Citizen Engineers:

Why and How We Engage City, State and Federal Governments On behalf of Engineering Education and Research

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In her keynote at ASEE last year, our president Dr. Sherra Kerns challenged us to imagine an age of the Citizen Engineer – socially conscious engineers engaged in proactively tackling the enormous challenges that face the world today. How, through us, could ASEE become a critical player in solving the world's greatest challenges? For example, how could corporate partners advocate for funding needed for engineering education and research in ways that academia cannot? Where do we begin? Why? How? What do we know? What do we need to learn?

In our own membership are citizen engineers. Who are we? Several activist members who met at the last conference will share our answers to these questions.

Charles Pezeshki will share his experience as an engineer activist for the environment, including his successful campaign to save forests in the Northwest.

Lueny Morell will share her history as a professor at the University of Puerto Rico and now a director in University Relations for hp, with engaging the Puerto Rican government to proactively attract industry for research and development and to aggressively advance engineering education. She will conclude with recent successful efforts in engaging the government of Brazil as well as several Latin American inter-governmental agencies for the same ends.

Isadore Davis will share his experiences with the city of Tucson, the State of Arizona and the U.S. government in economic and workforce development and industry/cluster partnerships in K-12 and higher education.

Tom Roberts will share the curriculum for a legislative workshop developed for the KSPE (Kansas Society of Professional Engineers) on how to influence the state government on behalf of engineering and research, and some of the achievements of those who have been through this workshop.

I'm Barbara Waugh and I will share H-P's University Relations and Government Affairs partnership-strategy for influencing state and federal engineering education and research. I will summarize lessons learned and questions outstanding from these presentations and explore with my co-presenters next steps for these and other citizen-engineers.

First, we'll hear from Charles:

One of the problems facing contemporary society is the increasing growth in complexity and interconnectedness of problems. Governmental processes have also expanded to account for the difficulties faced by decision makers in balancing competing causes to achieve maximal societal benefit. Often, in the context of making such decisions, the public is invited to participate. The landmark National Environmental Policy Act (NEPA) of 1970 is a case in point.

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However, what most citizens find is that real participation is stacked against them. Successful airing of citizen claims usually requires legal support, and even if the various legal ramifications are understood by the citizenry, the dedicated individual then faces a barrage of government experts, ostensibly operating under the deference to the government—i.e. "the king can do no wrong." Such citizens can rightfully suspect that such experts are under strong political influence, and they often are, by higher level decision makers and political campaign contributors. There have been numerous stories of government scientists harassed for attempting to do their jobs, and such books as Science under Siege: the Politicians ' War on Nature and the Truth by Todd Wilkinson document this in ample detail.

One of the groups that actually have the potential for successfully participating in the public arena is engineers. Engineers routinely deal with large problems, and have excellent analytical skills. They are trained in working with interdisciplinary teams, and are taught to consider multiple options before selecting one for final work—a core idea embodied in NEPA. Yet engineers are rarely exposed to the notion of broader participation in a democratic society. If given the option, most faculties around the United States choose to add more technical specialization to a program of study, that often have a very short half-life with regards to an individual's career, instead of filling out the budding professional with an ensemble of "softer" skills, such as negotiation skills, or an explanation of how one participates in their government.

My own experience as a professor in engineering, coupled with work as a forest activist in my service and private life, illustrates these deficiencies in exposure in a profound fashion. I originally accepted the position I currently hold at Washington State University because of the opportunity for work at a Research I university, coupled with a lifelong love of the outdoors. WSU is closer to more federally designated Wilderness Areas and Wild and Scenic Rivers than any other university in the country, and that factored heavily into my decision to locate in Pullman.

Upon arriving at WSU, I looked around for a community that was actively involved in decision making on the various National Forests located in Idaho, which are only two hours away from Pullman. There were no affinity groups associated with WSU or the adjacent University of Idaho, located only eight miles away across the border. Instead, I fell in with an odd crowd of timber cruisers and ex-hippies looking at doctored timber stand exam data, and an assortment of university employees participating in the NEPA process attempting to stall the large-scale clear cutting that was the rule on the National Forests at that time.

