like, "To make the world a better place." While that may have seemed cool to Google founders Larry Page and Sergey Brin, the reality of being a large multinational corporation is now becoming evident: It's all about money. Morals and good intentions take a backseat to the bottom line.

MILES WROBLEWSKI
Bensheim-Schönberg, Germany

A Light at the End of the Tower

On behalf of the Edison Museum Board of Trustees, I'd like to express thanks for your article, "Edison Museum to Rise Anew" [June, p. 13]. We greatly appreciate the IEEE support we've received. Hopefully, the broad circulation of your publication will stir additional support for our efforts. Note that we have been approved as an IEEE Milestone in Electrical and Computer Engineering, "Thomas Alva Edison Historic Site at Menlo Park, 1876"—and the dedication ceremony will be in September.

JOHN ZEMKOSKI
Edison, N.J.

Zemkoski is one of the Edison Museum's 12 trustees.

Enriching Ethics

I read with interest in "Ethics Is Serious Business" [June, p. 14] that employees of Sandia National Laboratories, whose business is nuclear weapons research, receive training about ethics. I wonder how they cover the first point of the newly changed IEEE Code of Ethics: "...to accept responsibility in making decisions consistent with the safety, health, and welfare of the public," when the product of their research can cause death and destruction. I think it is admirable that they attend ethics training where they learn it is wrong to falsify time cards and accept inappropriate gifts and gratuities, but do they ever consider the ethics of creating and perfecting weapons of mass destruction?

JOHN BAGLEY
Naperville, Ill.

Regarding "Ethics Is Serious Business," engineers face and make ethical decisions almost every day. They aren't just business or office decisions; they're one-decibel questions in a 10-decibel world and hardly ever worth falling on one's sword over.

CORTLAND RICHMOND
Ada, Mich.



Pictures Speak Louder Than Words

First, I want to say how much I enjoyed the variety of topics—from mentoring and wind power to the international scene—covered in the June issue.

However, "IEEE Warms Up to Wind Power" [p. 1] lost an opportunity to show an additional image of wind turbines, offering reinforcement to your discussion. Instead, the reader is shown an ad with an image of hydroelectric generators [p. 7], something quite in contrast to wind power. While the article suggests forward thinking in electric power generation, the image of the hydroelectric generators suggests "the same old thing."

DANA FREIBURGER
Madison, Wis.

The editor responds: We have no control over the illustrations advertisers decide to use in their ads. We regret, though, that we did not use another wind turbine photo in addition to the one on the front page.

Of State and Science

I want to thank IEEE President Michael Lightner for addressing the contentious issue of geo-political boundaries and functions of transnational organizations ["The Challenges of A Transnational Organization," June, p. 6]. Science and technology must rise above the fray of nationalism and xenophobia. Just as we value the deliberate separation of church and state, we should extend that same division to state and science. Only through transparency and the collective and collegial sharing of information, untainted by the politics of the day, can we hope to advance prosperity for all humans regardless of nation-state or economic status. The fruits of science and technology should not feed just the privileged few.

STEPHEN SETTMI
Washington, D.C.

Education in Peril

Regarding the letter "Unequal Opportunities" [June, p. 5], living in Serbia and Montenegro, I not only agree with the author, but I can also add that there is an increasing proliferation of so-called private universities in the country. They are mostly run by professors from the state-funded schools in their spare time. For the profes-

sors, it is a simple way to earn more money than they normally get from the government-funded schools. Those new "universities" often not only operate in poor surroundings and with a shortage of qualified staff, but also claim to provide the same (or even better) opportunities for students than the state-funded ones with more than 40 years of tradition.

The question is how only a handful of people are able to run a university while pretending to transfer the same or better knowledge to their students. It is very common in Serbia to pay a lot to attend these private universities compared with the state-funded institutions. But, interestingly, students somehow get their degrees much faster in the private schools.

I earned my first engineering degree in computer science from a university that has a long tradition, but in just a few years there appeared dozens of "universities" where you just pay money to get a diploma without much studying or work.

Many young people rush to enroll in these schools because it is guaranteed they will get their degrees faster—which can give them the same status as those of us who studied hard and long at a respected university. With this new approach to education, you can expect a decrease in the number of students enrolled in engineering courses, as well as a decrease in the quality of education in general.

MIROSLAV SKORIC
Novi Sad, Serbia and Montenegro

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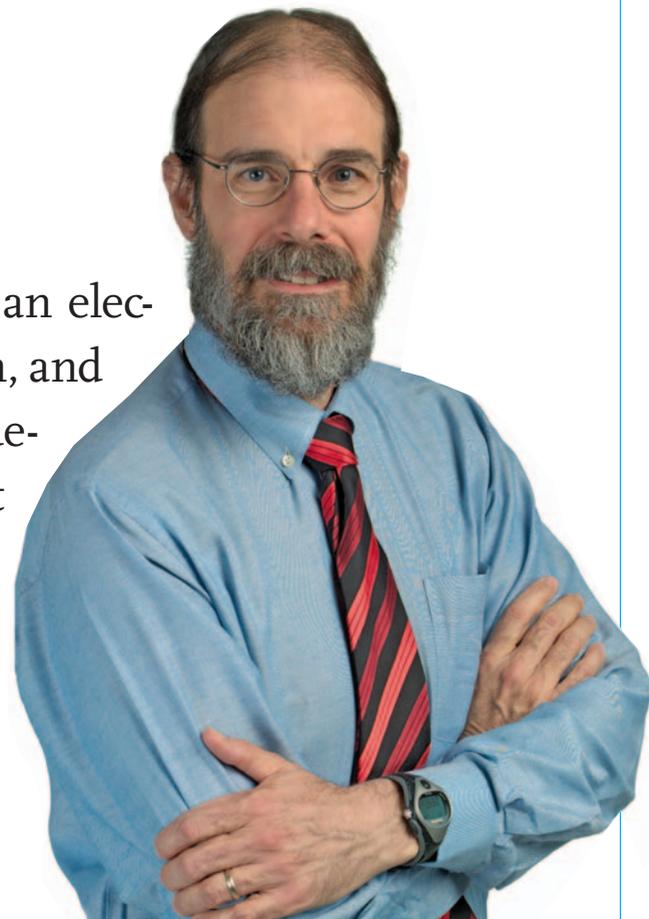
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Fostering a Truly Transnational IEEE

During the past decade, our organization has developed an electronic infrastructure that permits each of us to share, learn, and grow professionally in ways that the founders of our predecessor societies barely imagined. Our products are without equal. For example, the IEEE/IET Electronic Library is a standard resource in our areas of technical interest. Last year, the IEEE sponsored a record 388 conferences around the world, and their attendance and reputation for quality continue to grow.



IF YOU'VE READ MY previous columns, you know I am passionate about preserving and enhancing the transnational character of our organization. Since 1884, when our earliest leaders recognized the need for a community where technical professionals could share and learn, we have welcomed a global membership. This is as it should be because, as I have written before, technology has no national boundaries.

But when I talk with members outside the United States, three issues concern them. First, if the IEEE is transnational, why doesn't it behave like the Institution of Engineering and Technology (headquartered in Great Britain) and accept payment for membership and services in local currency? Second, why are more products and services available for U.S. members than for members in other countries? And finally, if the IEEE is transnational, why is there an IEEE-USA—and why can't there be, for example, an IEEE-Japan?

I want to share with you my responses to these members.

The IEEE is exploring the acceptance of local currencies so that we can better serve all members. After all, someone has to handle the difficulties, and why should it be members? But it's important to realize that because we have members in 150 countries, creating and managing the business system to work across currencies, handle conversions appropriately,

and comply with local and U.S. currency laws will be a complex undertaking. The cost-benefit analysis of this system must be considered in any decision.

All the nontechnical products and services offered to U.S. members are provided by third parties with whom the IEEE has developed relationships to benefit our members. Vendors work with us because we have sizable numbers of U.S. members. We have approached vendors in other nations, but without a large member base in a given country we have not succeeded in establishing services for our members elsewhere. However, we continue to examine how to provide nontechnical products and services for all members, and we welcome your ideas.

Lastly, in every country I visit, members ask me about IEEE-USA and its effect on our transnational character. Let me tell you my response and how I view our opportunities.

Almost every country has a national professional organization for its engineers. India, for example, has the Institute of Engineers in India. These national organizations support members' professional and career development, while also providing national policy or position statements on engineering-related issues. The United States has no organization with the IEEE's areas of interest, so IEEE-USA is the de facto U.S. national society. When I explain this to

members in other nations, they understand—but they also ask why we can't have an IEEE-X for their country. I always point out that as a transnational organization we want to remain a body of individual members—not a United Nations of national bodies. Most members agree this makes sense.

At the same time, I believe engineers are global players. We work in multinational companies and on technologies and products with global reach. As a result, we all share concerns about professional development and career enhancement, and IEEE members definitely have perspectives to share with the global community. I think much of IEEE-USA's work could be replicated globally, while maintaining our partnership position with national bodies.

I see three major opportunities for the IEEE:

- To develop global mechanisms to provide new professional and career services within the current IEEE structure.
- To clarify that IEEE-USA is the U.S. national association in our fields of interest.
- To explore how to make IEEE-USA stronger, perhaps even as a separate organization with which the IEEE would have close ties, just as it has with national societies around the world.

Ultimately, I believe the IEEE will advance by building on our transnational nature to include new products and services, placing renewed emphasis on the organization supporting the members instead of vice versa, and by having the will to examine our organizational structure to build the transnational IEEE of the next decade.

I welcome your comments on this important topic, at lightner.column@ieee.org.

Looking for a Few New Fellows

Nominations are being accepted for the IEEE Fellows class of 2008. The rank of IEEE Fellow is the institute's highest member grade, bestowed on senior members who have contributed "to the advancement or

application of engineering, science, and technology." The deadline for nominations is 1 March 2007.

Senior members can be nominated in one of four categories: application engineer/practitioner,

research engineer/scientist, educator, or technical leader.

To nominate an IEEE senior member or to learn more about the Fellow program, visit <http://www.ieee.org/fellows>.

THE CANDIDATES ANSWER QUESTIONS

Concerns on Declining U.S. Membership, New Benefits, Industry Support, and More

BY KATHY KOWALENKO

DECLINING U.S. MEMBERSHIP, maintaining the volunteer-led corporate structure, and establishing national IEEE entities were among the issues taken up by Lewis Terman and John Vig, the candidates running for 2007 President-Elect. The two presented their views on these and other topics at a June forum hosted by the IEEE Philadelphia Section. Each hopes to succeed Leah H. Jamieson, who will be president in 2007.

The 18th annual Candidates Night was held at the Sheraton University City Hotel in Philadelphia. The candidates answered questions from the audience, as well as others submitted by readers of *The Institute*. Merrill W. Buckley, 1992 IEEE President, moderated the event. Each candidate had five minutes for opening and closing statements and three minutes to answer each question or group of questions on the same topic.

This excerpted version of the discussion features selected questions and answers; the answers were edited for clarity and brevity. The event was videotaped, and you can see it all on the IEEE Election Web site at <http://www.ieee.org/elections>.

IEEE membership in the United States is declining. What would you do to reverse this trend?

VIG, an IEEE Fellow, said the key will be to offer more benefits and, if possible,



President-Elect candidates John Vig [left] and Lewis Terman fielded questions from members at the Candidates Night held in June in Philadelphia.

lower the dues. He suggested benefits such as digitized versions of Wiley-IEEE Press books. “Let’s digitize many of those 600 books and make them available to members—and only members—for free via the IEEE Xplore digital library,” he said. “Members want more practical content, and these books have far more

practical content than journal articles.”

He also noted that the Press has lost US \$4 million during the last 10 years, and added that making Press books available to members for free would create a valuable membership benefit out of a perennially money-losing operation.

Another possible new benefit he

described would be offering what he called “application notes,” which would be similar to those released by electronics companies, for example, containing brief instructions with illustrations on how to apply a particular product in a working application. The difference would be that the IEEE notes would be peer-reviewed to ensure that the information they present is unbiased, useful, and technically correct.

