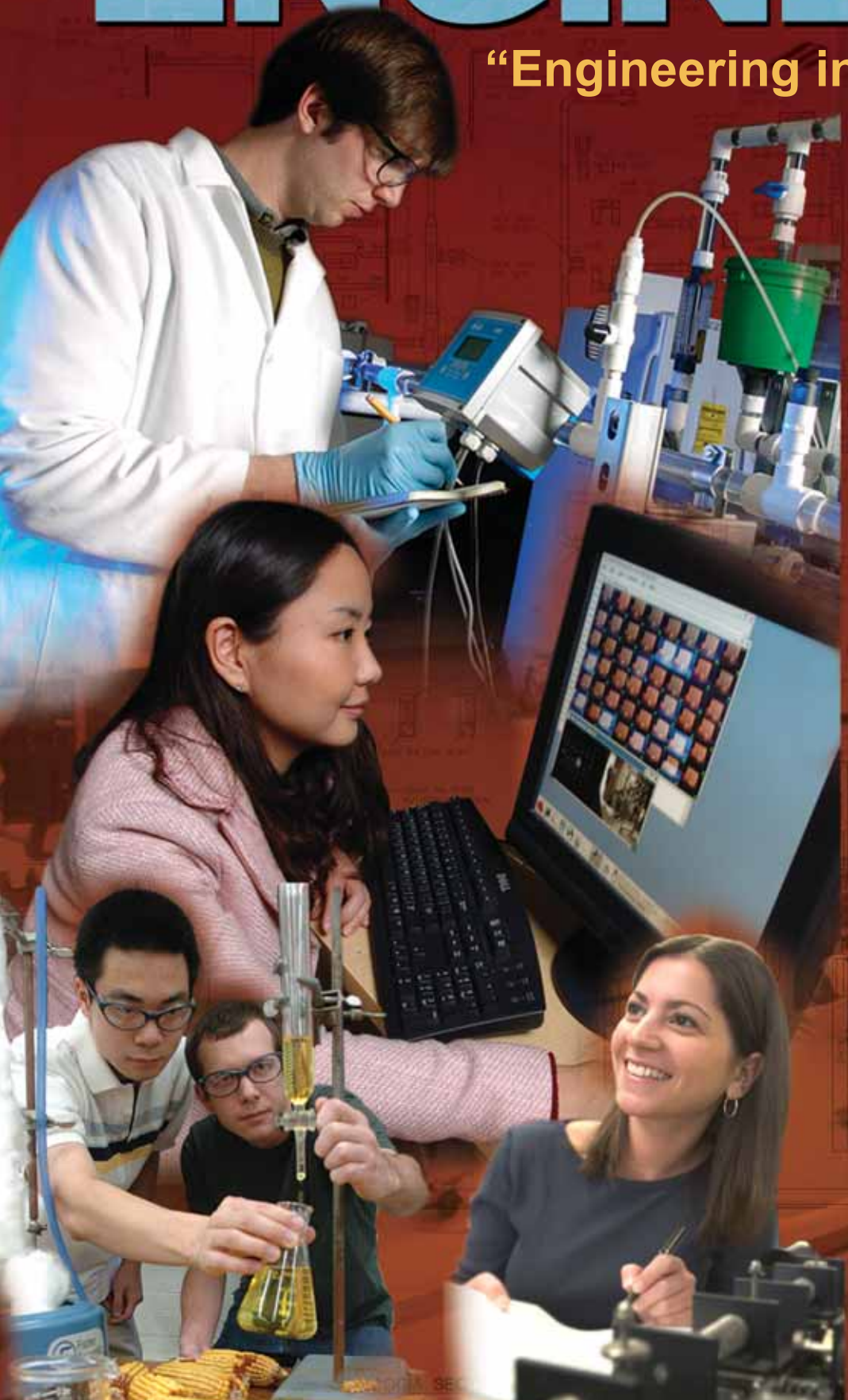
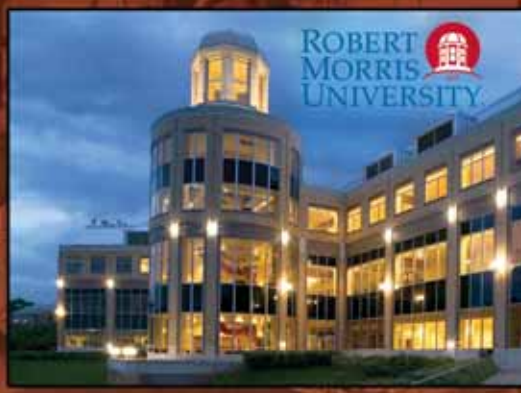
Pittsburgh ENGINEER

SPRING 2007

"Engineering in Academics"





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In This Issue...

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Questions and Answers with the Guest Editors

A Special Guest Editor Cloumn

David Dzombak, Gerald Holder and Dan Tis

The editorial committee of the *Pittsburgh ENGINEER* magazine recently sat down with representatives of four area universities that host a college of engineering; Carnegie-Mellon University, The University of Pittsburgh, Point Park University and Robert Morris University. With so much discussion about the declining numbers of engineering students in the U.S., the purpose of our discussion was to assess the state of affairs in their respective engineering programs, and to learn how these universities were preparing the engineers of tomorrow to better compete in a global market. We found their answers to be thoughtful and insightful, and we learned much about how these area universities are positioning themselves to stay at the forefront of higher education. Included in the conversation were Dr. Pradeep Khosla, Dean of the College of Engineering at Carnegie Mellon University; Dr. Gerald Holder, Dean of the School of Engineering at the University of Pittsburgh; Dr. Winston Erevelles, Professor of Engineering and the Dean of the School of Engineering, Mathematics, and Science at Robert Morris University; and Mark Farrell, Chair of the Department of Natural Sciences and Engineering Technology at Point Park University. Here are their thoughts.

How has globalization changed the way education, and, in particular, how engineering education is being taught and experienced by students?

Holder: In today's world engineers need to be able to function in an international environment. Many engineering projects are done overseas--for example, Westinghouse, one of the biggest employers of Pitt engineers, is building nuclear power plants around the world. Consequently, engineers are dealing with people of different cultures much more often than previously and we are trying to help our students be prepared to meet these changing needs though internationalization of our education. We expect that 25% of our undergraduates will have some sort of international experience by studying engineering overseas in places like China and Brazil, by taking foreign languages, and by participating in exchange programs including semesters abroad.

Erevelles: The global playing field offers the engineering education community fascinating opportunities to extend learning well beyond the walls of the classroom, campus, and nation. International exchange programs offer students opportunities to study abroad, work at their home institutions with exchange students from foreign countries, and even learn from the insights of visiting (or remotely located) scholars (in our case it is through the Rooney International Visiting Scholars program that has brought 4 STEM scholars to the University from Turkey, Oman, the UK, and India). These experiences broaden the student's perspective and better prepare him or her for the realities of the workplace today.

Also of import here are virtual teams and their collaboration – I refer specifically to cases where team members are not co-located and the geographic dispersion makes face-to-face meetings impractical. The ongoing evolution of information technology and computing capabilities offers students the opportunity to experience internet-enabled collaboration tools in such cases. These arrangements may be formalized so that teams of students can work together on projects despite being physically located in different countries and continents.