The doctored timber stand data turned into the Phantom Forest scandal, which made its way all the way to the halls of Congress. Through intensive data analysis, the aforementioned individuals conclusively demonstrated that the U.S. Forest Service had cooked the books with regards to stocking levels of the Panhandle and Clearwater National Forests. In short, the data showed that the Forest Service was reporting old clear cuts—bare ground—as standing timber, in order to inflate the inventory and create

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a justification for an increased level of cutting. The actions taken by this group of individuals, including myself in a peripheral way, led to dramatic reductions in deforestation in North Idaho by the U.S. Forest Service.

Following this scandal, an unusually wet winter caused a massive series of landslides across the heavily roaded areas of the Clearwater, Nez Perce, and Idaho Panhandle National Forests—the three largest forests in North Idaho. The landslides were caused by a series of "rain on snow" events—where heavy, warm rains rapidly melt large deposits of snow, causing the extensive road network present on the landscape (sometimes exceeding 10 miles/ sq. mile of land) to come unraveled, blowing out whole sections of road into adjacent waterways, filling clear pools famous for their populations of native salmonids and chars with gill-choking sediment. Accompanied by a former fish biologist, a GIS specialist, and a couple of other activists, I made the compelling regional media case that the Forest Service had gone too far with building their road network, that it was scientifically and socially indefensible, and that the agency must have reform in the various funding mechanisms by which it built roads. This pioneering work led to a complete moratorium on road building on all the National Forests in 1998, which then laid the groundwork for President Clinton's Roadless Initiative, which was to date the one piece of regulatory reform of an agency receiving the most public comments. Through the work of the Heritage Forest Campaign, sponsored by the Pew Charitable Trusts, the Sierra Club, and others, over 1 million people responded, with an overwhelming percentage (95%) wanting no more roads built on the National Forests, and the remaining roadless areas protected as wild places for all time.

During this time I also wrote a book documenting the various grassroots activities that led up to these events, called Wild to the Last: Environmental Conflict in the Clearwater Country (WSU Press, 1998). I also developed a professional photography capability that I used to photograph many of these remaining wild places and build a case for their preservation. Though the work that I accomplished in service at the time while I was employed at the university went relatively unrecognized, the skills I built running media campaigns, litigating bad timber sales, writing books and working the political process has paid off immensely with my career. I am now the Chair of the WSU Faculty Senate, and am co-chairing the committee on reorganizing the entire academic structure of WSU. Under my direction, the Faculty Senate has made important gains in issues that directly affect faculty, such as improved rights for temporary faculty, working on securing pay increases, and promoting interdisciplinary work.

Equally, my success as an activist was predicated on the backbone of my engineering education, which taught me critical thinking and problem deconstruction skills that I use to this day. While I don't advocate that everyone pursue the dominant role that social activism has played in my life – the personal toll exacted can be painful— I do believe that my career demonstrates that a more well-rounded engineering citizenry has the ability to affect public policy for the public good. In fact, the many nights that I spent plowing through public documents convinced me that engineers naturally had the stamina to read lengthy technical documents and comment intelligently on them—one of the keys for participation in any public process.

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How might we educate the Citizen Engineer so that more of the profession believes in a broader public role? I believe the mechanisms necessary to do so already exist, with some modification, in current curricula. By working on reform of lower-division social science and humanities requirements, one could introduce more complex models of how engineers interact with society, and how politics actually works. With a more active learning model, students could be required to track public policy on local issues over the course of a year. By participating in the public process, government and the inevitable tradeoffs that happen in a democracy might be made more transparent. Send the engineering students to City Hall.