Vig says members tell him the main reason they don’t renew their membership is that they feel the benefits don’t justify the cost. He finds it increasingly difficult to tell people about the tangible benefits because more and more engineers get free access to the IEEE/IET Electronic Library (IEL) through their employer or academic institution. Therefore, he emphasizes the intangible value of being a member.

“I tell them that you’re a member of a community,” he explained. “If you’re an engineer or an applied scientist, this is your home. The IEEE is your home society.”

TERMAN, an IEEE Life Fellow, said there are several factors that contribute to the membership decline, but “fundamentally the basic problem is that the engineering pipeline has emptied out in the United States, or at least dropped rather dramatically. We have to focus on that and try to rebuild that pipeline.”

Another way to reverse the decline is for the IEEE to “broaden its scope” and go after a wider range of people, he said,

referring to membership recruitment. “We need to reach more practitioners than we do. We have to make sure that working engineers understand what the IEEE can do for them.”

Although he said it would be nice to lower the dues, he noted that a reduction would have significant negative financial implications for the institute. Instead, the IEEE should focus on improving benefits for members, such as reducing the time between submission and publication of a manuscript, and offering more practically oriented publications. Starting publications in emerging fields such as nanotechnology offers real opportunities for the IEEE, he said.

“We need to respond to new technologies,” he said. “That’s absolutely key for membership.”

He also supports more continuing-education programs. “People are going to have more than one job in their careers, and they’re going to want to get up to speed as soon as possible,” he said.

He called for more flexible benefits. “One size does not fit all,” he said, noting that some benefits for U.S. members are not available to members from non-U.S. regions. “Membership outside the United States is increasing, and there will be a crossover within 10 years. We should be planning for it.”

Why is volunteer governance still a good idea for the IEEE?

For **TERMAN** the answer is simple. “The volunteers have their fingers on the pulse. They know what’s happening technically, and they recognize the direction things are going,” he said. “It’s very important to have people who are involved technically making decisions about how the organization works.”

He notes that volunteers work well with the IEEE staff, and “it’s very important to have staff, because they can take care of things that we, as volunteers, perhaps don’t want to do or don’t have an insight into doing as well as the staff does.” But, he cautioned, “They’re not going to be able to make the appropriate trade-offs. You get people who are involved technically; they know where things are going, what might work, what might not work, what the possibilities are. So it’s really a marriage between the staff and the volunteers, and the volunteer presence is extremely important.”

VIG said there are two good reasons for having a volunteer structure. “While many of the 900-strong staff stay with the IEEE for many years, volunteers have limited terms, including the one-year term of president,” he pointed out. “This turnover of volunteers brings fresh ideas from the volunteer leadership.”

His second reason is that the IEEE is, after all, a technical society. “You need to have some technical expertise in order to govern the IEEE. To manage the volunteers, we need somebody who has a technical background,” he said. “Many of our best staff people are not technical people. Our executive director, Jeffrey Raynes, for example, doesn’t have a technical background, but he’s very good at managing the IEEE staff. We have excellent staff and we have excellent volunteers in the IEEE, so I think it’s a great partnership.”

What are your thoughts on protecting the IEEE’s most valuable asset: its intellectual property?

VIG noted that IEL currently contains close to 1.4 million articles, and the IEEE has monitors to detect robots attempting to illegally download the whole library.

However, he added, “It would not be that hard to design a system, for example, that could simultaneously download different parts of the IEEE Xplore digital library, and it would be very difficult to detect if each one just downloaded portions of IEEE Xplore, so this is a real threat.”

He also noted other threats to the IEEE’s income, including libraries that sell reprints of papers without paying the IEEE copyright fee. He said he is vigilant about notifying the IEEE when he sees copyright violations so that its attorneys can contact the violators to stop them from selling IEEE articles or to make them pay the copyright fees.

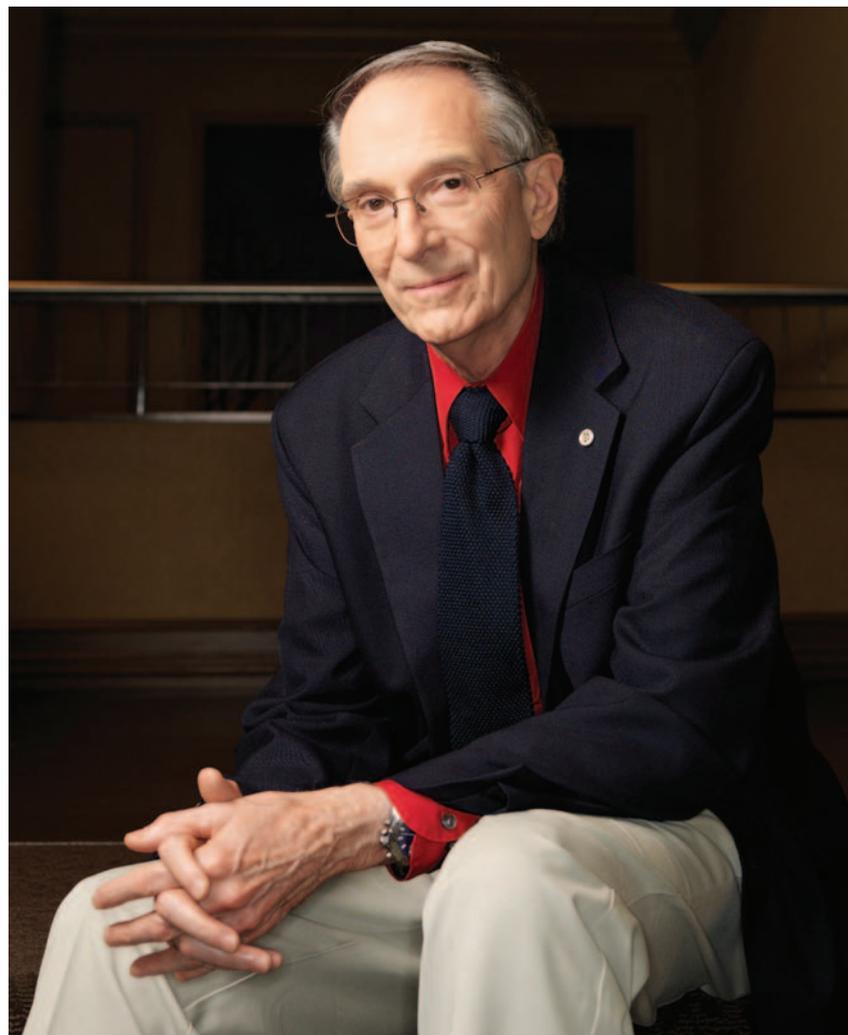
TERMAN acknowledged that protecting the IEEE’s intellectual property is a major concern.

“It’s quite possible for people to set up server farms around the world and start stealing our work from IEL,” he said. “But I’m not sure what the best way is of going about protecting IP, because there are large parts of the world where, in fact, we don’t have much control over this. It is a problem, or it can become a really serious problem, and we have to work on it.”

What are your thoughts on establishing national IEEE entities similar to IEEE-USA to work on behalf of policy issues relevant to engineers in those countries—for example, an IEEE-China, an IEEE-France, or an IEEE-Kenya?

TERMAN said that basically it is a good idea to have national entities that represent the interests of those countries’ technical communities. He noted that the IEEE represents the engineering society at large.

He expressed concern over whether



CANDIDATE AT A GLANCE:

LEWIS TERMAN

AGE 71

MEMBER GRADE Life Fellow (1975)

EDUCATION Bachelor’s degree in physics in 1956, master’s degree in electrical engineering in 1958, and doctoral degree in electrical engineering in 1961—all from Stanford University, California

EMPLOYMENT STATUS Retired in January after 45 years at IBM as a researcher, manager, and associate director

SOCIETY MEMBERSHIP IEEE Solid-State Circuits Society (SSCS); IEEE Electron Devices Society (EDS); IEEE Circuits and Systems Society (CAS)

VOLUNTEER ACTIVITIES

Editor, *Journal of Solid-State Circuits* (1974-1977); member, CAS Board of Governors (1981-1983); *IEEE Spectrum* Editorial Board (1989-2004); president, EDS (1990-1991); Technical Activities Board (1990-present); president, SSCS (1998-1999); editor, *SSCS Newsletter* (2000-present); Division I director, IEEE Board of Directors (2004-2005)

AWARDS American Association for the Advancement of Science Fellow (1981), IEEE EDS Distinguished Service Award (1995), IEEE SSCS Technical Field Award (1995)

it might be possible in countries that have relatively small memberships for that country’s group to get “hijacked” by people whose ideas don’t perhaps represent the majority.

“That would be a real concern, and we have to put in place some mechanism

to make sure that, in fact, when they come up with statements and ideas, they represent the opinions of the technical community in that country,” he said.

VIG said he had no problem with such a structure, provided [Continued on page 10]

that national entities have no seat on the IEEE Board of Directors. “If IEEE-USA has a member on the board of directors,” he said, “should IEEE-Japan, IEEE-China, IEEE-France, or IEEE-Kenya also have seats on the board? This would make an already unwieldy board of directors even more so.”

He noted that some countries, including Australia, have national societies, and he said those societies and the IEEE have agreements, whereby they do not try to “poach” each other’s membership. He said some of the national societies interpret the anti-poaching rule as not allowing any publicity about the IEEE at, for example, conferences and exhibit booths.

“As a global organization, we should be free to advertise the IEEE and recruit everywhere,” he declared. “We should not make such agreements about poaching. But the principle of having national IEEE organizations to help the members’ professional interests is fine.”

In recent years the IEEE has become more financially sound. How do you think a cash surplus should be used?

VIG noted that the IEEE financial reserves currently stand at \$169 million, which is about \$500 per member. “That’s more than enough, much more than enough,” he said. He noted that during his three-year tenure on the IEEE Investment Committee, the committee’s experts recommended that the minimum level of reserves should be half the IEEE’s expenses. According to Vig, last year the IEEE’s expenses were \$270 million—which would mean the reserves should be at a minimum of \$135 million.

At \$169 million, the IEEE is well above the minimum level recommended by the experts, he noted, adding that with such high reserves, the IEEE has more flexibility to spend on developing new products and services. It should also consider reducing the dues for certain segments of the membership, such as members who live in developing countries and those who work for institutions that provide free access to IEEE’s publications.

“We can do a lot of things with the extra money we have; we just have to have the will,” he said. “Unfortunately, the board of directors raised the dues again—which I think was very unwise.”

TERMAN said it’s important to continue to increase the reserves and add to them each year. He pointed out that with membership growing outside the United States,

“we don’t want the reserves to decrease in purchasing power at this point, because we’re going to have to spend more money to be really globalized.”

He also explained that surpluses help pay for the charges related to infrastructure costs, as well as for important new initiatives and new member benefits.

“We need to raise membership benefits so people decide to join the IEEE,” he said.

ON NEW BENEFITS:

TERMAN: Start new publications in emerging fields such as nanotechnology

VIG: Digitize Wiley-IEEE Press books and make them free for members

Could you discuss the IEEE’s industry relations program and how companies are supporting their employees in the IEEE?

TERMAN said it would be great if the IEEE can get industry to support members. However, “the trend in industry in the United States and pretty much around the world has been away from that. Everybody’s trying to be as lean and mean as possible,” he said.

He noted there are two kinds of support that industry can provide. One is to pay for membership. The other is to offer time—time away from the office to attend IEEE meetings. “We have to do a much better job of telling the corporation that, look, your person’s going out there, meeting other people, working with them, and becoming a much better employee because of the involvement with the IEEE,” he said. “I firmly believe that is true, and I think that’s a case we need to make a lot better than we have in the past.”

He also supports a reduced membership rate for employees of companies that subscribe to IEL, in recognition of the fact that the companies are already paying a substantial amount of money. “That’s been talked about, it’s been rejected, but I think it’s not a bad idea,” he said.

VIG noted that companies are not as altruistic today as they used to be. He

proposed making a deal with the companies that provide free access to IEEE publications.

“When a corporation buys a subscription to IEL—which can cost anywhere from \$115 000 to \$500 000—the price should include a discounted membership for its employees,” he suggested. “We can attract more members, and at the same time, the company gains because its employees get access to some of the benefits of IEEE membership.”