Farrell: In a very real sense the fundamentals of science and engineering are universal and thus globalization does not change the underlying tenets of engineering education.

"...the fundamentals of science and engineering are universal and thus globalization does not change the underlying tenets of engineering education..."

The development of educational methodologies that incorporate diverse technologies, especially in communications, provides increasing opportunities to enhance our curriculum with regard to global issues. Point Park University has a large number of adult students who are already working for multinational corporations and who expect that the education we provide will enhance their ability to work as members of a global team.

Khosla: Our challenge at Carnegie Mellon's College of Engineering, not unlike the past, is to predict and position ourselves for future changes so that we maintain our competitive edge. It is true that the U.S. graduates about 73,000 engineers per year as compared to India and China, which graduates about 750,000 per year. It also is true that competitive pressures have forced U.S. companies to invest significant resources in manufacturing and R & D in countries such as India and China. This is motivated by the availability of lower-cost, trained workers and the need to reduce operating costs.

No amount of investment can change the winds of globalization – or reduce the cost of doing business in this country to the point where India and China become irrelevant. While it is in our interest to convince youth in this country to pursue careers in science and engineering, I do not believe that increasing the number of engineering students alone will sharpen our competitive edge.

"...To compete... we have to follow a strategy of "comparative advantage" – in which we develop engineers who can marshall resources, create and innovate in ways that will enable U.S. engineering to compete and prosper..."

To compete with these countries – and maintain our standard of living – we have to follow a strategy of "comparative advantage" – in which we develop engineers who can marshall resources, create and innovate in ways that will enable U.S. engineering to compete and prosper. We need to build our comparative advantage by rethinking our undergraduate engineering education, maintaining our research infrastructure and culture and developing a strategy for globalization.

Gerald D. Holder

Innovation is a hot button now for corporate America. How are the nation's engineering programs incorporating innovation into programs and projects, etc.?

Holder: Many schools, including Pitt, are incorporating innovation into their curricula. For example, we offer courses in New Product Development and Entrepreneurship as part of the education in several departments. Our students can work in the Swanson Institute for Technical Excellence, which includes product design, development, RFID technology development, and manufacturing from every scale from nano to macro. Students can create new products, manufacture them and in some cases create companies that are based upon these products.

Farrell: An important aspect of undergraduate education is to develop the thought processes and design skills needed by our students to become the innovators of the future. Point Park University faculty seek opportunities for the involvement of students in activities, projects and internships that are innovative and sometimes entrepreneurial.

"An important aspect of undergraduate education is to develop the thought processes...needed to become the innovators of the future..."

For example, Pittsburgh is a world-center for research and development of fuel cells. Accordingly at Point Park our thermal sciences courses deal extensively with fuel cell Technology. We also emphasize the use of current models of equipment to teach crucial "hands-on" laboratory skills and

incorporate instructional technology such as Blackboard to work more effectively and efficiently with our students both on and off campus.

Erevelles: One sees an increased infusion of course work on strategy, innovation, technology, and entrepreneurship in both graduate and undergraduate programs in engineering. Courses and programs that emphasize these hot-button topics are being offered by a number of institutions, including Robert Morris, and are often realized through collaboration between engineering and business schools at an institution. In addition, university centers, in RMU's case - the Center for Applied Research in Engineering and Science and the Massey Center for Business and Industry Development, can be focal points for such work by bringing together faculty, students, and the business community to work on joint projects. This is a great way for students to experience innovation and entrepreneurship firsthand.

"...engineers will always need the basic skill sets of science, math, and engineering. However, there is more and more emphasis on communication and teamwork in today's world..."

Khosla: Carnegie Mellon's College of Engineering has created a new graduate degree program designed to help corporations turn invention and creativity into shareholder wealth. Since January, we have given students the opportunity of earning a one-year interdisciplinary degree in Engineering and Technology Innovation Management (E&TIM). Carnegie Mellon's scholarly research into the economics of technological change provides a basis for the program's core courses. The program also builds on the university's long standing strengths in engineering, entrepreneurship and integrated product development courses. The new E&TIM program will equip students for meaningful careers as leaders in innovation and the strategic management of technology. Some of the program's core courses will include managerial and engineering economics, the strategy and management of technological innovation, and a product or process innovation project.

What skill sets will the engineers of the 21st century need to retain and continue to relearn as competition for jobs and projects increases?

Holder: Engineers will always need the basic skill sets of science, math, and engineering. However, there is more and more emphasis on communication and teamwork in today's world. We try to ensure that our students are exposed to team projects every year, and we try to make sure they are frequently writing and speaking about their work. Every freshman works in a team on the subject of sustainable engineering. In a small team, they choose a subject, conduct literature research, write a conference paper and present that paper before an audience. Subjects might include sustainable water supplies, sustainability in computer manufacturing, green building design, and energy use.

Farrell: Surveys of our alumni and regional employers show that companies continue to value employees who understand the fundamentals of their profession, who are versatile and able to migrate to new areas of responsibility, and who have the skills to continue learning on their own. Indeed the ability to be a life-long learner may be the most important attribute that any professional can develop. An essential skill required of modern engineers or engineering technologists is fluency in the use of analytical tools founded on a fundamental understanding of the basic algorithms which are the core of such tools. We can be justly proud that products such as ANSYS and Algor which are considered the "gold standard" in their field of application were developed in Pittsburgh.

ESWP Publications Chair Dan Tis

Erevelles: According to the *The Engineer of 2020: Visions of Engineering in the New Century* from *The National Academies Press*, the following skills will be required of engineers going forward: strong analytical/technical skills, creativity, good communication skills, mastery of business and management, leadership, high ethical skills and a strong sense of professionalism, resilience and flexibility, and lifelong learners. Our interviews with employers in the region yielded the following set of desirable attributes and skills: engineering fundamentals, oral communication/listening, project management, teamwork, good customer relations skills; interpersonal skills, written communication, business knowledge, market foresight, problem solving, troubleshooting, critical thinking, critical analysis, strategic thinking, international, global perspective, internship or co-op experience, product/process design and quality.

"...the engineer of the future must be able to enable, create, manage, and deploy innovation in a multicultural environment..."

I believe that engineers of the 21st Century will continue to need a solid foundation in engineering demonstrating superior analytical, technical, and problem-solving skills – that is a given. In addition they will need strong communication and interpersonal skills and the ability to work effectively with a global customer base. These young men and women will also need to have the ability to look at the big picture and see how their work fits into the strategy followed by their employer. Finally, they will need to be able to look forward and anticipate market changes, identify new opportunities, and respond with agility to change.

Khosla: Basic science and technology knowledge and skills will remain important. But I believe that broadening engineering education with additional exposure to management, policy, finance and entrepreneurship will serve our students well. Our vision is that the engineer of the future must be able to enable, create, manage, and deploy innovation in a multicultural environment.

What impact does low grade school and secondary school math and science test scores have on our ability to recruit the best and brightest in the United States?