Additionally, a stronger emphasis could be placed on informal communication skills. While ABET mandates, and rightfully so, a large component of report writing and oral presentation, there is often little space in the curriculum for development of negotiating and public debate skills, as well as straightforward public speaking. Public persuasion communication, such as writing a press release, speaking to television cameras in the 30 second news clip format, is something wholly lacking in most curricula. Even an improvement on intimate communication skills would have a pay-off. I have watched my students, with my work in the Industrial Design Clinic I founded, struggle with the simple task of taking a project sponsor to lunch.

With appropriate emphasis, much of this work could be done without sacrificing the engineering core, or even displacing the introduction of advanced analysis skills students learn in the junior and senior year. In order for this to be successful, however, such skills have to be valued, and learned first by the professoriate.

Current issues, such as global outsourcing of engineering jobs, as well as understanding the ramifications of dealing with intellectual property, will require a politically sophisticated engineering cadre. Many of the problems facing the profession are no longer technical—they are political and social. Only by addressing such concerns straight-on can we expect to have our interests represented in the broader societal debate. In order to facilitate this, we must start teaching the appropriate skills in the classroom. And in order to do this effectively, we must learn them ourselves.

Next we'll hear from Lueny Morell:

I have given the subtitle to my section: ***From engineering to economic development: small steps to provide others opportunities in a competitive world.***

I joined the Chemical Engineering Department of the University of Puerto Rico Mayagüez (UPRM) campus in 1978, fresh out of graduate school. As the university is a land grant institution, its primary focus is teaching. Therefore, I dedicated most of my academic career teaching (later on I started my research career to finally ended up going back to teaching). Unfortunately, during my first decade, I was as unsuccessful as my former professors (now colleagues) were and my students were not learning as efficiently as I would have expected (taking into consideration the many hours of preparation and

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dedication to deliver the perfect lecture!). Given that the campus lures the best students on the Island, I was tremendously ashamed of my performance. Thus, my curiosity led me to start teaching myself about the learning process, teaching methodologies; outcomes assessment and other matters engineering professors usually do not care much about. And, lo and behold, things started to change! My students were actually learning more than their counterparts in departmentally taught courses [1]. By that time, unconsciously I had shaped what I now believe is my mission in life, which I passionately pursue in all dimensions (personal, professional, spiritual): to make a difference in other people's lives, no matter what it takes.

It was through knowing people like Rich Felder from North Carolina State and his wife Rebecca Brent, that I realized that by doing small things in the classroom, one can really touch the life of so many students and have them experience joy in the learning process (as opposed to the painful experience it is for many…).

Thus, in addition to developing the research scholarship of my career, I dedicated most of my academic life to share my teaching/learning experience with as many others as possible. And so, NSF, NASA and industry provided funding to three of the most important curriculum innovation projects in which I was involved. Thanks to NSF, the Alliance for Minority Participation project, which consisted of the main higher education institutions in Puerto Rico collaborating to substantially increase the quantity and quality of students receiving baccalaureate degrees in science, mathematics, engineering and technology (SMET) fields. As the director of the Curriculum Innovation Center for this effort, I created and managed a program to have SMET faculty around the island learn how to teach, focusing on the learner not the teacher. Among other activities, many faculty incorporated the use of cooperative learning in their classrooms with significant success [2]

In 1994, NSF sponsored the Manufacturing Engineering Education Partnership (MEEP) a coalition of three institutions (UPRM, Penn State University and the University of Washington in collaboration with Sandia National Laboratories and industry) to develop an undergraduate product realization/manufacturing engineering option the partners called the **Learning Factory**, an outcomes-based undergraduate curriculum integrating laboratory facilities and industry partnership. The Learning Factory was successfully institutionalized at the three partner institutions by 1997. Under the leadership of Al Soyster and John Lamancusa from Penn State, the program had a significant impact at UPRM, on its faculty, students and partners. I was fortunate enough to lead the curriculum development activity at UPRM and the system-wide outcomes assessment strategy.