“Other than that, I’m afraid companies will do whatever is in their self-interest. Unless we can convince them of some altruistic purpose, we’ll have a difficult time convincing companies they should pay for their employees’ IEEE membership dues.”

The probability of long-term employment in our profession at a single company has been decreasing. What do you see as the IEEE’s interest in this matter, if any?

VIG said the IEEE’s role is one of helping engineers keep up with changing technology. He pointed to the IEEE Educational Activities Board, which he said is doing an excellent job of creating materials that help engineers keep up to speed. Expert Now IEEE conference tutorials, certification programs for software engineers, accreditation of college engineering and technology programs, and other activities are going a long way toward helping engineers, he said.

He also noted that tutorials and short courses from IEEE societies help engineers stay on top of what’s happening in their field and in other fields. “The answer is that engineers must keep up, and they’ll have a much better chance of retaining their job than if they don’t keep up,” he said.

TERMAN said it is critical that engineers get to the highest levels they can in education and experience.

“It’s very important to make sure that people are not only involved with the IEEE, but also go back to school and get a higher level of education,” he said. “I know people who started out as technicians and over the years went to school and got a master’s degree and Ph.D. and became really top contributors,” he said.

He also said the prospects for long-term employment are getting worse. He also noted another problem that increasingly faces engineers in the United States: a lack of respect for the profession. “Outside the United States, I think engineers, scientists, and technologists receive a lot of respect. You see this in China, in Europe—in Western Europe, certainly—and in India. That’s something that we need to reverse, and IEEE-USA can contribute mightily.”

Terman returned to his earlier point about filling the engineering pipeline. “Otherwise you get in a death spiral where there are fewer people doing things, so there’s less work here, more of it goes overseas, and it just spirals down,” he said.

The most serious loss of IEEE members comes from the young engineers who drop their membership in the first five years after graduation. What are your thoughts on solving this problem?

TERMAN pointed out that when students graduate, they go through a major change in their lifestyle. “This is a pretty scary time” for them, he said, citing his own experience when he began his IBM career.

“I realized everything had changed and that I was on my own. I didn’t know anybody,” he recalled. “The IEEE can help people navigate the changes and all the new things that are going to come up in the first few years of their employment.”

He described several possible new products and services that could help with the transition, such as career management training modules. Another was a mentoring system where young people could ask questions and get answers from more experienced engineers.

“Maybe a ‘Dear Abby’ section for recent graduates, whereby they write in ‘I’ve got problems with this [engineering] application, and how do I handle this?’ That’s a very important part of their career, and if we can tell them, show them at the beginning, before they leave, there’s going to be this help from the IEEE, they’ll stay longer and perhaps renew their membership,” he said.

VIG said the key is to make the students feel that they belong to a community: the IEEE community. “This is their technical home, their professional home,” he said. “Once we succeed in making the student feel that, I think we’ll have a much better chance to retain that student.”

He also said another way to retain young engineers would be to introduce a merchandise program, which has been planned for but not yet implemented. The merchandise would include items such as business cards, T-shirts, pens, and the like to help them identify with the IEEE.

“A student who wears an IEEE shirt is more likely to renew than a student who just sees publications as the benefit of being an IEEE member, because they’ll probably get the publications for free from their eventual employer,” he said. “That will not make them renew their membership, but identification with the IEEE will.”

Would you support a so-called cafeteria plan, in which all IEEE products would be unbundled from dues, and let members pay a basic fee and pay separately for IEEE Spectrum and other benefits?

VIG said he does not support making all IEEE products and services available à la carte.

“If we make everything in the IEEE cafeteria-style, we’ll probably end up with nothing but Technical Activities and Standards, because only those two organizations are self-supporting,” he said. “Just about everything else in the IEEE relies on revenues from others. IEEE Educational Activities, for example, is not ready to be self-supporting. Many of our products and services would disappear, and that would not be in the best interest of the IEEE.”

TERMAN explained that the cafeteria plan is one of the proposals currently being studied at the behest of IEEE President Michael Lightner. He said such a plan would have a significant negative financial impact, and though it is interesting to consider, “we really have to look at the implications for the organization and the funding that we have at this point before we could go forward.”

To help guide the IEEE in deciding whether to unbundle its offerings, he pointed to recently released results from a survey commissioned by the IEEE Membership Development Committee that asked members to rank the benefits they were most interested in if cost were not a factor. The results showed that out of the 105 current benefits listed on the

survey, there was no single group of benefits that the majority of members chose. The next phase of the study, he said, will explore different membership packages that could be offered. However, Terman says *IEEE Spectrum* should remain a part of basic membership.

“We ought to have one flagship publication that should be included,” he said. “*Spectrum* should not be viewed as a separate entity.”

How would you describe your management style?

TERMAN first pointed to his experience as a former member of the IEEE Board of Directors, and as a member and the president of the IBM Academy of Technology, an independent internal group of about 300 IBM technical leaders who advise the company’s senior technical management.

“I listen to what people have to say, work with people, involve them, understand what they’re saying, why they’re saying it, and try to work to get a consensus,” he said. “You do it in a low-key manner. You do it behind the scenes so that you’re not getting in people’s faces too much.”

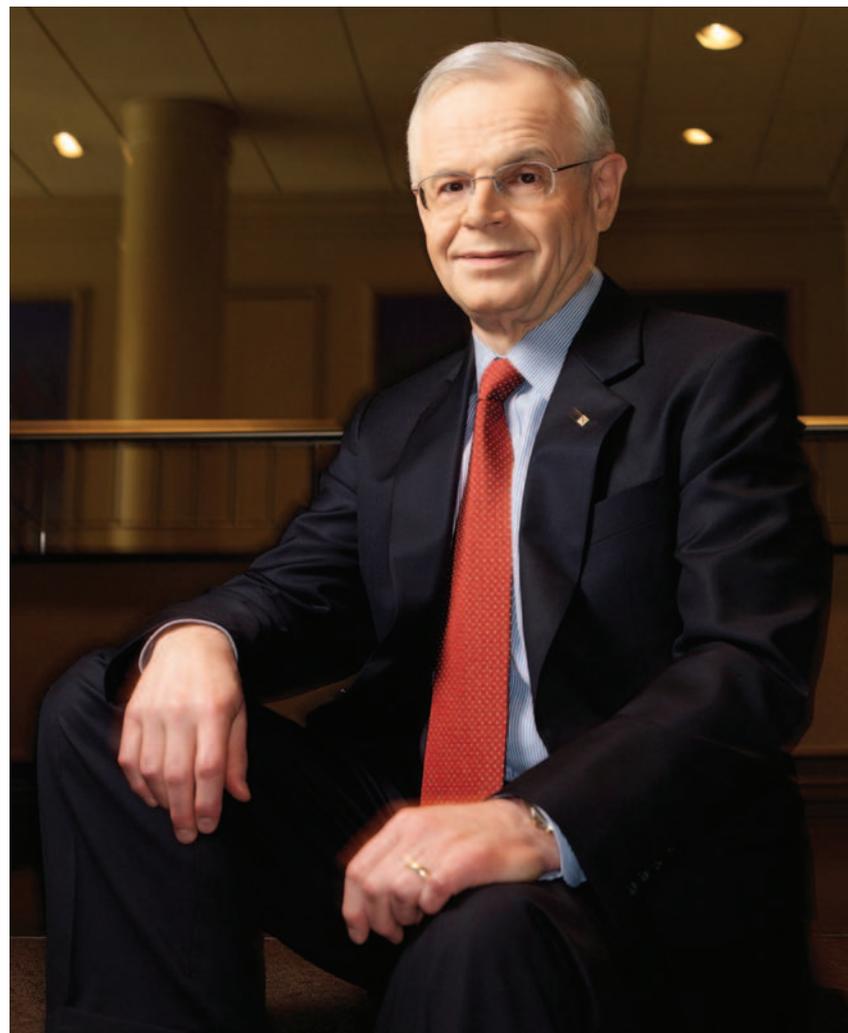
“I think this works pretty well, because you’re giving people a chance to come up with ideas which, indeed, may be half-baked. Maybe they need to think it through further, but you give them advice behind the scenes so they have a chance to work things out. Then you can go forward with the ideas.”

Terman also said it’s important to get people to work together: “I would love to have the equivalent of a president’s Cabinet of the major boards, to get together and discuss, for example, what the Technical Activities Board and the Regional Activities Board could do together.”

VIG described his management style as assertive.

“You can’t get anything done in the IEEE without being assertive,” he said. “When I served on the board of directors for three years, I proposed many motions to change the IEEE, and most of them were successful. The way that you can be successful at the IEEE is to work with others. I work with staff, I work with volunteers, and I work with board members.”

He said he counted 19 co-authors among the various motions he proposed while on the board. “That’s the only way you can get things done,” he explained. “You find like-minded people and you ask them to work with you to pass the motion, and then you persuade others to help you. You have to do the work ahead of time so when the board of directors meets, it’s a done deal. You count the votes, and



CANDIDATE AT A GLANCE:

JOHN VIG

AGE 64

MEMBER GRADE Fellow (1989)

EDUCATION Bachelor’s degree from the City College of New York in 1964 and doctoral degree from Rutgers University, New Brunswick, N.J., in 1969—both in physics

EMPLOYMENT STATUS Retired in February after 36 years of R&D work for a government research laboratory

SOCIETY MEMBERSHIP IEEE Ultrasonics, Ferroelectrics, and Frequency Control Society (UFFC); IEEE Instrumentation and Measurement Society (I&M)

VOLUNTEER ACTIVITIES

Founder, IEEE Sensors Council; president, UFFC (1998-1999); member, Technical Advisory Board (1998-2006); chair, I&M Committee on Time and Frequency (1999-2001); editor, *Transactions on UFFC* (2002-2006); Division IX (Signals and Applications) director, IEEE Board of Directors (2002-2003); editor, *IEEE Sensors Journal* (2003-2006); vice president, Technical Activities, Board of Directors (2005)

AWARDS IEEE Candy Award (1990), IEEE UFFC Achievement Award (2000), IEEE UFFC Distinguished Service Award (2005), IEEE Sawyer Award (2006)

when you have the votes, you can pass the motions and make significant changes.”

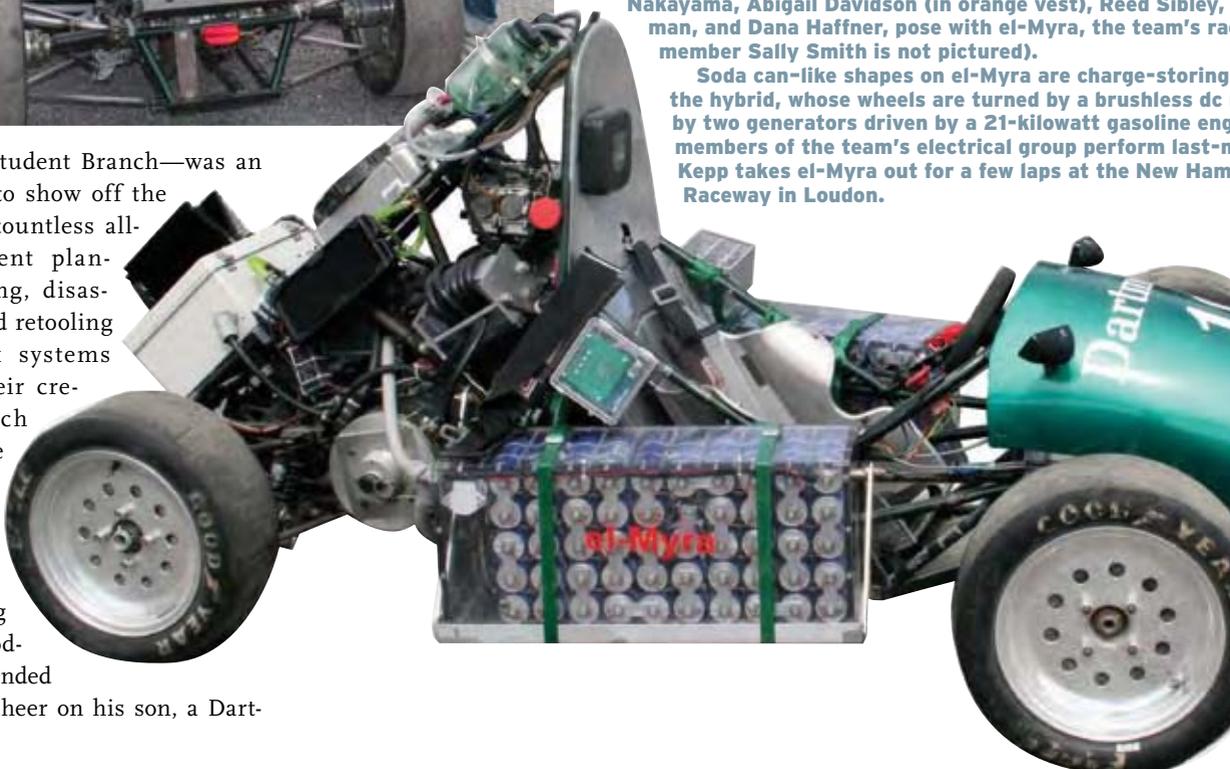
Vig said that if he becomes president-elect, he plans to introduce a blog.

