ENGINEERING A NEW VISION FOR NCE

Q&A WITH DEAN MOSHE KAM

Moshe Kam, the new dean of Newark College of Engineering, comes to NJIT from Drexel University, where he served as the Robert Quinn Professor and Department Head of Electrical and Computer Engineering. Kam, who holds a Ph.D. from Drexel, is a former president and chief executive officer of the Institute of Electrical and Electronics Engineers (IEEE) and member of the boards of directors of the accreditation agency ABET Inc. and the United Engineering Foundation.

Before becoming a department head at Drexel, Kam served as technical coordinator for the U.S. Department of Defense funded project ACIN (Applied Communication and Information Networking) and as director of Drexel's Center for Excellence in Information Assurance Education. He had also served as principal investigator on more than 30 projects funded by the National Science Foundation, Office of Naval Research, Naval Surface Warfare Center, the U.S. Army, Lockheed Martin and the Defense Advanced Research Projects Agency.

Kam is a Fellow of IEEE "for contributions to the theory of decision fusion and distributed detection," and recipient of an IEEE Third Millennium Medal. He received a National Science Foundation Presidential Young Investigator Award (1990-1995) and is a licensed Professional Engineer registered in the State of Pennsylvania.

Following are thoughts that Dean Kam recently shared with Christina Crovetto, assistant editor of *NJIT Magazine*.

What motivated you to study engineering?

The enthusiasm to build new things, to build new machines and devices, to create new processes that can have a positive impact on the way we live.

When I was entering engineering in the 1970s, my main interest was communications. So consider, for example, what engineers have done for the field of communications since then. Take the cell phone. Think about how it has transformed the way we communicate, and what it means for developing communities, such as communities in parts of Africa and Asia that did not have infrastructure for landlines before that invention.

A revealing example was described in a *Washington Post* article a few years ago. Their reporter visited fishermen in a village near India's southern tip who, due to the availability of cell phones, were able to contact different markets as they still collected fish at sea. They used the information to find out what the fish sell for so that they knew where to head when they got to shore. They often even sold the catch while at sea. This process has eliminated the middlemen on whom these fishermen relied before, increased efficiency of the markets, and completely changed the way the local economy works.

I could not really envision a development such as this when I was still thinking about my future vocation as a teenager. But I knew that by becoming an engineer I would not be doing the same kind of work 10 years in the future as when I entered the field. I knew that engineering is dynamic, that it changes many of its practices and techniques every decade. This thought was – and still is – very appealing.

There is little relationship between the research that I am doing now and what I studied in school or worked on during my first job. Engineering is a field that almost guarantees the opportunity to move on from one area of interest to another as technology and society change, to be surprised every few years by new developments, and to learn how to adapt and be inventive and original again with a completely new set of tools.

The other side of the coin is that when I became an engineer I signed up for lifelong learning. A commitment to lifelong learning is a professional necessity for all engineers. You can't just finish school and say, "I've got it. I know what I need to know and now I can coast." You need to update your arsenal of tools and adjust your worldview every few years. In this respect, engineering is a lasting, ongoing adventure.

More specifically, why did you decide to study electrical engineering?

While I was interested in several areas of engineering as a student – as I am today – I found the potential of electronic and optical communications especially exciting. I grew up when communications was evolving from an analog to a digital discipline, with the additional potential of computing entering the picture. In electronic communications I could work with technology that ranged from antenna design to integrating computers into wide-area networks. At the age I started to think about this, I couldn't foresee exactly what changes would occur. However, I did feel that this technology would change the way we live, that much more bandwidth would be available to each one of us, that new devices and new frequencies would open up. I wanted to be part of it.

Why did you decide to become an engineering educator?

Being an educator was not on my mind when I began working as an engineer in microwave communications. However, I did come to a point where I realized that I needed more education beyond my undergraduate studies. It was when I was working on a microwave link that behaved unexpectedly. After a few weeks of trying to understand and repair it, we decided to call an expert from a local university to help us with the apparently difficult electromagnetic propagation problem we had encountered. The expert did a magnificent analysis, thorough and elegant. His equations explained exactly what caused our "abnormal" observations and what needed to be done. I was humbled and impressed.

This event turned out to be very important to me. It demonstrated that if I were to do work at a higher level, to be able to address more sophisticated challenges, I had better get more education. I decided to go to graduate school.