One of the most significant impacts this program had was on participating faculty. The program seeded a change in attitude that encompassed how they view teaching and learning, and in how to go about course development and assessing outcomes. Faculty shifted its view on education from a faculty-centered activity to a student-centered activity, focusing on developing a program that had as a primary goal effective student learning. This, of course affected faculty teaching. The new paradigm catalyzed a

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different way of designing/developing courses and programs. It called for involving all stakeholders (students, industry, faculty, administrators) in the design phases, having to reach a consensus in defining the graduating engineer skills, his/her competencies and values, as well as the desired learning outcomes. To enhance the learning experience, courses had to include hands on activities, industry projects and other non-traditional experiences, which emphasized skills development, like teamwork, ethics and effective communication. Students had to learn to not only solve a problem in teams, but also define and characterize the problem, to build a prototype, write a business proposal and make effective presentations. Finally yet importantly, besides delivering content and knowledge in a non-traditional way, faculty needed to integrate student learning and program outcomes assessment, a new experience for them all. Thus, the 'seed' that was planted through the Learning Factory program germinated and expanded through the Campus promoting innovation of engineering and science education.

One of this program's legacies is the learning facilities that developed. Called the ***Learning Factory,*** these laboratory facilities, managed by the Industrial Engineering Department, have evolved significantly with industry support, most particularly from Hewlett Packard. As UPRM is a strategic partner for the company, it has provided support of UPRM education and research activities for over 20 years (98% of the local manufacturing plant engineers are alumni). In December 2002, HP upgraded the LF facilities to a real-life state of the art Surface Mount Technology (SMT) manufacturing line, donating more that $2.4 Million in equipment with partners. The $2.4 Million SMT production line which includes $400K donation from Solectron, Puerto Rico Storage and Distribution, Fuji America, and Precision PCB Products will offer services to local companies in the electronics manufacturing sector. HP University Relations matched the grant with two high performance server clusters.


Model Factory at UPRM

The facility, now known as the ***UPRM Model Factory***, aims at providing students with an exemplary manufacturing experience in terms of quality, delivery, continuous improvement, and productivity. Students begin their experience by attending a Printed Circuit Assembly course, which recruits students in their third or fourth year (UPRM has five-year engineering programs). These students are then recruited to work in the Factory for pay and credit. After the experience, students participate in summer and Coop internships at companies in the electronics sector.

Learning Factory at UPRM

The Learning Factory curriculum has served as a model and benchmark to design and implement other multidisciplinary programs at UPRM [3]. Most notably are the Remote Sensing/GIS (which I led for 5 years) and Industrial Biotechnology (which is currently being led by former NASA PaSCoR faculty, Dr. Rosa Buxeda) programs. In 2001, the Industrial Biotechnology Program was re-engineered to follow the Learning Factory model. The program has a strong industry board with representatives for major biotech companies on the island, investors and government officials. As part of the hands-on

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learning experiences, undergraduate students are required to do a summer internship. One of the most significant outcomes of this program is the placement of almost 50% of its graduates in graduate school. As a result of the program's success, two biotech giants, Amgen and Eli Lilly, have made UPRM investments in the thousands of dollars to establish the Biotech Learning Center. The outstanding human resource capabilities of UPRM have contributed to make Puerto Rico attractive to these kinds of investments.

Where else has this project had an impact? Most definitively in the College of Engineering accreditation process. Ever since the approval of the new Accreditation Board for Engineering and Technology (ABET) Engineering Criteria (EC 2000) by the Board of Directors of ABET on November 2, 1996, and its mandatory application as of Fall 2001, educational institutions across the United States have had to assess and evaluate their undergraduate engineering programs from a different perspective. That is, ABET EC 2000 was designed to employ the philosophy and practice of continuous quality improvement to engineering programs. Engineering Criteria 2000 call for each engineering program to identify its constituencies and, based upon their feedback, to formulate the services that each program will provide. The first step is the development of program educational objectives – statements describing expected achievements of graduates in the early years of their careers after graduation as a result of their educational preparation. Usually, educational objectives are expectations of graduates' performance after they have left the school and been in the workforce for three to five years. Subsequently, the second step requires the more specific definition of program outcomes – skills, knowledge and behavior that would be expected of students at the time of their graduation. All this requires considerable time and effort, not only to clearly define the program educational objectives and program outcomes, but also to develop proper and continuous assessment methods and tools, the documentation, the processes, and the necessary culture and philosophy changes that would be introduced as a consequence of the cyclical processes.