“I would invite everybody in the IEEE—staff, members, and students—to go to the blog and post their ideas, and

have discussions about whatever,” he said. “No subject will be off-limits.” ●

FOR MORE INFORMATION on the two candidates, visit their Web sites: <http://www.terman.org> and <http://www.johnvig.org>.

Students Fast-Track **HYBRID** RACE CAR



BY WILLIE D. JONES

When you think about hybrid electric vehicles, what springs to mind? Probably terms such as “environmentally friendly,” “fuel efficient,” and “economical.” But a group of engineering students at Dartmouth College in Hanover, N.H., aims to change that thinking with high-performance hybrid race cars they’re building from the chassis up.

In May, the student-run Dartmouth Formula Racing Team, composed of electrical and mechanical engineering majors, held a demonstration of the pair of hybrids it built during the past two years. Dartmouth’s cars are known as series hybrids. Their gasoline engines do not provide power to the wheels, but turn electric generators that then power electric motors that turn the wheels. Excess charge is stored in ultracapacitors for subsequent use during, say, rapid acceleration.

For the seven students on this year’s hybrid team, the event—sponsored by Dartmouth’s Thayer School of Engineering, SAE International Inc. (the new name of the Society of Automotive Engineers), and the IEEE’s

Dartmouth Student Branch—was an opportunity to show off the products of countless all-nighters spent planning, building, disassembling, and retooling the complex systems powering their creations, which have the shape and cramped quarters of Formula 1 race cars.

According to David Goodman, who attended the event to cheer on his son, a Dart-

HYBRID DEMO [Clockwise from above] IEEE Student Member A. Kepp (bottom left) and his Dartmouth Formula Hybrid teammates Nakayama, Abigail Davidson (in orange vest), Reed Sibley, [name obscured], and Dana Haffner, pose with el-Myra, the team’s race member Sally Smith is not pictured).

Soda can-like shapes on el-Myra are charge-storing ultracapacitors. The hybrid, whose wheels are turned by a brushless dc motor, is powered by two generators driven by a 21-kilowatt gasoline engine. The team’s electrical group performed last night’s demo. Kepp takes el-Myra out for a few laps at the New Hampshire International Raceway in Loudon.

mouth electrical engineering student on this year's team, getting the hardware to work as a propulsion system may seem simple, but is actually quite complex.

"You not only have an engine like a car would have, but you have an electric motor, energy storage devices, and conversion devices to convert the voltage," he notes. Goodman, an engineer who owns an interest in ISE Corp., a leading manufacturer of large hybrid vehicles such as buses, notes that automakers spent decades and millions of dollars developing today's hybrids. "For this Dartmouth team to put together this vehicle in nine months with under US \$25 000 is just an amazing accomplishment," he says.

The car to which he was referring, dubbed el-Myra, has a 21-kilowatt motorcycle engine that turns two 92-volt generators. A dc-to-dc converter steps the voltage up to 265 V, which is compatible with 98 onboard ultracapacitors that store electric charge. The ultracapacitors, housed in three suitcase-size lexan boxes, deliver the charge to the car's brushless dc motor, which drives the rear wheels.

Just after noon on 4 May, Arne Kepp—an IEEE student member who, like Goodman's son, Jacob, was soon to graduate from Dart-

mouth's fifth-year engineering degree program—donned a fireproof racing suit and helmet, climbed into el-Myra, and took off. As Kepp steered the car through the maze of traffic cones forming the course in the otherwise empty parking lot of the New Hampshire Raceway in Loudon, one of his classmates said it looked like he was taking a victory lap. In a sense, the description was accurate: this event was a victory for Dartmouth's Formula Hybrid effort.

Next year, hybrids built by students at

Dartmouth and other colleges will face off in a multievent competition designed to test the cars' acceleration, fuel efficiency, and cornering and handling abilities. The Formula Hybrid competition is a takeoff on the Formula SAE

student racing competition for gasoline-powered vehicles held in Detroit. Each year, more than 125 teams from around the world vie for that title.

The idea to enter a hybrid car in the competition came in 2003, when Dartmouth students reasoned that because electric motors deliver higher torque at low speeds than do internal combustion engines, a hybrid could offer advantages in the competition's 75-meter drag race—and when coming out of curves on a track designed to lower racing speeds by having more curves than straights. But when word got out about what the Dartmouth team was hatching, the Formula SAE rules committee amended the qualifications, effectively banning hybrids.

"Still, we've learned that it's better to try out your idea and apologize for it later than to ask for permission on the front end," says Abigail Davidson, a member of el-Myra's mechanical group. SAE, having seen the Dartmouth students' progress, agreed to make a hybrid-car competition part of its student design series, which includes Formula SAE, Formula Baja (for amphibious vehicles), and a snowmobile contest.

"The idea of a hybrid race car is exciting," says Douglas Fraser, an IEEE member who is director of the Dartmouth Formula Racing program. "And it's timely. We have a looming energy crisis. Hybrids are admittedly a short-term solution, but I think that it's important that we do these sorts of things."

How would el-Myra, the Dartmouth hybrid, hold up against the cars in the gasoline-only Formula SAE competition? The students say the gas-powered cars, which can go from zero to 100 kilometers per hour in less than 3.5 seconds, should still have an advantage over the hybrids in high-speed cornering because the hybrids' extra components, such as the ultracapacitors and the electric motor, make them heavier. El-Myra, for example, is 100 kg heavier than Myra—a gas-engine Formula SAE car developed in 2003 by Dartmouth students—whose chassis is used for the hybrid.

"It's got a lot of mass, a lot of inertia, so it's going to be tough to turn," says Will MacPherson, a graduate student in mechanical engineering. He was one of the captains of the Dartmouth team building the gasoline-powered race car for this year's Formula SAE competition. "But it should have a very good top speed, and it would be all right in the acceleration event."

UPS AND DOWNS After a few laps around the course, Kepp, beaming like the father of a newborn, turned el-Myra over to Dana Haffner, a mechanical engineering student who will captain next year's Formula Hybrid team. During her second spin around the track, the car suddenly lost power. The team diagnosed the cause of the failure: a capacitor had exploded. The bad news was that el-Myra was sidelined for the rest of the day. The good news was that a fuse rated for 450 amperes didn't blow, so the team was able to discharge all three capacitor banks and safely remove the one containing the damaged unit.

Kepp was philosophical. "We're pretty happy," he said. "We got all of the systems running, and the malfunction came from something that probably wasn't our fault. So as far as we're concerned, this is a win."

Meanwhile, e-STAB, the hybrid built by last year's team, continued to zip around the track. Capacitor problem notwithstanding, el-Myra is superior to its predecessor. Although they are roughly the same weight, e-STAB's 4-kW lawn-mower engine (which requires a pull start) delivers much less power to its onboard generator than el-Myra's 21-kW engine, so there is less power to store in its capacitors. And its solid rear axle makes it less agile than

el-Myra, which has an independent suspension. Much of the difference was attributable to disparity in finances and manpower. El-Myra was produced by seven students with a budget of about \$19 000; e-STAB's three-student team got by on roughly \$11 000.

Students and faculty advisors from a dozen other schools, who came to New Hampshire to see what it would take to build formula hybrids of their own, were impressed. "We thought this demonstration would be the ideal situation for us to see what technologies are out there and weigh ourselves against the other schools," says Sanjaka Wirasingha, an IEEE student member and a graduate student at the Illinois Institute of Technology, in Chicago. He says building a hybrid would be "an awesome opportunity" to apply what he is learning in class to a practical project.

Engineering professionals had gathered at Dartmouth on the day before the demonstration to discuss next year's inaugural Formula Hybrid competition—including safety issues, the rules, and the criteria for judging the best entries. They were amazed at what the students had accomplished.

"I think you're going to see a lot of good things come out of the competition. It's a challenge, and I think the students are up to meeting it," said Steven Daum, the collegiate program manager for SAE. ●

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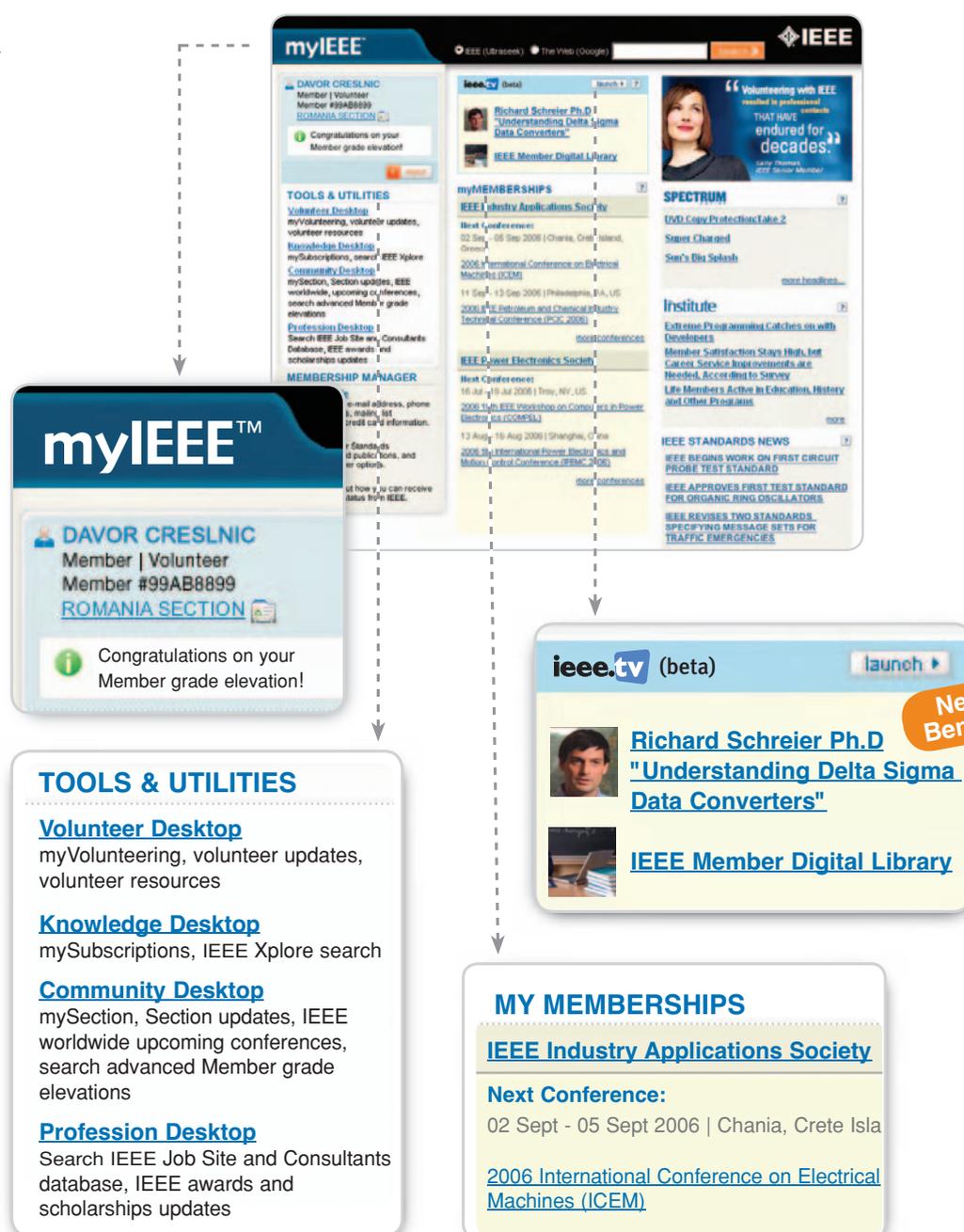
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Robert Popp:

THE COUNTERTERRORIST

BY STEVEN CHERRY

CAN SOCIAL SCIENCE and information technology catch terrorists? Robert L. Popp says it can, and he has devoted the five years since 9/11 to promoting technologies that he figures will be critical to what he calls “21st-century warfighting.” What he has in mind is marrying political science, economics, psychology, sociology, and cultural anthropology to mathematics, statistics, operations research, and computer science.