Farrell: The "best and the brightest" students still will seek to enter professions in science, engineering and medicine. I see many such students each summer at the Pennsylvania Governor's School for the Sciences held in Pittsburgh on CMU's campus. The bulk of the work that will be done in the fields of engineering and their related areas will be done by a much larger group of students who possess above-average but not necessarily outstanding math and science skills. It falls to the universities to develop these skills in our students to ensure that they leave us on graduation ready for the varied challenges of the modern workplace. This responsibility requires continuous assessment of our programs and ongoing modifications to achieve our desired educational outcomes.

I wish to point out that, in my opinion, often students who would excel in science and engineering and find truly rewarding careers are dissuaded from pursuing such careers. This is not happening in other parts of the world and we may soon find ourselves at a competitive disadvantage in the global environment mentioned earlier.

"...students who excel in science and engineering and find truly rewarding careers are dissuaded from pursuing such careers. This is not happening in other parts of the world and we may soon find ourselves at a competitive disadvantage in the global environment..."

Erevelles: Engineering is a demanding field of study with mathematics and the sciences as its foundation. Inadequate preparation in the areas of mathematics and science can be a significant barrier to success at the university level. The failure to master fundamental concepts in mathematics and the sciences limits the student's ability to fully understand physical phenomena routinely modeled by engineers or solve problems in various engineering disciples. This is just one example of where students will struggle.

Inadequate preparation may manifest itself in a student not being prepared to enter the calculus sequence in a timely fashion. This may well cause them to struggle with the material, fall behind their classmates, and perhaps even delay their graduation.

We need to work in partnership with our school systems to ensure that our nation's youth develop a sense of excitement about mathematics and science and their applications at an early age. Outreach programs and participation in funded initiatives such as the Math Science partnership are all steps that can address this problem.

Holder: The United States has not been effective in encouraging more students to select engineering as a profession. We need a better reward system for high school math and science teachers and we need incentives for encouraging students to enter engineering. At Pitt the qualifications of our students have steadily risen, virtually every year for the past ten. We have better undergraduates and better graduate students each year, but that may not be the case for the entire nation, where engineering is still below its peak enrollments of 20 years ago.

"...we need to work...with our school systems to ensure that our nation's youth develop a sense of excitement about mathematics and science at an early age..."

Khosla: The impact will continue to be critical if state and federal governmental bodies do not allocate sufficient funds to recruit the best teachers to deploy and share the most creative programs to pique more interest in math, science and engineering education. Low test scores put us all at risk. The "No Child Left Behind" program addresses only the tip of the iceberg. We need to beef up funding and concern about our public education system before it resembles an "academic Enron.'' At Carnegie Mellon, we still admit the cream of the crop, but we remain concerned about the wider implications of increasingly low test scores in the hard sciences. We support very active outreach programs. We attend the NSBE National Conference and we sponsored a booth in March 2007 at the Society of Women Engineers (SWE) Regional Conference. As part of National Engineering Week, our Engineering College sponsored the "Introduce a Girl to Engineering'' program conducted by our student chapter of SWE. We also have co-sponsored several joint panel forums about the "Future of Engineering" with the Engineers' Society of Western Pennsylvania. We offer a variety of other outreach programs to admitted students and inner city high school and junior high students.

To learn more about the specific programs at CMU, Pitt, Point Park and Robert Morris, we invited each of the representatives to provide more information, which can be found throughout this issue of Pittsburgh ENGINEER. Also, the editorial committee would like to express our thanks to the Guest Editors and also Chriss Swaney and Dr. David Dzombak of Carnegie Mellon University and Dr. John Kudlac, Director of the M.S. in Engineering Management program; Mr. Daniel Reed, coordinator of the Civil Engineering Technology program, Dr. Donald Keller, coordinator of the Electrical Engineering Technology program and Mr. Robert Draper, coordinator of the Mechanical Engineering Technology program from Point Park University for their contribution.

Bioengineering at the University of Pittsburgh School of Engineering

by **Gerald D. Holder, Ph.D.**
US Steel Dean of Engineering at the University of Pittsburgh

Gerald D. Holder

Imagine being the parent of a newborn baby with a heart defect. Imagine having to hear the doctor announce, "There's little we can do. There just isn't a device that is small enough to implant into and support your newborn's heart. The chance of your baby's survival is minimal."

Now imagine the same scenario, only the doctor delivers good news about a device the size of a quarter that has been developed to help support infants with congenital heart defects.

Such a device, called a Pediatric Ventricular Assist Device (VAD), is already in development by bioengineering pioneers at the University of Pittsburgh, and it is just one example of how bioengineering research—the point where the medical professions meet engineering—is helping to better our world.

The Growth of Bioengineering Education

Bioengineering is a recent addition to the spectrum of traditional engineering programs offered in the United States. Although biomedical engineering research was underway in the late 1970s, formal educational programs in bioengineering did not develop at many institutions until the 1980s and 1990s. Since then, bioengineering programs have expanded rapidly, due in large part to the need for bioengineering research, which helps advance the therapies and technologies available to treat patients.

The growth of bioengineering programs was also spurred by The Whitaker Foundation, which provided grants to launch and develop formal bioengineering degree programs across the nation. The University of Pittsburgh received a major Whitaker Foundation award to establish a formal Department of Bioengineering in 1998.

In 1987 Pitt created what is now the Center for Bioengineering (CBE). Bioengineering research was underway at Pitt before then, but the CBE brought the research efforts of bioengineers and physician researchers at the University of Pittsburgh Medical Center (UPMC) to a new level of collaboration. A decade later, Pitt used the Whitaker grant to establish the Department of Bioengineering, which solidified research bonds and allowed Pitt to offer more graduate courses as well as begin an undergraduate bioengineering degree program. (Pitt had already been offering masters and doctoral degrees in bioengineering before the formal establishment of the department.)

Today, the Accreditation Board for Engineering and Technology (ABET) recognizes 42 programs in bioengineering. Engineering schools across the country have reported incredible increases in enrollment in their bioengineering programs in

the short amount of time the programs have existed. Pitt, for example, reports that its bioengineering programs are the fastest growing of all its engineering programs with more than 300 students, at all levels, in the program. As of December 2006, Pitt has graduated more than 50 doctoral students and 125 MS students. We expect to produce 20 Bioengineering PhD's per year, competing with the top schools in the nation, evidence of the quickly growing field of bioengineering and in particular, the growing interest in bioengineering by outstanding students.

The Nature of Bioengineering

As with other fields of engineering, bioengineering integrates the study of the traditional sciences of physics, chemistry and math with engineering principles. Where bioengineering is unique is in the incorporation of biology and medicine, with the aim of developing innovative approaches to improving health and the field of medicine using engineering based therapies and devices.

Thus, the interdisciplinary nature of bioengineering requires close relationships with the study of medicine, physicians and medical researchers. The country's most successful programs (Pitt has been ranked as high as 6th in the country in Bioengineering) have strong connections to excellent medical schools, such as the University of Pittsburgh School of Medicine and UPMC, which has been placed on *U.S. News & World Report*'s "America's Best Hospitals" list as one of the top ranked hospitals in the United States seven times in the last eight years. Approximately 5% of Pitt's bioengineering doctoral students also are studying for their medical degrees in a combined M.D., Ph.D. Program in what is the largest bioengineering M.D., Ph.D. Program in the nation.