It so happens that I, as special assistant to the Dean of Engineering, led UPRM's College of Engineering ABET 2000 accreditation strategy (www.abet.uprm.edu). And therefore, the process was based on the Learning Factory experience. The strategy incorporated the outcomes assessment plan and assessment tools developed by MEEP and PaSCoR. The College of Engineering realized the significance of EC 2000 early on and undertook planning and organizational steps fully four years prior to the actual site visit. All six of the College's undergraduate programs were evaluated during November 2002. Success of both the curriculum and the assessment process are best described by this ABET accreditation visit team comments: *"The institution's systematic and innovative effort to introduce the culture of outcomes-based assessment to the College of Engineering community is especially noteworthy.*" [4].

But the Learning Factory has gone beyond Puerto Rico and has had an effect in US and Latin American Schools. As early as in 1997 while the MEEP project was coming to an end, the UPRM team knew that it had to disseminate this model program to other faculty and institutions. Thus in 1998 UPRM received two dissemination grants from NSF's Engineering Education Action Agenda and Raytheon Company, which was later,

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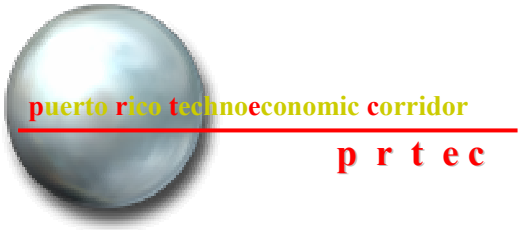
matched by Microsoft Research and more recently by Hewlett Packard. More than 35 ½ day, 1 day or 1.5 day workshops have been offered nationally and internationally to hundreds of faculty and deans many of whom adopted or adapted this model program to some extent. The workshops (http://www.ece.uprm.edu/lfw/) provide attendees the steps that helped MMEP and PaSCoR partnerships develop their programs. Outcomes assessment and accreditation strategies are also shared. Some of the sites where this workshop has been offered include:1998 & 1999 Frontiers in Education Conferences,1999, 2000 ASEE Conferences, 2000 SUCCEED-GATEWAY conference in Greensboro, NC, UTEP, Tennessee State University, Southern University, North Carolina A&T, 1999 ICEE Conference, Texas A&M - Prairie View, Polytechnic University - Puerto Rico, University of P.R. at Bayamón, Worcester Polytechnic Institute, 2000 ADMI Conference, Hampton University, VA, University of Chile; Pontifical Catholic University of Chile; University of Buenos Aires, Universidad Tecnológica Nacional, Argentina, and Universidade Estadual de Campinas, Brazil.

The impact the program has had in some of these sites has been outstanding. The most noteworthy example occurred in Chile, where the Engineering Deans Council decided to sponsor workshops to more than 130 participants nationwide, resulting in curricular reform supported by government grants and in which the UPRM workshop leaders are assisting faculty at the Universidad Federico Santa Maria in Valparaiso, Chile, Universidad de Bio-Bio, Chile, and more recently at the Universidad de la Frontera, Chile in their implementation efforts.

Now, what does innovating engineering education and measuring its outcomes have to do with economic development?

I mentioned earlier that I have a personal mission: to provide those around me better opportunities in life. Moreover, I am a systems person, that is, I look at the forest more so than individual trees. UPRM students were being recruited continuously by more than 120 multinational companies around the world. What could I do to open up investments in Puerto Rico and provide these kinds of opportunities locally?