Popp says he believes that the new threats are completely different from those that the Cold War presented. Because modern adversaries—transnational terrorists, insurgents, warlords, and the like—live alongside us, the new battleground is in the hearts and the minds of ordinary citizens.

Popp, 44, an IEEE senior member, and two co-authors state their case in the essay “Utilizing Information and Social Science Technology to Understand and Counter the 21st-Century Strategic Threat.” What is needed, they argue, is “a strategy that leads to a greater cultural awareness and thorough social understanding of the threat.”

The essay is the first chapter in a new book, *Emergent Information Technologies and Enabling Policies for Counter-Terrorism*, which Popp co-edited with John Yen, an IEEE Fellow and a professor of information sciences and technology at Pennsylvania State University. Wiley-IEEE Press published the book in June.

ATTACKS LIKELY Popp’s interest in counterterrorism predates 9/11, and it led him into one of the biggest controversies in government research and development in recent years. In February 2001, he was an assistant deputy undersecretary of defense at the U.S. Department of Defense’s Office of Advanced Systems and Concepts, which complements the Defense Advanced Research Projects Agency (DARPA) by focusing on shorter-term research. He had just read a new report titled “Roadmap for National Security: Imperative for Change” by former U.S. Senators Warren B. Rudman and Gary Hart. It laid out a powerful case that terrorist attacks were increasingly likely and that the United States was woefully unprepared. Among other things, the report recommended creating a new “homeland security agency.”

Popp and his colleagues were beginning to evaluate the annual crop of about 100 research proposals. With the Rudman/Hart report fresh in his mind, Popp noted that none of the proposals was about asymmetric threats—that is, novel forms of attack by a weaker enemy.

And not a single proposal related to homeland security. So Popp designed his own proposal, which focused on domestic first-response command-and-control issues, improving foreign intelligence gathering at the federal level and then sharing it with state and local law enforcement. After 9/11, Popp’s proposal became an overnight attraction within

the Department of Defense. “I suddenly became very popular,” he says.

“I opened my e-mail one morning in October 2001 and there was a message from Admiral John Poindexter. I knew he had been involved in some controversy, but I kept searching for ‘Poindexter’ and ‘Watergate.’” Poindexter and Oliver North were responsible for Iran-Contra, a 1986 covert scheme to fund a guerrilla organization in Nicaragua by selling arms to Iran. “Poindexter’s message said, ‘Because of 9/11, I’m looking to come back into government service. I’m looking for a deputy, and your name has been floated.’”

JOINING UP Popp was hired as deputy director at a newly created Office of Information Awareness within DARPA. The office soon funded what would become a controversial program known as Total Information Awareness.

The heart of the research consisted of two new programs: Genisys and Genoa. Genisys considered ways to search massive, distributed databases, and Genoa would be a support tool for intelligence analysts querying Genisys-style databases.

“The goal was the prevention of terrorism,” Popp explains. “We thought information technologies would play a huge role. Terrorist plans and actions will involve information transactions—phone calls, e-mail, fertilizer purchases, and so on—that will leave information signatures.

“We had a team of 20 people imagining terrorist scenarios and asking themselves what transactions would be needed, and what would be the signatures. There will be many different types of transactions in many different databases. And they’ll be embedded within data of ordinary transactions made by innocent people. So there was a privacy component, and it was very important, and that was part of our research agenda,” he says.

PUBLIC BROUHAHA In August 2002, William Safire, a *New York Times* op-ed columnist, wrote an article, “You Are a Suspect,” that excoriated the program as “a virtual, centralized grand database” that would contain “every purchase you make with a credit card, every magazine subscription you buy and medical prescription you fill, every Web site you visit and e-mail you receive, every bank deposit you make, every trip you book, and every event you attend.”

Poindexter’s past sins were trotted out as well. “This ring-knocking master of deceit is back again with a plan even more scandalous than Iran-Contra,” Safire wrote.

Poindexter was forced to resign in August 2003. The Office of Information Awareness was disbanded, and Popp moved to DARPA’s Information Exploitation Office, where he worked on a deficiency he had long noticed. “There were no research programs exploiting the social sciences at DARPA,” he says.

Popp changed that by persuading the DARPA director to hire a social science Ph.D. as a program manager and to initiate new research programs.

For example, the Defense Department looks at the stability of nations based on reports prepared by analysts with expertise in the region. Popp organized a research project that applied what he refers to as “quantitative and computational social science tools” that allow a non-expert to come up with much the same analysis as the experts.

The experience whetted Popp’s appetite for doing the research, so in January he took a job as executive vice president at Aptima, in Woburn, Mass. The 10-year-old company is almost entirely devoted to advanced research and development in defense, national security, and intelligence, combining social science with quantitative analysis.

“The one constant for me has been supporting intelligence analysts and other people who use technology to solve problems and execute missions,” he says. “We have to understand the bad guys to find them and stop them. And our approach really works.” ●

IEEE to Beef Up Its Global Accreditation Role

BY WILLIE D. JONES

ALTHOUGH THE NUMBER of technical jobs in countries such as India and China keeps growing, the lack of standards for evaluating engineering and computer science programs presents a grave challenge there and in other parts of the world. The absence of accrediting bodies to control and affirm program quality has resulted in an uneven approach to accreditation of engineering programs in different countries. The result is that some universities turn out degree-titled graduates who are unprepared to fill the industry's needs in engineering and technology.

Describing the extent of the problem, Moshe Kam, vice president for IEEE Educational Activities, noted that Chinese universities confer approximately 250 000 engineering degrees annually, and those in India hand out around 200 000, compared with about 70 000 in the United States. The numbers do not tell the whole story, however. India, for example, is experiencing a shortage of qualified technical personnel in spite of the 60 000 out-of-work engineers who reside there.

"We have a large number of engineers, but we also produce many unemployable ones," says Pratap Bhanu, president of India's Center for Policy Research and a member of the National Knowledge Commission.

According to Bhanu and many high-tech recruiters, industry considers the imprimatur of India's main accreditation body for engineering education to be meaningless. The result is that many graduates cannot find jobs, and those who are hired must often receive extensive (and expensive) training from their employers. A similar phenomenon is occurring in some of the former Soviet republics.

Even in parts of the world where accreditation activity is gaining momentum, such as Central and South America, new accrediting bodies struggle to remain free of undue government intrusion.

Kam asserts that the IEEE must begin to take a more active role in accreditation of engineering, engineering technology, and computer science programs worldwide. The IEEE owes this action to its members in countries where accrediting bodies are underdeveloped or do

not exist, and it is a mandate that stems from the IEEE's status as the leading professional association in its fields of interest. To that end, Kam presented a plan at the Board of Directors meeting in February, calling for the IEEE to expand its accreditation activities, mostly outside the United States.

LARGER IEEE ROLE The board approved Kam's plan, which would increase the IEEE's influence on the activities of existing accrediting bodies and assist IEEE members in creating accrediting bodies where they do not exist. Among the steps that the IEEE will take are developing

the IEEE must do some fact-finding. The IEEE Educational Activities Board (EAB) plans to hold several meetings of accreditation experts and educators from countries and regions that need an accrediting program. The aim will be to gather information and advice on how the IEEE's assistance could be most effective. The first meeting took place in June in Arequipa, Peru. Two new local education committees on accreditation outside the United States were scheduled to have their first meeting by September.

Next, the EAB plans to create and maintain a Web portal to provide information on national and international

not done in a vacuum. The leading U.S.-based accrediting body for engineering and applied science, ABET, performs some accreditation activities outside its home territory, as does the Institute of Engineering and Technology in the United Kingdom (the IEEE is a founding member of ABET and has many cooperative projects with the IET).

ABET has for some time conducted "substantial equivalency" visits to selected programs that request them, and the IET conducts accreditation visits to programs outside the UK. An ABET accreditation task force is in the process of examining ABET's long-term role in international accreditation, including the possibility of proceeding from "substantial equivalency" certifications to full-fledged accreditation of some non-U.S. programs.

PROBLEMS In Kam's opinion, there are several problems with these processes, which depend on evaluators from one country managing the accrediting operations in other countries. Among the hurdles are differences in language, culture, and volume. It is unlikely that U.S.-based or UK-based organizations will have the logistical resources and volunteer corps required to evaluate effectively the thousands—if not tens of thousands—of academic programs that could be in need of accreditation. ABET is already hard-pressed to find enough volunteers from industry to evaluate U.S. programs.

"ABET is a U.S.-based organization, while IEEE is transnational," Kam says. "Not surprisingly, our views and objectives are sometimes different."

The IEEE's position is that accreditation by foreign evaluators should be a temporary measure, taken in order to provide a local accrediting body with an opportunity to establish itself and eventually take over the process. The IEEE's efforts will therefore concentrate on assisting countries (and groups of countries) in developing their own independent accrediting bodies and help them wean themselves as soon as possible from substantial equivalency or accreditation visits by foreign organizations.

Although the IEEE seeks to maintain a leadership role in providing guidance for engineering and computer science programs across the globe, Kam says he would like national accreditation bodies

and disseminating institute guidelines for accreditation of degree-granting programs in its principal fields of interest. Further, the IEEE will create a comprehensive database of existing accrediting bodies and the programs they recognize. The IEEE also will assist in expanding existing mutual-recognition agreements whereby accreditation bodies in one country recognize the credentials conferred by their counterparts in another, and vice versa.

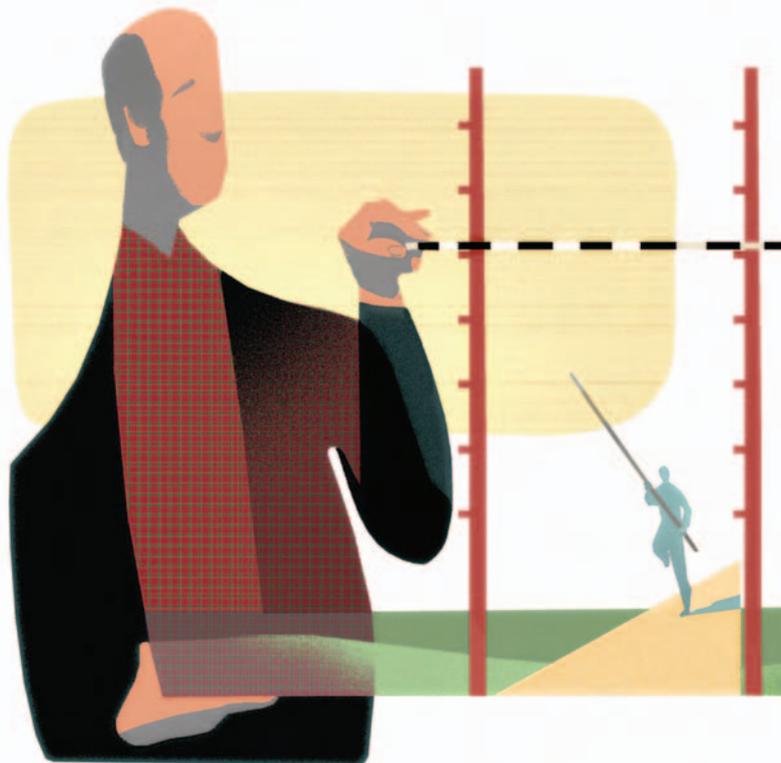
"These agreements," Kam says, "would foster increased mobility of professionals and create more efficient and flexible job markets."