"Rapid technological advancements and the changing medical needs of the world's population require the field of bioengineering to grow and adapt"

Bioengineering in and of itself is a vast discipline with many specialty areas. Rapid technological advancements and the changing medical needs of the world's population require the field of bioengineering to grow and adapt. Some current bioengineering specialties include: bioinstrumentation, biomaterials, biomechanics, cellular, tissue and genetic engineering, clinical engineering, medical imaging, orthopaedic surgery, rehabilitation engineering, regenerative medicine, and systems physiology.

Bioengineering research activities and developments truly are interdisciplinary. At Pitt, for example, collaboration is ongoing with medical faculty from the areas of critical care medicine, cardiology, surgery, ophthalmology, orthopaedic surgery, neurosurgery, urology, obstetrics and gynecology, radiology, and pediatrics. There also is collaboration among the various engineering disciplines, such as mechanical and electrical engineering, nanotechnology, and materials science. That collaboration is necessary, as the development of devices and processes requires knowledge about the human body as well as instrumentation design.

Real Life Applications of Bioengineering

The examples of how bioengineering research is helping to advance the field of medicine and positively affect the health of humans range from tissue regeneration to the study of how elderly people fall to researching and creating better joint replacements.

Take the example of the pediatric. This is a very real-world example. Infants do not have heart assist devices available to them and the mortality rate of babies with heart defects is currently very high. However, thanks to the ongoing research of Dr. Harvey Borovetz, *Professor and Chair of Bioengineering and Robert L. Hardesty Professor of Surgery* at the University of Pittsburgh, and a very large team of collaborators, this may not always be the case. Dr. Borovetz and

colleagues have received research funding from the National Institutes of Health to further this research.

Another impact that bioengineering has on everyday life is related to human muscles, bones, and joints. The numbers of broken hips, torn knee ligaments, and the like are in the hundreds of thousands each year. Pitt researchers at the School of Engineering's Musculoskeletal Research Center (MSRC), led by Professor Savio Woo, a renowned expert and member of both the National Academy of Engineering and the Institute of Medicine, are studying and developing technology that will improve how these problems are treated. Specifically, Woo and researchers at the MSRC are developing a new kind of tissue that will scaffold—or wrap around—the torn ligament in a knee to aid in the tissue regeneration process and speed up recovery of injured anterior cruciate ligaments (ACL) or medial collateral ligaments (MCL), for example. Woo's research group is also working on ways to improve repairs to shoulder injuries.

"...the applications of bioengineering research are truly limited only by the imagination..."

Surgical assist instruments are another common area of bioengineering research. A groundbreaking medical device is currently in clinical trials at UPMC: The Sonic Flashlight, invented and developed by George Stetten of Pitt's Department of Bioengineering. This device—which consists of the combination of a conventional ultrasound scanner with a see-through mirror and a small flat-panel display, similar to those found on the view screen of a digital camera—allows medical personnel to "see" into a patient's body by superimposing images. The end result is to make it easier for medical personnel to conduct surgery, biopsy tumors or insert catheters.

These are just a few examples as the applications of bioengineering research are numerous and broad. Pitt, for example, has more than $25 million in current research projects integrating various medical and engineering areas.

The Future of Bioengineering

As technological developments continue apace and more sophisticated devices are created, the applications of bioengineering research are truly limited only by the imagination. One can look forward to a future when no doctor will ever have to turn away an infant in need of ventricular assistance like in the opening scenario. Bioengineering has the capacity to make that and much more not only possible, but common place.

Pradeep Khosla

Will We Continue To Lead In Engineering

by Pradeep Khosla, Ph.D.
Dean of Carnegie Mellon University's College of Engineering

There is a lot of buzz these days around words such as outsourcing, innovation, competitiveness and globalization. A lack of engineers and hefty restrictions are generating challenges as well. The general tone is that sourcing and security restrictions are hurting innovation and resulting in lost jobs, and visa restrictions are adding to a sharp decline in the foreign student population at U.S. universities.

This, so the argument goes, is causing the U.S. to fall behind in innovation and creating a shortage of engineering talent as a higher percentage of foreign students educated here go back home.

Another part of the concern has to do with sheer numbers. A decade ago, close to 40 percent of total engineering work hours were based in the U.S. Current predictions are that by 2010, only about 10 percent of those work hours will be in the U.S. The reasons are that India and China are graduating 10 times more engineers a year than the U.S., and the cost of doing engineering work there is about 20 percent of that in the U.S.

But based on personal experience and anecdotal evidence, I believe that while more students may be going back home, the absolute numbers are not large enough to be concerned about. The U.S. still has advantages that most countries don't possess. In addition, whatever work is sent offshore, higher skilled work will remain stateside, thereby ramping up U.S. worker skill levels and continuing to attract the best and brightest from around the world.

While it is in our interest to convince youth in this country to pursue careers in science and engineering, I do not believe that just increasing the number of engineering graduates will sharpen our competitive edge. We have to develop that advantage, which is our ability to manage the global process of innovation.

To do that, we need to rethink our undergraduate education in engineering, while maintaining our research infrastructure and culture at universities. The U.S. can still boast that its research enterprise is the best in the world. It has been based on federal and industry investments in universities, and the availability of graduate students to perform cutting-edge research.

"...The U.S. can still boast that its research enterprise is the best in the world..."

To maintain that advantage, we must invest more in research and development, and, therefore, in graduate education. We must develop avenues that enable talented foreign engineers and scientists to leverage their knowledge with U.S. industry. This will require a new relationship between universities and industry. Universities must find ways to become the research and development arm of industry. To do this, we must rethink our intellectual property policies vis-à-vis industry.

Curriculum changes also are important. At Carnegie Mellon, we are now developing a curriculum, at both the graduate and undergraduate levels, that will allow students to enable, manage, and deploy innovation in a multilingual, multicultural and multinational environment while maintaining excellence in technical education. I call this the Carnegie Plan for a "Flat World." Every business has had to face the challenge of globalization and alter its way of doing business. Universities have failed to respond to those global pressures. This is the real threat to U.S. leadership in innovation.

"...American universities must develop the flexibility to operate beyond their campus borders so as to engage today's global enterprises..."

American universities must develop the flexibility to operate beyond their campus borders so as to engage today's global enterprises and the brightest young minds around the world. Deploying such a plan will enhance our comparative advantage.

Even if the U.S. has a smaller percentage of the world's engineers, it will be able to compete because its engineers will be the managers of complex global interactions. And in the final analysis, it's the quality of engineer that counts, not the quantity.

ESWP's 123rd Annual Banquet

Luffy Wins Prestigious Metcalf Award

by Chriss Swaney

Chriss Swaney with Robert Luffy (r)

More than 600 regional engineers and business leaders crammed the Sheraton Station Square Hotel Ballroom on February 21 to honor the 2007 Metcalf Award winner sponsored by the Engineers' Society of Western Pennsylvania (ESWP).

A gala affair attracting some of the region's most prestigious engineering companies, the 123rd ESWP annual banquet celebrates important contributions made daily by engineers.