As I was getting more education, I was also looking at the people who were providing me with this education. Increasingly, I realized how vital engineering education is to society. I started my career in education with small steps, as a teaching assistant. I discovered I can do it, I like it, and it makes an impact.

"THERE IS A VERY STRONG LINK BETWEEN 'HAVING YOUR FINGER ON THE PULSE OF TECHNOLOGY' AND THE ABILITY TO BE A MEANINGFUL EDUCATOR."

At the same time, even as teaching became an important part of my life, I was always engaged in engineering field work, in research, development and testing, and in meeting the needs of clients. There is a very strong link between "having your finger on the pulse of technology" and the ability to be a meaningful educator. It is essential to retain a very good understanding of what it means to build, to deploy technology in a practical way, to meet specifications.

Have you always combined work as an educator with significant commitments in other areas?

I have tried. In addition to working on projects for industry and the U.S. government, I became an active volunteer in IEEE, a large professional association active around the globe. My activities as an IEEE volunteer exposed me to many professional colleagues around the world, to schools in two dozen countries, and to interesting projects and local challenges that would have otherwise been known to me only from second-hand reports. Becoming a volunteer for such an association was one of my best professional decisions.

What attracted you to NJIT and Newark College of Engineering?

I was familiar with NJIT for a long time. There are many good engineering schools, but there aren't many universities where engineering is such a principal focus as it was at Drexel University and as it is at NJIT. I also knew many faculty members at NJIT as professional colleagues, reviewers of my papers, speakers at the same conferences I attended and, to be honest, as competitors for research grants.

I believed I understood the student population of NJIT fairly well, the background, aspirations and career objectives of NJIT's engineering students. I had reached the point in my career where a dean's position was the next logical step. The availability of the position at this level at NJIT – a school I knew, appreciated and understood – was an ideal opportunity. The ad NJIT had placed for the dean of NCE described my dream job.

What is your vision for the future of NCE?

Like all engineering schools, we have not yet seen the full impact of computing on engineering. We have not seen the inevitable integration of engineering with the life sciences, *[continued]*

PHOTO: ANUOLUWAPO AKEREDOLU

"IF YOU ARE AN ENGINEER TODAY, COMPUTING IS YOUR FIRST LANGUAGE. I AM NOT TALKING JUST ABOUT COMPUTER ENGINEERS; I'M TALKING ABOUT ALL ENGINEERS."

ILLUSTRATIONS: HARRY CAMPBELL

and we have not seen the increased transformation of the engineer from a technical expert to an agent of societal change. These are three key areas that promise to keep engineering vital, exciting and relevant.

We must be in the lead at NJIT, and make sure that our students are at the forefront of technological change. Mastery of computing is part of this challenge. If you are an engineer today, computing is your first language. I am not talking just about computer engineers; I'm talking about all engineers. Computing has become central to the way all engineers work and function.

When there are interesting specifications and challenges in an engineering project, the first question is often "What are the software assets that I can mobilize to start attacking this problem?" If we were to revise our engineering curriculum from the beginning, a revision that would happen in time anyway, courses and labs in computing would be there on par with the courses in mathematics and physics that for almost a century were considered the fundamentals of engineering education. Computing, the theory of algorithms, computational complexity, and even programming would be there at the core of engineering education. Directing the curriculum on this path is a considerable but absolutely necessary and timely challenge.

A second challenge is the increasing necessity to address the needs encountered at the intersection of engineering and the life sciences. Many more engineers will be working at this intersection, in areas that range from medical imaging to smart prosthetics.

When I became president of IEEE, I was invited to speak at an annual meeting of engineers in France, a meeting that I attended only once before, 20 years earlier. During my previous opportunity to attend, this group was dominated by engineers working on power generation, electronics, and communications. I do not think there was one engineer among them who was engaged in the biomedical field. Two decades later, fully one third of the attendees had jobs related directly to biology and the life sciences; they were working directly with physicians, nurses and patients. This is a strong trend toward the life sciences that affects many aspects of engineering. We need to be aware of it if we are to prepare our students for the environment they will encounter after graduation.

The "marriage" between engineering and the life sciences is guaranteed to be one of the most exciting forefronts of technology over the next 50 years. We need to emphasize this connection and the opportunities it presents, not just for biomedical engineering students, but for those majoring in virtually every branch of engineering.

You've mentioned the relationship between engineering and society several times. Should the programs at NCE promote a greater awareness of this relationship?

Yes, absolutely. We do want the engineers who come from NJIT to have a solid understanding of how their work affects people's lives, how their inventions and practices shape the community where they live, and to be aware of the relevant needs, desires and hopes of their "target audience," namely the general public.