It is likely to take months to put the wide-ranging plan into action. First,

accreditation bodies in the IEEE's fields of interest. The site will list the mutual recognition agreements and recognition procedures currently in effect, as well as provide a review of existing accreditation models and how they differ in direction and philosophy. The site will outline IEEE resources that are available to IEEE sections and members who require help with setting up accrediting bodies and educating local decision makers about the subject. One of those resources will be the IEEE's model accreditation guidelines.

The proposed budget for the first two years of the project is US \$465 500.

Establishing international standards for engineering education and fostering accrediting bodies in multiple countries is



to devise the accreditation standards applicable to their communities.

“We would not like to see schools [outside the United States] continuously accredited by ABET or IET, nor would we like them to be forever subject to equivalency visits from the outside,” he says.

For several years, the IEEE played a leading role in helping to establish local accrediting organizations by conducting extensive accreditation workshops, Kam notes. The workshops exposed IEEE members, educators, and decision makers to the different approaches used by existing accrediting bodies to engineering and technology accreditation. These newly trained attendees provided assistance to new accrediting bodies and in at least one case, founded one. The most recent regional accreditation workshop was held in December in Lima, Peru. Earlier workshops took place in Bangkok; Bratislava, Slovakia; and Helsinki, Finland.

Kam says that although schools in many parts of the world face the same problem—educators, practitioners, and policy makers lack a thorough understanding of the accreditation process—the workshops have taught the IEEE that one size does not fit all.

“Successful accreditation systems cannot be imposed from the outside,” he says. “They need to be tailored to local conditions and grow out of local traditions and cultures.” ●

EDUCATION

New Engineering Web Site Targets Kids, Teachers, and Parents

HAVE QUESTIONS ABOUT ENGINEERING? What is engineering all about, anyway? And where can my daughter study it?

The new TryEngineering Web site (<http://www.tryengineering.org>) has all the information you might want on engineering careers, and it adds a helpful dose of interactive activities. The site, which went live in June, aims to inform students (ages 8 to 18), teachers, school counselors, and parents about what engineering is and what engineers do. It was put together by a partnership of the IEEE, IBM, and the New York Hall of Science.

The site is divided into a number of different sections to answer the many questions people have:

- **Ask an Expert** lets visitors get answers to engineering-related questions. An engineer or an engineering undergraduate student replies to each query. Just e-mail your question and await the answer.
- **Become an Engineer** provides information on university programs, tips for choosing courses, and the plain truth on how to apply for financial aid.
- **Find a University** lets you search for accredited engineering and technology degree programs in Canada and the

United States. The list is expected to be expanded soon to include programs in other English-speaking countries, as well as in France and Germany.

- **Lesson Plans** allows teachers to download free lessons developed according to U.S. National Education Standards on a variety of technical topics, such as building a robot arm, the workings of electric motors, and constructing functioning models of household items.
- **Life of an Engineer** profiles real-life engineers, highlighting the many duties they perform daily.
- **Play Games** lets students try virtual activities that introduce them to basic engineering concepts. The Beat the Heat game has them design a house that can remain at a comfortable temperature year-round using solar energy, and Millennium Train calls for the design of a railway transportation system that would run in the next century.

TryEngineering is a project of the IEEE Center for Pre-University Engineering Education, an outreach organization that encourages students to study engineering in college. ●

FOR MORE INFORMATION see “Program Promotes Engineering to Young People,” *The Institute*, March 2006.

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EMPLOYMENT SERVICES

THE IEEE JOB SITE

<http://careers.ieee.org/>



Last year was a banner year for the IEEE Job Site, with more jobs posted and more job seekers coming online to view them than ever before. So many job leads in one place has spurred more IEEE members to register at the site and upload their résumés or profiles containing their answers to questions regarding their ideal job. Or they post both. Some 9000 member profiles—and 7000 résumés—were added to the site in 2005, bringing the total to 41 000.

Recruitment videos—45-second presentations that highlight the benefits of working for a particular company and 30-second clips that focus on specific jobs—also made their debut on the site last year. In addition, the Job Site has an agreement that allows IEEE members to see job ads posted on the Web sites of 150 newspapers and other media organizations. And the Featured Jobs box on the Job Site home page highlights postings that employers pay extra to spotlight.

SALARY SERVICE

<http://www.ieeeusa.org/careers/salary>



Want to know how much a particular job might pay? The Salary Service offers estimates of base pay and what human resources pros call primary-source income (bonuses, commissions, and net self-employment income) for a wide range of technical fields and geographic areas in the United States. The hallmark of the service is the Web-based IEEE-USA Salary

Calculator, with which you can find out quickly what you're worth in today's job market.

If you're into statistics, you may be interested to know that the service does its job by combining the power of online relational databases, sophisticated regression modeling, and data extracted from IEEE-USA's renowned Salary and Fringe Benefits Survey of its members.

The Salary Service for individual IEEE members is free for those who complete the annual salary survey.

CONSULTANTS DATABASE

<http://www.ieeeusa.org/consultants>



The IEEE-USA Consultants Database offers an online site for consultants and clients to find each other. Consultants register their credentials and fields of interest, and can update them at any time. Clients post descriptions of projects they need help with, and can also search the database to find the consultant who's right for the job.

EMPLOYMENT NAVIGATOR

<http://www.ieeeusa.org/careers/employmentnavigator>



Need a job? How would you like some 5 million leads to pore through? Sounds like an incredible treasure trove, but that's how many leads the people behind the Employment Navigator say it collects from some 160 000 Web sites with job openings. The navigator puts them all in a single searchable database.

The information comes from corporate Web sites, job boards, and niche job sites that may be specific to a particular industry, occupation, or geographic region. The navigator ferrets out jobs on education, government, and newspaper sites as well. Because the navigator can sniff around corporate sites, you have access to those hard-to-find opportunities that may never leave an employer's Web site. Some 30 percent of the job openings identified by the navigator are not listed on any of the major job boards or niche job sites.

The navigator portal also provides tools for creating a résumé and distributing it to organizations where it might do the most good.

FORUM: EMPLOYMENT AND CAREER STRATEGIES

<http://www.ieeecommunities.org/ecs>



It can't hurt to network and collaborate with one another on employment and career strategies, even if you're not out of work. This online community has discussion groups, chat rooms, and resource files, including documents on résumé writing, job hunting, networking, and interviewing skills, as well as advice on setting fees if you decide to become a consultant.

CAREER PLANNING GUIDE

<http://www.ieeeusa.org/communications/eBooks>



Whatever your goals and interests, the online Career Planning Guide can help you get more satisfaction from your job and provide you with advice for having a greater impact at your workplace. The guide helps you first to identify your needs, goals, and work situation, and then to devise solutions to problems you face. Included are techniques for gaining recognition on the job and finding the freedom to work more independently. Tips in the guide also can help engineers improve work relationships and influence important decisions being made in their organizations. As

a bonus, the guide has information you may find useful in improving your finances and moving toward financial peace of mind.

BEYOND JOB SATISFACTION

http://salaryapp.ieeeusa.org/rt/salary_database/shop



Learn how to set your career goals, the steps to take to accomplish them, and how to put yourself in a position to succeed. *The Beyond Job Satisfaction Field Book* (IEEE-USA), by Nigel J.A. Bristow, has tools and templates for maximizing what it describes as your "vitality" at work. One section outlines the factors that differentiate high-performing technical professionals from their competent but not-as-effective colleagues. Other topics cover how to handle conflicts, network with colleagues, manage your boss, deal with change, and build informal influence networks. Case studies and anecdotes illuminate the book's concepts.

EBOOKS

<http://www.ieeeusa.org/communications/eBooks>



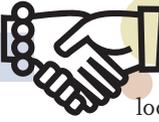
IEEE-USA's ever-growing series of downloadable publications provide practical career and public-policy information in a convenient and inexpensive format. Choose from such titles as *The Reliability of the Electric Transmission Infrastructure in the 21st Century*; *Interoperability for the National Health Information Network*; and *The State of Radio-Frequency Identification (RFID) Implementation and Its Policy Implications*. Another, *The Best of IEEE-USA Today's Engineer: On Consulting* provides tips on topics such as how to make the transition from being an employee to being self-employed and how to ensure that as a consultant your fees are paid.

The eBooks are written by IEEE members who are subject experts, and the material is then peer-reviewed and edited to meet the suggestions of the reviewers before the books go online.

CONTINUING EDUCATION

EDUCATION PARTNERS PROGRAM

<http://www.ieee.org/partners>



IEEE members interested in continuing their education need look no further than the IEEE Education Partners Program, which offers classes, seminars, and even graduate degree programs, online or on campus—and at a 10 percent discount on the price to the general public. Members can choose from more than 6000 courses from 20 providers, including academic and private online learning organizations. The list of partners includes long-established institutions such as the 136-year-old Stevens Institute of Technology, in Hoboken, N.J., and the 30-year-old Thomson NETg, an online professional education company.

The IEEE program offers a broad assortment of classes—from one-day seminars for a few hundred dollars to graduate-level degrees for many thousands of dollars. Topics include systems engineering, photonics, and RFID technology. Students also can learn project management and business law, and hone their writing skills. In most classes members can earn continuing education units or professional development hours, the credits engineers need to maintain their professional licenses.

LEADERSHIP COURSES

<http://www.ieeeusa.org/careers>



Achieve Global, which presents professional development courses online, has teamed with IEEE-USA to bring members career-enhancing courses at discounted prices. Courses for individual improvement include Giving and Receiving Constructive Feedback, Managing Your Priorities, Proactive Listening, and Listening and Speaking Skills, which is especially important as engineers are involved in more give-and-take situations and are called on to make presentations.

Leadership training topics include:

- Managing change.
- Improving team productivity, including learning to focus on key goals.
- Negotiating within the organization and handling team dynamics.
- Developing skills to influence others—which has become vital as engineers find themselves competing for limited internal resources.
- Problem solving and collaboration, strategic thinking and innovation, and dealing with emotions and conflict.

And be sure to check your IEEE section, region, and society for career-related services they may be offering. ●

E-CYCLING from page 1

electronics in an environmentally safe way,” says Holly Elwood of the EPA, co-chair of the IEEE committee that developed IEEE Std. 1680. Many private firms have similar policies.

“Those agencies [which include the Departments of Defense, Justice, Energy, and Transportation] account for 84 percent of the federal IT budget—and that budget amounts to about 7 percent of the world’s IT budget,” Elwood says.

By providing a series of green product benchmarks along with product ratings, IEEE Std. 1680 and the GEC aim to give purchasers the knowledge they need. Computer makers that want to reach environmentally aware buyers might now choose to produce greener products.

That’s different from motivation by mandate, the approach that has prevailed around the world. In Europe, for example, a Restriction of Hazardous Substances (RoHS) directive limits the use of lead, cadmium, mercury, and other toxic substances in new electronic equipment sold after June 2006 (IEEE Std. 1680 requires RoHS compliance). A European directive on waste electrical and electronic equipment mandates that, as of 2008, manufacturers take back products for free and recycle at least 65 percent of the products’ average weight.

Japan, South Korea, and Taiwan have electronics take-back regulations. China, which has outlawed the import of electronics waste containing toxic materials, is considering similar legislation. In the United States, a state-by-state patchwork of electronics recycling laws is emerging; at least 10 states are considering or have passed electronics recycling laws, an approach that almost guarantees inconsistency.

REWARDING GUIDELINES In 2002, a nonprofit environmental group, the Zero Waste Alliance (<http://www.zerowaste.org>), proposed a different model to the EPA: “Rather than coming up with a standard and trying to stuff it down people’s throats,” says IEEE Member Larry Chalfan, executive director of the alliance and co-chair of the IEEE P1680 Working Group, “we should identify what the market really wants and help manufacturers understand it. That will help purchasers get what they need and reward manufacturers for developing it, through market access and visibility.” That strategy, Elwood adds, should “get environmentally preferable products into the marketplace.”