It would be very difficult to enjoy life if we did not have engineers to keep us safe. Shadowed by peril from the dawn to dusk, engineering wizardry keeps the cabbies brakes from failing when you are in the crosswalks and its smart engineering design that keeps us safe during our high-speed automotive pinball game that has become our daily commute.

Other challenges stalk us every day, but the ESWP has found a way to recognize distinctive projects and people that continue to make our lives both healthy and happy.

The $225 million Findlay Connector Highway project designed by Michael Baker Jr., Inc. and managed by McTish-Kunkle/ Raintree for the Pennsylvania Turnpike Commission was named Transportation Project of the Year by ESWP. In addition, the Commercial Project of the Year went to the University of Pittsburgh's new Biomedical Science Tower 3 (BST3) designed by Payette Associates, Inc. and managed by a joint venture of Mascaro-Hunt.

Engineering leadership was a major theme throughout the festive evening as Charles M. Russell, Jr., of Michael Baker Jr., Inc. was named Engineer of the Year by the ESWP.

"I'm extremely proud of this award, but I'm also very proud of the big part engineering plays and continues to play in the rebuilding of Iraq,'' said Russell. For more than 20 years, Russell has skirted the world to share his management and engineering skills on a variety of infrastructure projects.

Like so many ESWP awardees, Russell and his peers pointed out that the effect of information technology is just beginning to be felt in many engineering sectors.

"...We need to get out and do a better job of getting more young people interested in engineering..."

"We need to get out and do a better job of getting more young people interested in engineering, and we need to show them how technology is changing how we all work,'' said Robert H. Luffy, the 2007 Metcalf Award winner and president and CEO of American Bridge Co. The Metcalf Award, named after the founding president of the ESWP, is a lifetime achievement award for significant contributions to engineering fields normally associated with western Pennsylvania. The award has been presented since 1963.

An aggressive competitor, Luffy has developed American Bridge into a global company whose profits are dependent upon relentless innovation. This University of Pittsburgh alum has set the company on a course to broaden its traditional structural steel skills, developing marine and concrete construction capabilities.

Industry peers say American Bridge is a vertically integrated construction, manufacturing, and engineering company that is the industry leader in technical capability, innovation and profitability.

Scenes from the 123rd ESWP Annual Banquet

Alex Sciulli congratulates Past President Michael Bock

Alex Sciulli and parents

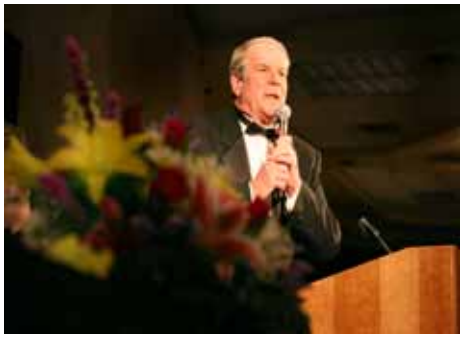
Robert Luffy and Alex Sciulli (r)

Guests browse the Silent Auction

Darlene and Bob Luffy

The ESWP Board of Directors, Brad Wolf, (foreground left)

The ESWP Executive Committee



Guest Speaker Richard Lederer

Chuck Russell (L) and Alex Sciulli

Luffy said tomorrow's engineering leaders must learn to change the nature of power and how it is employed. He said that business is already moving to create fungible modules around information networks, flexible work forces and webs of strategic partnerships.

"We need engineers to get into the backrooms where the decisions are being made,'' said Luffy. "We have to understand policy and globalization, and we need to stay involved,'' he said. "Leadership has never been more complex.''

Yep. Leadership used to be so simple. You had it or you didn't. It was in the cut of your jib.

But Luffy and his ESWP peers are calling for more engineers to step up to the plate and keep America from falling behind when it comes to technology and engineering education.

"...We need engineers to realize that we implement action, and we need to be at the decision making table..."

The American Society for Engineering Education reports that in 2004 less than 5 percent of the bachelor's degrees awarded in the U.S. – around 73,000 – were in engineering. China reports that in 2004 it granted more than 600,000 bachelor's degrees and other technical engineering degrees. While the number of engineers that China produces is debatable, statistics still raise questions. How can we entice more American students to study engineering? Where will we get those needed technical skills to stay competitive in a global marketplace?

Alex G. Sciulli, ESWP president and a senior vice president of corporate operations and real estate at Mellon Financial Corp., said the ESWP is developing a plan of action in conjunction with the Carnegie Science Center to reach 50,000 school age children over the next five years to pique their interest about engineering and science.

"We need engineers to realize that we implement action, and we need to be at the decision making table,'' said Sciulli, who also praised the ESWP staff for their excellent coordination and execution of the awards event and silent auction.

Michael G. Bock of Schnader Harrison Segal & Lewis LLP and a past president of the ESWP, said the Metcalf Award ceremony helps bring attention to the importance of engineering as a career.

Chriss Swaney with Harold Hall (r)

"This award ceremony continues to draw a wonderful mix of participants from so many important business and academic sectors,'' Bock said.

Harold Hall, a 1997 Metcalf Award winner, praised the ESWP for its tenacious dedication in recognizing engineering excellence. "It remains a rare privilege to be a member of such an organization, and we continue to attract top leadership,'' said Hall, owner of Hall Industries.

"I didn't realize how much impact I could really have as an engineer until I began doing design work for Hall Industries,'' said Matthew Bonacci, a 2006 engineering graduate from Carnegie Mellon University. "This awards event inspires me to think about striving for a Metcalf award some day,'' he said.

In addition to a night of accolades and leadership mantras, the ESWP guests were treated to the verbal wit and wisdom of linguist Richard Lederer. With crisp humor and some anecdotal tall tales, Lederer admonished his engineering audience to avoid unnecessary words and pompous frills so endemic to today's meaningless jargon.

"...It was simply a great evening, and we look forward to next year's event..."

"Good writing has an aliveness that keeps the reader reading from one paragraph to the next, and it's not a question of gimmicks to personalize the author. It's a question of using the English language in a way that will achieve the greatest strength and the least clutter,'' Lederer said.

Lederer said our natural tendency is to inflate and thereby sound important. He cheerfully reminded us all that we are all prisoners of the vicious language of everyday American commerce and enterprise: the corporate report and the interoffice memo or the bank's latest simplified statement? What father or mother can put together a child's toy – on Christmas Eve - or any other eve – from the instructions on the box?

"It was simply a great evening, and we look forward to next year's event" said Anthony M. DiGioia, Jr., first vice president of the ESWP and a 1998 Metcalf Award winner.

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Insights into Engineering and Engineering Education in Pittsburgh

by **Winston Erevelles, Ph.D.**
Dean – School of Engineering, Mathematics, and Science at Robert Morris University

Winston Erevelles

In recent years much attention has been focused on American competitiveness in the face of outsourcing and the global economy, the impending shortage of engineers in the United States that is in stark contrast to nations such as India and China that graduate five to nine times the engineers that we do, and the importance of attracting our youth into STEM disciplines when data from ACT's Educational Planning and Assessment System indicates that student interest in engineering has dropped from 7.6% to 4.9% over the past ten years. These are disturbing trends but they are not new – in fact, they have been in the making for quite some time now. As we grapple with these issues at a national level, it is important to examine these issues and their impact in southwestern Pennsylvania.