Some years ago, I did some consulting in wireless communication for communities in New Jersey. I found myself spending a lot of time in zoning-board meetings speaking about the location and number of planned cell-phone towers. In this country, zoning boards represent democracy in its rawest and purest form. Members of the boards are individuals from the community who get together to solve local problems. They hired me to help them with one of their problems.

During these meetings, I met often with engineers sent to represent the major telecommunication companies that planned the cell phone towers. I had taught some of these engineers personally at Drexel. It dawned on me that we had never prepared our students for this kind of activity.

We prepared our students to devise the network and plan the communication link, but we did not prepare them to stand in front of fellow citizens who typically know very little about the intricacies and performance of communication systems. My former students needed to speak to the board members in a way that is accurate, informative and persuasive, yet honest. These engineers should have been concerned with more than just the financial interests of the companies that sent them to make a presentation. They should have been aware of what is best for the

"THE 'MARRIAGE' BETWEEN ENGINEERING AND THE LIFE SCIENCES IS GUARANTEED TO BE ONE OF THE MOST EXCITING FOREFRONTS OF TECHNOLOGY OVER THE NEXT 50 YEARS."

community, and how to explain technical matters that often are quite complex to a lay audience.

On a larger scale, as engineering educators, I felt that we did not pay enough attention to this aspect, to what we teach our students about the social impact, positive and negative, of what we develop and implement as engineers. We have educated students to design and manufacture devices like the smartphone, which almost everybody here carries today. However, quite often we leave it for "someone else" to worry about the social and environmental implications of what we have built, advertised and marketed – about the way the smartphone affects our community.

Addressing the social impact of engineering is a challenge for all engineering schools, and one that I think we at NJIT are very qualified and ready to address. It is a most important goal, of course, to give our students the knowledge and technical skills needed to investigate, specify, research, design, implement, test and market methods, tools and products. It is equally important that students also understand what these do for society, and how what engineers design can be better integrated into the fabric of life, be safer, be more widely and equitably affordable, be friendlier to the environment and sustainable, and be used for the common good.

What should be done to encourage more young women to choose STEM careers?

There is full acceptance of women today in professions that were essentially closed to them a century ago, such as law and medicine. Still, there are too many individuals who do not believe that engineering is an appropriate career choice for women. There is obvious gender bias in how many high school students are counseled about engineering. Too many authority figures – parents, teachers, guidance counselors – will not suggest engineering as a career choice for young women, or will do so reluctantly and unenthusiastically. This attitude needs to change.

In many engineering enterprises, the work environment for women is still less accommodating compared to the work environment in other occupations. Increasingly, employers understand the need to improve accommodation for women engineers, but in some parts of our industry we still have a long way to go.

Women are 50 percent of the population, but just about 20 percent of engineering students are women. Because of this gap, our profession loses access to a tremendous pool of talent. It is a major responsibility we have at NJIT to send the message to young women that the engineering career path deserves their consideration. To this end we must also ensure the presence and influence of role models that help to deliver and internalize this message. We need to get to gender equality among students in engineering schools as we – almost – have in the student populations in medicine and law.

What gives you the greatest satisfaction as an educator and an engineer?

I'll give you a specific example to answer the question. My first Ph.D. student was Amit Goffer, who is now president and chief technical officer of a company called ReWalk. The FDA recently announced that a device that he designed at ReWalk has been approved for use in the United States. This device is for individuals who have spinal injuries and cannot walk as a result. The device is an exoskeleton made mainly of metal that, with the associated control algorithms, sensing and power, allows many paraplegics to raise themselves from their wheelchairs and walk.

This is an awesome achievement. Amit is extremely talented and original – I certainly did not teach him how to accomplish this feat. Still, you want to think that you had something to do with this exciting accomplishment, maybe something you taught, maybe resources you helped provide.

Academic administrators often sit in closed rooms, discuss infrastructure, and spend a lot of effort on budgets. It may feel sometimes that it would be more exciting to go to the lab instead, and try a new robotic arm or a new chemical compound. However, at the end of the day, the reason we academic administrators spend so much time on infrastructure and on budgets is so that we can give students – students like Amit Goffer – the resources they need to research and develop innovations that culminate eventually in inventions like ReWalk's exoskeleton. When you see the innovations materialize, you realize that you are engaged in a useful effort. ■

engineering.njit.edu