With EPA funding, Chalfan says, “we pulled together major procurement folks, as well as recyclers, academics, and so forth, to work out the elements of this [approach]. The development teams also included people from the governments of four states working on recycling laws. It was a chance to harmonize the laws.”

Working out the details, and shaping them into a standard that met IEEE and American National Standards Institute requirements, took three years. “The IEEE process ensures that the standard has been developed in a very open and public way,” adds Reggie Caudill of the IEEE Computer Society, who is chair of the IEEE’s Technical Committee on Electronics and the Environment. “The process requires that no single interest group hold the majority role, and that all interested stakeholders take part.”



More stringent recycling guidelines would reduce the amount of time it takes for electronic equipment, such as this computer, to become obsolete.

Since mid-July, buyers have been able to assess the greenness of prospective computer purchases by checking them against the product registry at <http://www.epeat.net>. At the top of the Electronic Product Environmental Assessment Tool (EPEAT) ratings chart—and given so-called “gold” status—are products that meet all 23 of IEEE Std. 1680’s required criteria plus at least 75 percent of the standard’s 28 optional ones. Next comes a silver rating for products that meet the required criteria and at least half the optional ones. Those that meet the required criteria and fewer than half the optional ones get a bronze rating. But the rating system need not remain static.

“EPEAT has a built-in mechanism to escalate the system,” says Jeff Omelchuk, EPEAT’s program manager and director of the GEC. “As the industry moves forward, purchasers’ expectations will continue to grow. Although there is no platinum level, there someday could be.”

The criteria mostly covers equipment design and construction. Besides RoHS compliance, manufacturers must at least report—and preferably reduce—the amount of mercury used in display-panel light sources. Other materials such as hexavalent chromium and certain flame retardants should also be eliminated or at least reduced to levels far below those allowed under RoHS and other European directives. IEEE Std. 1680 also covers the use of recyclable plastics such as those made from plant sugars

and oils rather than petrochemicals.

Only reusable or recyclable materials should be used. Equipment should be built to simplify recycling—with enclosures, as well as circuit boards and components containing hazardous materials, easily removable. The manufacturer should clearly identify materials that are hazardous or require special handling, and it should label plastics with their international resin-identification codes. The larger parts of enclosures should be composed of only one type of plastic, and metal inserts molded or glued into plastic should be easy to remove. Paints and coatings incompatible with recycling or reuse should not be used.

To prolong service life, products must carry extendable warranties or service agreements, and be upgradable with common tools. They also should comply with Energy Star power consumption requirements in effect or soon to be in effect at the time of certification.

Manufacturers should provide take-back service for the products and their rechargeable batteries, and recycling organizations should be audited for compliance. Makers of certified products must demonstrate an environmental policy consistent with the International Standards Organization 14001 standard and meet certain reporting requirements, with optional third-party verification of environmental management systems.

Producing EPEAT-compliant products will initially add to design and construction costs but, Elwood says, standards should help make green construction commonplace. “For most manufacturers, it doesn’t make sense to run a bunch of processes when making similar products,” she says. As computer makers change their products and processes for the institutional market, individual consumers are likely to wind up with more eco-friendly computers as well. ●

Tips for Getting A TRANSACTIONS ARTICLE PUBLISHED

BY BIMAL K. BOSE
IEEE LIFE FELLOW

GETTING PUBLISHED is important for promotion and tenure in the academic community, and publication can do much to bolster the careers of engineers in industry. Have you ever published a paper in an IEEE transactions journal? Certainly, publication of a transactions paper, including your photo and a brief biography, adds to your status in the professional community. Some say that one transactions paper can be worth four conference papers in terms of prestige. If you're already a university professor, transactions publications help you become better known and can lead toward being elected an IEEE Fellow or to receiving other awards and honors.

For an engineer in industry, publication in transactions reflects career success. And if you're currently a researcher in industry and aspire to a university career, it is also wise to establish a publications base. Perhaps most of all, publications bring their authors a tremendous amount of career satisfaction.

WHAT TO PUBLISH Transactions normally publish archival articles describing research that others may find valuable to their work and that they're likely to reference. If you've invented something or have investigated a technical topic that advances the technology or could lead to noteworthy applications, you should consider writing about it in a transactions publication. If you're an experienced professional, you might consider writing a state-of-the-art survey, which transactions publications often accept. Research results can be written as short letters to the editor.

When you feel you've made a contribution to technology, you must judge for yourself whether you've covered enough new ground to justify a transactions paper, or if a conference paper would suffice. Note that some IEEE societies, such as the Industry Applications Society, require that a subject first be unveiled in a conference paper before it can be considered for a transactions publication. Such societies hope to assure their readers as to the paper's basic quality.

For a research topic presented in a transactions article, your results should include a technical description, a mathematical analysis, and a simulation study. Experimental results are usually required to validate any theoretical discussion and simulation results. For an emerging technology, however, a description of the work, along with an analysis and simulation results, may suffice. Of course, a simulation is only as good as the model; a model that is not sufficiently accurate will yield only approximate results.

ORGANIZING THE PAPER Once you have decided that your work is transactions-worthy, you must organize what you want to write. And that can be tricky because a transactions paper has many details. A flowchart for organizing your writing can be of great assistance (see illustration).

A good paper tells a clear, concise, well-organized story and presents a logical flow of ideas. To get a good feel for how material should flow, it is helpful to review transactions papers published by other authors, particularly those who are established in their fields.

The title of the paper should clearly reflect the essence of your contribution. Below the title, list the primary contributor as the first author; co-authors should be listed in the order of the importance of their contributions. Remember, it is unethical to name a co-author who has not contributed to the work. Likewise, it is unethical to provide as a co-author the name of a project manager, financial supporter, or department head. Carefully avoid any appearance of plagiarism, and do not simultaneously publish the same material elsewhere.

Next, collect—in the proper IEEE format—references to earlier work that are applicable to your paper. References should be as comprehensive as possible while remaining relevant. It is also wise to cite one or two books dealing with background material that pertains to the subject.

Before starting to write, organize your points in the sequence you wish to make them for each section and subsection. Plan any figures that can clearly describe your work, with their titles and important parts labeled. The figures—whether

schematic diagrams, functional block diagrams, or simple block diagrams—should be self-explanatory and should make a clear contribution to the paper.

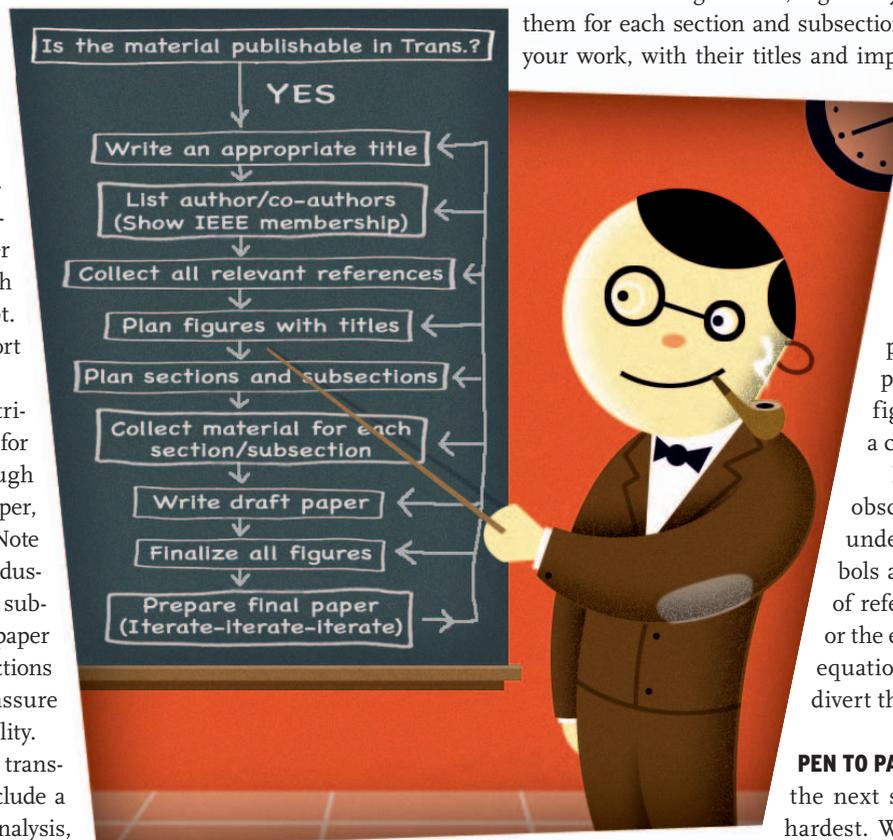
Make sure the grids of any graphs are light in color, and that variables and their scales are clearly indicated. Then, adjust the different sections and subsections of the paper, give them each appropriate titles, and put your figures in order. (Note, though, that figures can be finalized only after you've made a complete draft of the paper.)

Equations are always desirable. Don't be obscure with them; be sure to use commonly understood textbook symbols. Define the symbols as they are introduced in the paper, instead of referring to a list of symbols at the beginning or the end. Sometimes, though, you should include equation derivations in an appendix so as not to divert the reader's attention from the main text.

PEN TO PAPER Once the material has been organized, the next step—writing the paper—is certainly the hardest. Writing for transactions, and doing it well, remains a difficult art.

Correct English grammar and spelling are important. Publication in transactions may prove difficult if you're from a non-English-speaking country. Often, a paper with an excellent contribution will be rejected because of poor English. Even minor grammatical or punctuation errors can annoy a reviewer and contribute to rejection of the paper. Knowing proper English is not enough, however. Avoid ambiguous expressions, and be clear in your writing.

Although an otherwise good paper may be rejected because of poor organization and poor English, a paper making even a mediocre contribution to its field may be accepted because it is well written. This applies to papers from both industry and aca-



demia. Good writing is of paramount importance and should not be left to assistants or students unless those individuals are accomplished writers.

FIRST, THE ABSTRACT Start by writing the abstract. It needs to summarize the contribution you have made. It should be a single paragraph, concisely written with carefully selected wording, and it should appear at the beginning, stating exactly what the paper is about. The key words, known as index terms, are appended to the abstract.

Next comes a more difficult part: the introduction. Broadly describe, in a convincing way, the general importance of your work. Describe past contributions to the topic, together with the references on which your new contribution is based, and emphasize in what ways your contribution is important. It is best to cite others' past contributions. Doing so can dispel suspicion that the contribution might not be your own.

Next comes the body of the paper, a clear description of your work in logical sequence. Finally, the results and significance of your contribution are discussed in the conclusion. Some overlap between the conclusion and the abstract is common. If you got help from others (such as managers, financial supporters, and colleagues), you should include an acknowledgements paragraph after the conclusion.

Go over the draft several times to polish the text. It is always a good idea to prepare an extended manuscript first, and then cut it down as you go over it to strive for clarity and to satisfy length constraints. After completing the paper, make sure you've satisfied all the questions presented.

THE REVIEW PROCESS Every transactions paper is peer-reviewed by more than one person. The reviewers' judgment determines its acceptance or rejection. Normally, if two reviewers recommend acceptance or rejection to the transactions editor, that settles the matter. If the score after two reviews is tied, a third review becomes essential.

Finding appropriate reviewers can be difficult, and the review process is far from ideal. Often, a reviewer's expertise does not exactly match the subject of the paper,

and the reviewer may not understand the paper well, even though he agreed to review it. Because reviewers are often busy professionals, it is important to make the best possible impression with a well-written, polished paper.

If the reviewer does not understand the paper, it likely will be rejected. Clumsy or unclear figures can be grounds for rejection as well. But don't simplify too much: if the treatment of your topic seems overly simple, your contribution may be considered trivial.

Because the reviewers' identity is unknown to the author, they do not fear rejecting a paper. Appropriate reasons must be given for rejection. However the justification may be simply, "The contribution in the paper is not significant enough to justify transactions publication." Or a reviewer's recommendation for major revision to the paper may be the reason. Whatever a reviewer recommends is usually accepted by the transactions editor. On average, transactions editors accept about one in three submitted papers.

Finally, after several attempts, you may be lucky enough to receive an acceptance letter. Note that most accepted papers come with recommendations for minor revisions. In submitting the revised paper, clearly note in a cover letter the revisions you made, and highlight the revisions in the text. Papers that have been accepted conditional on revisions are rarely rejected once the paper has been resubmitted.