A recent study conducted by Robert Morris University in conjunction with Critical Competitive Strategies, reveals some interesting data about our region. Total engineering employment in the Pittsburgh Metropolitan Statistical Area (MSA) was 19,820 in 2002 and is projected to increase at a modest rate of 0.4% per year, to 20,550, through 2012 (Overall engineering employment is forecasted by the Bureau of Labor Statistics to grow only about 7% over the decade). This information from the Center for Workforce Information and Analysis at the PA Department of Labor, suggests that the number of newly graduated engineers entering the Pittsburgh labor market through the year 2012 will meet the forecasted demand for the region. While the overall level of hiring is projected to remain flat at about 475 per year, computer software engineering will represent the largest discipline of engineer hired. The other major disciplines hired include mechanical, industrial, electrical, civil, nuclear, and environmental engineering. Table 1 summarizes the forecasted demand – it is interesting to compare the openings due to growth to the openings due to replacement as retirement depletes the workforce.

Type of Engineer	Annual	Due to Growth	Due to Replacement	% Due to Growth	% Due to Replacement
Computer Software Engineers, Applications	81	58	23	72%	28%
Computer Software Engineers, Systems Software	75	60	15	80%	20%
Mechanical Engineers	59	1	58	2%	98%
Industrial Engineers	41	0	41	0%	100%
Electrical Engineers	28	-14	42	0%	100%
Civil Engineers	22	-4	26	0%	100%
Nuclear Engineers	20	-28	48	0%	100%
Environmental Engineers	17	11	6	65%	35%
Subtotal	343	84	259	24%	76%
All Others	129	-11	140	0%	100%
Total	472	73	399	15%	85%

Table 1. Average Annual Openings for Engineers in Pittsburgh MSA, 2002-2012

The data does not account for recent events such as the entry of Google or the increased hiring at Westinghouse in response to its recent contract award in China. These additions (or for that matter, departures from the region) will obviously impact the forecasts. The hiring patterns presented in the table were confirmed by the participants in our study, however, the numbers alone do not tell the entire story. The attributes desired of new engineering graduates and the realities of the work environment in the region reveal that employers are looking for more than sheer numbers – they need quality engineers with the right skills and preparation. Many of the employers that we interviewed indicated difficulty finding qualified engineers to meet their current needs.

Over the course of the study, RMU and Critical Competitive Strategies probed the environment at current area employers. Several common themes emerged in our discussions including:

•Doing more work with the same or reduced headcount. This requires employees to have high skill levels in productivity-increasing technology.

•Getting products to market faster.

•Teaming internally with other functional areas and outside with customers and suppliers to come up with a better product or service, with faster lead times.

•Integrating intelligent computer controls into machinery thereby allowing users to access essential information about operating conditions and maintenance requirements.

•Offering more engineering-based services after the sale.

•Adjusting to dynamic markets that require engineering to be highly flexible during the design process.

•Managing projects using skills that go well beyond computer planning tools. These skills include understanding the big picture, being proactive, and developing back-up plans.

•Navigating global markets that require travel, relocation, and an awareness of cultural & market differences.

•Requiring employees to be innovative and agile due to ever-changing technology and markets.

•Creating new products that fuel bottom-line growth.

This environment demands engineers with extended skill sets. During the study, participants were asked to rank the core capabilities that they seek in new hires. We used the competency gap analysis tool developed by the Education Foundation of the Society of Manufacturing Engineers to structure the dialog. Engineering fundamentals ranked as the most important capability and all companies interviewed stressed its importance. Next in importance were oral communications, teamwork and project management. Following on the heels of these were interpersonal skills, written communication, and customer interaction. Together these capabilities constitute the top tier of requirements. The second tier included a wider range of requirements that fell into three categories: the ability to think and solve problems with a broad business view, an international/global perspective, and technical knowledge including but not limited to product/process design and quality. The organizations interviewed also emphasized the importance of internship/co-op experiences. Interviews revealed that graduates from engineering schools in the region fell noticeably short in the areas of communications, teamwork, problem-solving, critical thinking, and strategic thinking. In some cases, these shortfalls have adversely impacted the bottom line through lower productivity of new graduates and the need for additional education and training.

"...Interviews revealed that graduates from engineering schools in the region fell noticeably short in the areas of communications, teamwork, problem-solving, critical thinking, and strategic thinking..."

Many engineering programs are aware of these issues and have sought to address them in different ways. At Robert Morris University, our educational model is based on small class sizes with personalized attention, full-time faculty teaching

the vast majority of our classes, hands on learning across the program, outstanding laboratories, the infusion of real world experiences and projects across the curriculum, a required internship program, and strong advising/mentoring. The RMU engineering experience seeks to build an understanding beyond traditional curricula. Each engineering graduate must also complete our award winning communication skills program and demonstrate proficiency in core business subject areas.

However, filling the science, technology, engineering, and mathematics (STEM) pipeline entails more than degree programs at the university level. What is needed is an extensive, coordinated, and sustained outreach initiative aimed at middle and high school students and teachers, their school systems, and the community at large. The Pittsburgh area offers numerous academic and community-led initiatives targeting these audiences with strong support from the philanthropic community. Robert Morris has been involved in such outreach activities dating back to 2001. Most recently, we have received a two-year grant from the Benedum Foundation for an outreach project to promote STEM education at the middle and high school levels. Aimed at reshaping the way young people develop interest in STEM careers by providing middle and high school students and their teachers with skills and career knowledge through hands-on experiences, the outreach program will include programs for educators, residential summer camps and school year workshops for middle and high school students, and a conference for women in STEM careers.

"...What is needed is an extensive, coordinated, and sustained outreach initiative aimed at middle and high school students and teachers, their school systems, and the community at large..".

These are exciting times that bring change, challenge, and opportunity to our landscape. This is our reality as a community and as a nation. We need to acknowledge and confront this reality while implementing initiatives at all levels including policy-making and government, industry, education, and economic development, in order to remain competitive as a nation.

Engineering Science and Engineering Technology Education for the Modern Workplace

Mark Farrell

by Mark Farrell, Ph.D.
Chair of the Department of Natural Sciences and Engineering Technology and Donald M. Keller, Ph.D., P.E.
Coordinator of Electrical Engineering Technology at Point Park University

Young people seeking to pursue careers in the engineering enterprise find a broad range of opportunities available to them in the Pittsburgh region. With the appropriate education, they may work to deploy and support existing technologies, to develop and apply new technologies, and to investigate the fundamental principles of science and mathematics that underlie all technology. The traditional designations for these three career tracks—technician, engineering technologist, and engineering scientist, respectively—have historically set up definite job titles and areas of responsibility within engineering firms. Unfortunately, they also have tended in many cases to stifle creativity and collaboration while fostering an unwarranted perception that certain employees are "less important" or that certain jobs are "more prestigious" based on educational requirements or salary.

In today's leaner, more agile technology companies, enlightened managers realize that all employees on their technical staff must work as a team across the traditional boundaries separating technician, technologist, and scientist. Likewise, each employee on the team must be prepared to take on a variety of responsibilities that cross traditional boundaries: a research scientist is expected to have good hands-on laboratory skills while a technician may be called upon to do design work.

Preparing students for technical careers has always been a challenge, and the educational institutions of the Pittsburgh region have excelled at meeting this challenge. We have a large number of high schools that offer vocational training and engineering "tech prep" courses, excellent community colleges and proprietary schools that grant associate degrees, and internationally-recognized universities and colleges that offer baccalaureate and graduate degrees.

Within this broad range of educational opportunities, the three technology career tracks mentioned earlier have traditionally staked out well-defined and mutually-exclusive areas: Technicians took vocational courses in high school followed optionally by a two-year program at a proprietary school or community college. Engineering technologists earned an associate or baccalaureate degree in engineering technology at a two- or four-year college. And engineering scientists earned a baccalaureate degree in engineering science at a four-year college or university followed, in most cases, by one or more graduate degrees.

Mirroring the workplace changes at today's technology firms, educational institutions (as well as their accrediting and regulatory agencies) have come to realize that traditional boundaries do not necessarily serve students well in preparing them for careers in our modern world. Students' educational backgrounds, the schools that they have attended, the content of the courses that they have studied, and the names of the degrees that they have earned are now of less importance than the extent to which they have achieved their educational objectives. The increasing use of outcomes-based assessment at all levels is an acknowledgement by teachers and administrators that students' achievement—as measured by their demonstrable knowledge and skills—is the central mission of education.

As the boundaries within technology education continue to blur, students, teachers, and practicing professionals alike may be confused by the variety of degree programs and institutions available in the marketplace. A common source of confusion is the differences—real or imagined—between Engineering Science ("Engineering") and Engineering Technology programs and between the colleges and universities that offer them.

"...Preparing students for technical careers has always been a challenge, and the educational institutions of the Pittsburgh region have excelled at meeting this challenge..."

From an educational standpoint, the measure of any undergraduate engineering curriculum is its accreditation by the Accreditation Board for Engineering and Technology (ABET). ABET accredits Engineering Science programs through its Engineering Accreditation Commission (EAC) and accredits Engineering Technology programs through its Technology Accreditation Commission (TAC). Most of the undergradu-

ate programs in the Pittsburgh region, including the Engineering Technology programs at Point Park University, have earned this coveted designation from their respective commissions.

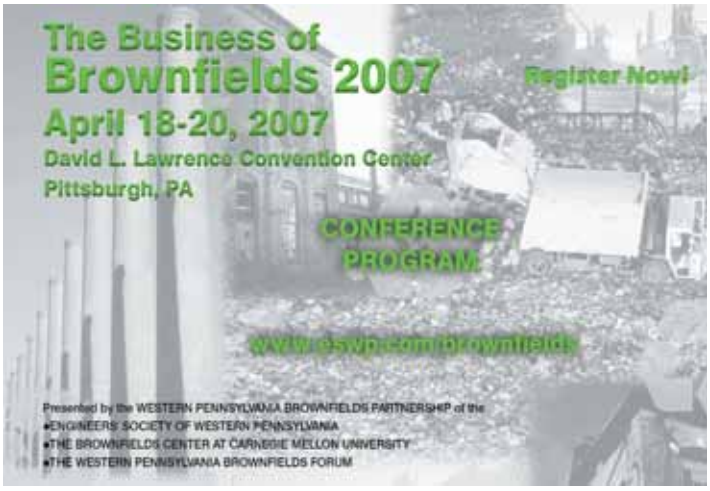
While earlier ABET criteria could have been—and often were—interpreted to confer higher status on Engineering Science, recent changes to outcomes-based criteria make clear that the two branches deserve equal status in the educational and workplace arenas while retaining subtle but real differences in their emphasis.

"...The use of outcomes based assessment...is an acknowledgement by teachers that achievement as measured by demonstrable knowledge and skills is the central mission of education..."

Under the current ABET criteria, both degree programs require a student to take a number of courses in basic mathematics and science and a number of additional courses in his or her technical specialty such as civil, mechanical, or electrical engineering. Throughout this coursework, Engineering Science programs emphasize a theoretical study of mathematical, scientific, and engineering principles; these programs typically prepare graduates to do research and development work and to go on to graduate school. On the other hand, Engineering Technology programs emphasize the practical application of mathematical, scientific, and engineering principles; these programs typically prepare graduates to work effectively in such settings as laboratories, factories, and construction sites doing product testing, development, and sales while still giving them the educational background to pursue graduate work.

From a regulatory standpoint, both Engineering Science and Engineering Technology degrees offer a graduate the opportunity to become a registered Professional Engineer (P.E.). In Pennsylvania, as well as many other states, students enrolled in baccalaureate programs accredited by EAC of ABET or by TAC of ABET can take the Fundamentals of Engineering (F.E.) examination during their senior year and accelerate their opportunities to earn the P.E. registration. Likewise, the designation of P.E. may be conferred on graduates of either EAC- or TAC-accredited programs following the required professional experience and a second comprehensive examination.

Both Engineering Science and Engineering Technology programs today are playing vital roles in the broad spectrum of technology education. With their new emphasis on outcomes-based assessment, they are preparing their graduates well for the more collaborative, team-oriented, and productive workplace that characterizes engineering firms in the Pittsburgh region and the world beyond.



Wednesday, April 18; 3:30 - 6:00 PM

NBA - PA Chapter Brownfields Boat Tour

Wednesday, April 18, 6:30 - 8:30 PM

Butler Room, Westin Convention Center Hotel

The "Business of Brownfields" Conference Opening Reception

Augie Carlino; Steel Industry Heritage Corporation, Barry Ford; Continental Real Estate and Pat Ford; City of Pittsburgh Director of Economic & Community Development will be discussing several of the developments that were viewed on the NBA Brownfields Boat Tour and what the future holds for brownfields redevelopment in Pittsburgh. This event is included in your conference registration, or available "ala carte".

Thursday, April 19; 8:00 - 8:30 AM

Room 407 at the David L. Lawrence Convention Center

Plenary Keynote Session: PA DEP Secretary, Kathleen McGinty

9:00 - 10:00 AM

Market 1 - Financing the Deal

The financing of brownfield projects has always been difficult. In this session we will discuss the constraints of traditional real estate lending for brownfield redevelopment along with ways to address these limitations. We will also take a look at several federal tax incentive programs that are playing an increasingly vital role in brownfield financing and how to creatively apply these programs.

SR 1- Groundwater Remediation Methods – Part 1:

This session will introduce several innovative technologies used for remediating significant groundwater contamination sites. Our speakers will discuss specific cases they worked on from the alternatives analysis through implementation of the selected innovative technique.

SC 1 - Sampling & Analysis: Deal or No Deal

The success of any brownfield redevelopment project rests on the validity of the site characterization data. This session will examine the state-of-the-art and current trends in field sampling methodologies and technologies; sample handling; analytical methods; matrix issues; reporting limits; data usability and other related issues. After the presentations, the panel will address questions for the attendees.The Proper Selection and Use of Innovative Sample Collection and Field-Based Analytics

Success 2 - What is Going on in Western PA?