After the paper has been published, you can proudly visit <http://www.ieeexplore.ieee.org> and note how many people are referencing it, and you can find where the paper is referenced at <http://www.scholar.google.com>. The latter Web site can provide a gauge of your contribution's importance.

Good luck to you. ●

ABOUT THE AUTHOR Bimal K. Bose is the Condra Chair of Excellence in Power Electronics at the University of Tennessee, Knoxville.

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ARTIFICIALLY INTELLIGENT The basis for most serious games these days is artificial intelligence, a slippery concept at best, according to IEEE Associate Member Sushil Louis, director of the University of Nevada computer science and engineering department's Evolutionary Computing Systems Lab. "Intelligence is in the eye of the beholder," Louis says. "It's hard to come up with an objective definition of intelligence, because subjective perceptions are what's important. According to computer pioneer Alan Turing, if a computer program can fool a human into thinking that it's human, then you would consider that program intelligent."

AI has gained the edge in recent years over the so-called expert systems that were a leading area of research in the 1970s and 1980s for such potential applications as diagnosing diseases. Expert systems were supposed to embody all knowledge about a specific field, but their design proved to be what developers called "brittle," Louis explains: "Their knowledge was out of date almost as soon as it was programmed into the system, and they were difficult to update because the systems wouldn't learn."

Those drawbacks sparked interest in AI systems, which were designed to learn from imitation, mistakes, experience, and trial and error—more the way people

acquire knowledge rather than the way computers are programmed.

That's useful in training, because the AI system can learn even as a player learns. Thus, the game itself can get tougher to play. "According to learning theory, you learn most from an opponent who is just slightly better than you are," Louis says. "In serious games, where the goal is to have the player learn, AI allows the opponent to adapt as the player learns skills and strategies, so the game grows along with the player."

TRAINING BEHAVIOR The U.S. Army is using AI in computer games not only for teaching military strategy and tactics but also for training soldiers to interact with others, says IEEE Member Michael van Lent, professor of computer science at the University of Southern California, in Los Angeles, and one of the keynote speakers at the IEEE conference.

"The Army is already good at training tactics. What's difficult is teaching soldiers leadership skills and how to conduct negotiations in a stressful environment," says van Lent, who is also a research scientist at USC's Institute of Creative Technologies (ICT). The institute was initiated six years ago by the Army to blend Hollywood movie graphics with USC's expertise in AI to create wholly realistic simulations. "Role-playing games can immerse a soldier in the stress and emotion of the moment," he added.



This soldier is playing a game developed for U.S. Army captains to teach them leadership skills.

In one research demonstration ICT developed for the Army, "you're a lieutenant trainee traveling with a platoon in Bosnia, and one of its vehicles injures a child," van Lent recounts. "The animated AI characters in the game have their own goals, whose reactions depend on the trainee's choices. For example, there's a TV cameraman who adds to the stress by filming the episode, and there's the child's mother, who models more or less emotion as the trainee acts to get the kid to a hospital or to send the rest of his platoon ahead."

How realistic do soldiers find the games? Van Lent says realism is achieved by collecting stories from soldiers returning from Iraq. "Stories more effectively

communicate information to people than a list of dos and don'ts," he says. And it's the stories that ICT turns into game-playing training scenarios.

In addition, developers are devising what they call "explainable AI," where at the end of a training session the trainee can quiz each of the AI characters to see why it responded the way it did to each of the trainee's decisions. This technique has the potential to be valuable in helping soldiers learn the Army's detailed procedures for the "right" way to carry out every kind of order, from loading a rifle to building a bridge.

Other games funded by the U.S. Navy have the potential for treating soldiers with post-traumatic stress disorder. ●

SOCIETY SPOTLIGHT

IEEE Product Safety Engineering Society

BY LINDSAY ELKINS

THE IEEE PRODUCT SAFETY ENGINEERING Society (PSES), which was formed in January 2004, is growing at a hefty pace. Membership was up 9.7 percent from June 2005 to June 2006. And, though still relatively small, the PSES was the only IEEE society that had double-digit membership growth last year, finishing 2005 up more than 14 percent over 2004.

IEEE Senior Member Jim Bacher, the society's vice president of communications, attributes the growth to the popularity of the society's IEEE online community. Members discuss regulations and standards, and can ask for guidance on their safety problems. Members also communicate through an e-mail list (emc-pstc@ieee.org), one of the busiest on the IEEE server, according to Bacher. Word of mouth and the increased visibility of the society's annual symposium through advertising are also factors, he says.

FIELDS OF INTEREST: Product safety engineers focus on

protecting the public against hazards in the workplace and on designing safe equipment used in the scientific, engineering, industrial, commercial, and residential fields—in other words, just about everywhere.

Although the PSES became a full-fledged society in 2004, it has been around in one form or another since 1987, when a group of product safety engineers created a technical committee to help resolve problems with moving product approvals through the Canadian Standards Association. In 1991 the committee formed an association with the IEEE and became part of the IEEE Electromagnetic Compatibility Society within that society's product safety technical committee.

PUBLICATIONS: A quarterly newsletter, plus a journal in the planning stages.

The *Product Safety Engineering Newsletter* is a Web publication that covers developments in safety and reports on the society's activities. Although access to the latest newsletter is restricted to the society's members, archives of issues back to 1988 are available at the Web site to anyone.

The society plans to publish a journal once the rate of technical-paper submissions is high enough to ensure a viable periodical. Until the journal is launched, papers on product safety engineering will continue to be published in the newsletter. Also in the works are online interactive discussions associated with each paper, as well as Webcasts of presentations by authors of selected papers.

CONFERENCES: The annual IEEE PSES symposium covers advancements not only in safety engineering but also in regulations and standards, and in workplace and software safety. The third Symposium on Product Safety Engineering is scheduled for 23 to 24 October at the Hyatt Regency Irvine, in California.

AWARDS: None; however, the PSES has put together a team of members to establish an awards program.

MEMBERSHIP: More than 530. Members receive the society's newsletter and free online access to the society's conference proceedings. Also available is a reduced rate on subscriptions to the *International Product Safety News*, a newsletter published by Product Safety International that is devoted to electrical product safety compliance.

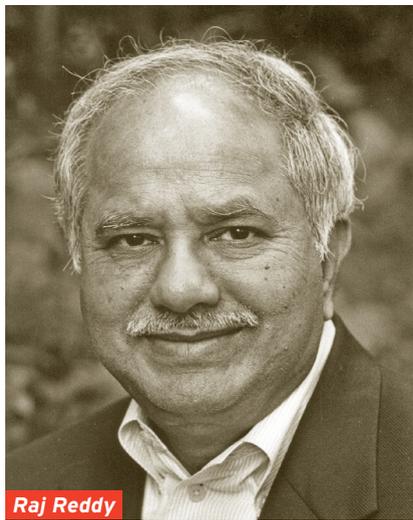
SOCIETY URL: <http://ewh.ieee.org/soc/pses>. ●

MEMBER RECOGNITION

Townes and Reddy Share Award for Lifetime Contributions

BY NANCY SALIM

TWO TECHNOLOGY PIONEERS, one in quantum electronics and the other in robotics, share this year's Vannevar Bush Award for Lifetime Contributions and Statesmanship to Science. IEEE Life Fellow Charles Townes, a Nobel laureate known as the father of quantum electronics, and Fellow Raj Reddy, a computing and robotics inno-



Raj Reddy

vator, received the award in May from the U.S. National Science Board.

Townes and Reddy were cited for their lifetime contributions to science and for their long-standing statesmanship in science on behalf of the nation. They received the award during a 9 May ceremony at the Smithsonian's National Museum of Natural History, in Washington, D.C. The science board established the annual Vannevar Bush Award in 1980 to honor that prominent scientist's contributions to public service.

Townes won the 1964 Nobel Prize in physics for his invention of the maser (microwave amplification by stimulated emission of radiation) and its optical counterpart, the laser. As a former vice chairman of the U.S. President's Science Advisory Committee, he provided advice and analysis to the president and the federal government on a wide range of scientific and technical matters. Townes was instrumental in helping form the Jason Group, a select team of scientists who conduct studies for dif-



Charles Townes

ferent branches of the U.S. government. He also organized and chaired the Science and Technology Advisory Committee for Manned Space Flight from 1964 until 1970. "I've always regarded the well-being of society as very important, and I am delighted to have had some important effects that are not simply technical," he told *The Institute*.

Raj Reddy also headed a U.S. presidential committee. He co-chaired the President's Information Technology Advisory Committee from 1999 to 2001, a group that advises the president on advancing the field of information technology. Reddy laid the groundwork for a national policy to significantly increase federal investment in information technology research.

Reddy is the founding director of the first robotics laboratory in the United States, the Robotics Institute at Carnegie Mellon University, in Pittsburgh.

Townes and Reddy met for the first time at the ceremony, but they both recognize the importance of each other's work. "Although I have not been acquainted with Dr. Reddy, I do know his work is important, and I'm very glad he has been recognized by the Bush Award," Townes says.

"Charles Townes is a giant in the area of physics," Reddy says. "He was my hero when I was in graduate school in the '60s." ●

IN MEMORIAM

Eberhardt Rechlin Space Communications Pioneer

BY TRUDY E. BELL

IN A LONG AND ILLUSTRIOUS career in telemetry and space communications, Eberhardt Rechlin is perhaps best known for designing the system of ground antennas and relay stations that NASA uses to communicate with every lunar and interplanetary spacecraft the agency has ever launched. NASA's Deep Space Network was first turned on in late 1958, and it is still in use today.

During World War II, Rechlin participated in the Caltech V12 Navy College Training Program, which supplemented the force of commissioned officers in the Navy. However, by the time he graduated in 1946 with a bachelor's degree in electrical engineering, the war was over. Rechlin continued at Caltech, receiving his Ph.D. in electrical engineering in 1950.

Rechlin's first job was at the Jet Propulsion Laboratory (JPL), in Pasadena, Calif. He worked on problems of radio guidance and missile telemetry, focusing on methods of guiding missiles to their

targets despite jamming by the enemy.

When JPL was transferred to NASA in 1958, its engineering priorities shifted to telecommunications and tracking spacecraft. To design such systems, Rechlin and his colleagues extended the mathematical foundations of phase-locked loop systems and coded digital transmis-



Eberhardt Rechlin

sion. By the late 1950s and early 1960s, NASA was using their developments for its spacecraft.

While at NASA, Rechlin designed the physical and communications architecture of what became the NASA/JPL Deep Space Network. A worldwide network of tracking stations, the DSN was established to track and acquire data from spacecraft receiving close-up scientific images of Jupiter, Uranus, and Neptune.

Rechlin held many positions, including director of the DSN and assistant director of JPL. In 1967 he became director of the Advanced Research Projects Agency, later renamed the Defense Advanced Research Projects Agency (DARPA). He also served as assistant secretary of defense for telecommunications. In 1973, he joined Hewlett-Packard Co. as chief engineer, and in 1977 he became president of the Aerospace Corp., in El Segundo, Calif. After retiring in 1987, he joined the University of Southern

EBERHARDT RECHLIN 80

DIED 14 April 2006

MEMBER GRADE Life Fellow

EDUCATION Bachelor's and doctoral degrees in electrical engineering from Caltech, Pasadena, in 1946 and 1950

FIELD OF INTEREST Aerospace and communications engineering

VOLUNTEER ACTIVITIES U.S. National Academy of Engineering, 1968; chair, U.S. National Academy of Sciences' Naval Studies Abroad, 1977-1982; U.S. Air Force Scientific Advisory Board; chair, Chief of Naval Operations Industrial Advisory Committee on Telecommunications; Advisory Group on Aeronautical Research and Development to NATO, 1958-1967

AWARDS IEEE Centennial Medal, 1984; IEEE Alexander Graham Bell Award, 1977

California as professor of industrial and systems engineering, aerospace engineering, and electrical engineering systems. He retired from USC in 1994. ●

Trudy Bell is a former senior editor at IEEE Spectrum who worked with Rechlin, editing two articles that he wrote for the magazine.

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