This session highlights case studies with a common theme: redevelopment of small and large former manufacturing sites. The Pittsburgh area communities are dealing with the plight of Steel Industry in a positive fashion taking advantage of government grants, low-interest loans, and help from various State agencies and non-profit organizations. Coincidentally, the Presentations address various stages of a Project Life Cycle including: initiating a project, planning a project, executing a project, and finally, the closeout of a project where a once idle site is returned to productive uses.

10:15 - 11:30 AM

Success 1- Industrial Wasteland to Traditional Neighborhood Development - Revitalization Along the Delaware River

Revitalization along the Delaware River is the topic of this session whereby panel discussions address the following: helpful hints for approaching the redevelopment of a brownfields site, ways to obtain both financial and technical assistance from government agencies, lessons learned along the way, and how to manage risks or the unexpected during the project.

LR 1 -On a Clear Day Can You See Forever?

Dealing with the Future at Complex Brownfield ProjectsThe focus of this panel is how to deal with future challenges that will confront parties involved in brownfield projects that require long-term remediation or post-remediation care activities. The panel discussion will include provocative ideas concerning some of the historic pillars of contaminated site law and policy, as well as currently accepted tenets of brownfield transactions, that should be reconsidered and perhaps altered.

1:30 - 3:00 PM

Market 2 - Environmental Liability Transfers - Seller Considerations and Case Studies

This session will provide an overview of Environmental Liability Transfer (ELT) concepts from the Seller's perspective. It will discuss: (i) the basics of an ELT, (ii) issues that a Seller should evaluate when considering an ELT, and (iii) basic components and steps in the ELT. Two case studies from the Seller's perspective will be reviewed to demonstrate the concepts.

LR 2 - Site Specific Remediation Under Act 2

Act 2 provides considerable flexibility in the choice of cleanup standards. The "Site-Specific Standard" was generally designed to allow a remediator to leave higher concentrations if demonstrated through site-specific data collection to be within the acceptable risk range. This session will explore this often-misunderstood approach in the areas of pathway identification and elimination; risk assessments, deriving site-specific standards and evaluating remedial alternatives.

LR 3 - Brownfields Redevelopment - Real World Issues

Some brownfields are easier to develop than others. If the site location supports an acceptable return on investment, then there is motivation to tackle the impediments. It is the marginal, less attractive properties that require an innovative spirit.

SR 2 - Breathing New Life into Landfills

Thousands of abandoned and closed landfills litter the landscape. These landfills can be properly closed and redeveloped for a variety of purposes by applying the latest science and understandings of waste degradation and stabilization processes. A discussion of these non-conventional, "state-of-the-science" closure methodologies will be discussed in the context of complying with solid waste management regulations.

3:30 - 5:00 PM

PH 1 - Managing Corporate Environmental Legacies

In the not too distant past, it was difficult to get responsible parties to speak about potential contamination on the properties that they own and/or operate. In this session, we will hear from environmentally progressive corporations about the strategies that they use to manage environmental liabilities — well into the future.

SC 2 - Brownfields Research

In brownfield development, both location and timing are critical components of success. It is important, however, to step back every once in awhile and assess what is working and what is not working so that future development can learn from the lessons of the past. In this session, we will look at university-based research projects that reflect on collections of past case studies to develop recommendations for sustainable future development.

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SC 3 - What's up with Vapor Intrusion?

Vapor intrusion guidance combines legal and technical issues as a means of addressing one of the more ill-defined aspects of brownfield redevelopment. This presentation will consist of a discussion of the legal nuances of vapor intrusion and an examination of the major technical concerns and some of the often overlooked areas of this complex issue.

Success 4 - Benchmarking 10 Years of Phoenix Award Winners –

The Phoenix Awards were created in 1997 to recognize and honor groups that develop significant brownfields sites across the country. A number of these awards, as well as applicants, are associated with brownfields sites in Pennsylvania. This session looks back at how these sites have been transformed into productive uses that have benefited investors, small and large business owners, the communities, and governments. The session will include some "lessons learned" about what made these projects so successful, and how others can take the techniques used in these projects and apply them to current brownfield projects and opportunities.

Friday, April 20; 8:00 - 8:30 AM

Room 407 at the David L. Lawrence Convention Center

Plenary Keynote Session: Myra Blakely, U.S. EPA, OSWER, Washington, D.C.

8:45 - 10:15 AM

LR 4 - All Appropriate Inquiry

USEPA's final rule for conducting "All Appropriate Inquiries" (AAI) took effect in November 2006 for purchasers of real property to potentially claim one of the CERCLA landowner liability protections (LLPs). Four AAI experts will present information related to the history of developing the AAI process, its regulatory framework, real world issues in applying the current ASTM standard in meeting AAI prior to property acquisition, and continuing obligations associated with maintaining LLPs following property acquisition.

Success 3 - Interagency Coordination Shapes a Sustainable Future in the Keystone State -

Collaborative partnerships between various State and non-profit organizations are key in a successful acquisition and redevelopment of a brownfields site. This session contains panel discussions that address the need and benefits of interagency coordination during the life cycle of a brownfields project.

PH 2 - The Future of Land-use Controls

Landuse controls: what a great concept for balancing remediation costs and long term risk! But, how do we know what what alternative we should choose? Once we decide, how do we know if the implemented controls are working or not? And, finally, what are the roles of the government and private sector with respect to long term liabilities?

SC 4 - Vapor Intrusion Pathways

Vapor intrusion has been receiving much attention over the past few years. This session will explore the guidance documents created as part of a three year effort by the Interstate Technology and Regulatory Council (ITRC), the guidance related to demonstrating attainment of the Pennsylvania Statewide Health Standard, and some of the more difficult technical issues related to vapor intrusion evaluation. After a series of presentations, our panel of experts will turn their attention to questions from the audienceVapor Intrusion Pathway: A Practical Guideline

10:30 - Noon

SR 3 - Groundwater Remediation Technologies

This session includes experiences with groundwater treatment technologies involving multiple and innovative approaches. Lessons learned by application of these technologies are highlighted, along with specific case studies and results.

LR 5 - Allegheny County's New Countywide Riverfront Park

Waterfront properties are attractive to developers but also offer access to one of Pittsburgh's greatest amenities.

PH 3 - Old Properties - New Uses

Brownfields are assets in the communities in which they are located. All of the neighbors are stakeholders and therefore need to be involved in the development process. Successful development is based on team work, communications and the ability to make the development fit within the framework of the social, economic and landuse contraints and objectives.

Market 3 - PA Community Choices Initiative

Transportation infrastructure is a crucial component to the revitalization of former industrial and commercial sites. The session describes the current transportation infrastructure financing process and how brownfield projects can utilize transportation dollars to enhance projects. Additionally, the session will address several proposals that are under consideration across the state that will help align public brownfield and transportation investments in the future.Connecting Land Use with Transportation Investments

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Wednesday, May 2, 2007

Keynote speaker Robert Moses, Ph.D.

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James Musolino
Evelyn Quade
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High School Educator
Jason Lucia
North Catholic High School

University/Post-Secondary Educator
Sanjeev Shroff, Ph.D.
University of Pittsburgh

Entrepreneur
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