Now I was facing the next crossroad of my life. The opportunity came quickly to my lap. Early 2001, I was appointed Director of UPRM's R&D Center, overseeing research and development activities on campus, including its technology incubator center. My first and foremost goal was to develop a strategic plan to increase R&D on campus that would be aligned with Puerto Rico's technology roadmaps (more of this later). As the center director and because of my involvement in engineering education innovation, I had the opportunity to visit other countries and learn of their knowledge-based economy strategies (most impressive to me the Hsinchu Science Park in Taiwan), which helped me understand the challenges Puerto Rico was facing.



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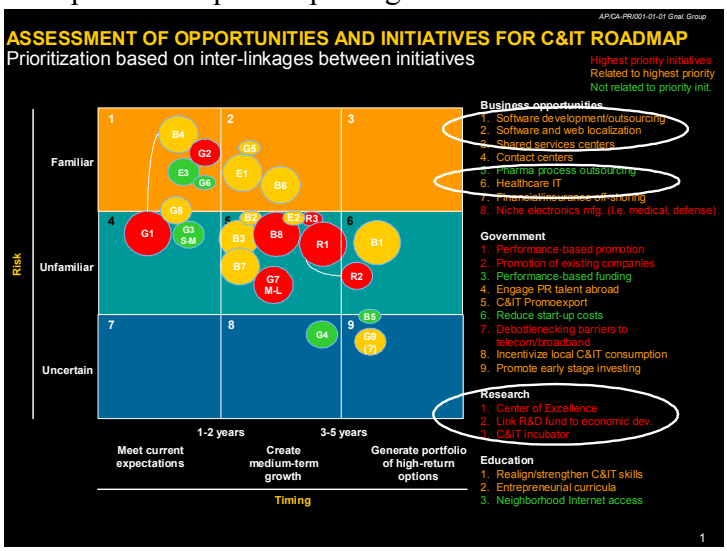
Simultaneously, a new idea was surfacing to enhance Puerto Rico's west coast economic development through a non-profit public-private sector alliance called the Puerto Rico TechnoEconomic Corridor initiative (http://www.prteconline.com). In collaboration with an extraordinary team of visionaries, I was instrumental in developing its mission, vision and strategies. This initiative allowed three sectors: government, private industry and academia, to leave their egos at the door and work together to enhance not only the business but also the ecosystem. Focused on developing technology clusters, PRTEC has been expanding its horizons and supporting various initiatives, including a technology incubator, the development of Las Americas Technology Park, a local airport and "Porta del Sol" Tourism campaign.

It was during this year that the Science & Technology Office of the Puerto Rico Industrial Development Company (Pridco) began a major effort to develop its technology roadmaps. Lasting more than 2 years, this effort which involved all sectors of the economy, provided me the opportunity to understand the strengths, opportunities and together with thought leaders, develop a roadmap to help bring Puerto Rico to another phase in its economic development history: from an agricultural economy to a manufacturing-based economy to a knowledge-based economy to be able to compete with its most fearsome jurisdictions: Singapore and Ireland. The Island decided to develop two roadmaps, based on its core competencies and strengths: Communications and Information Technology, and Lifesciences/Pharma/Biotech.



This is the framework and background with which I happily joined HP University Relations after a very satisfying 24-year career at UPRM. I felt comfortable with academics, with government officials, especially those in economic development and with the private sector. I understood very well the academic world, I had begun to understand both industry and government, and thus I was in a singular position of providing discussion groups insight from the three sides of the equation.

HP engages with the higher education community and leading academic institutions in many ways. From research interaction and student recruitment, to customer relationships and policy advocacy - numerous HP organizations and hundreds of HP employees advance the company's interests with higher education globally. University Relations, a unit of HP Labs, works to add value to these various company engagements. We cultivate close relationships with HP's academic partners and align trends in education with HP's technology and business directions. We articulate company positions in higher-education

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forums, manage strategic technology initiatives, build market presence with thought-leaders, and facilitate high-level engagement with partner institutions all over the world (http://hpl.hp.com/research/ur). Our mission is to deliver talent, technology and sales opportunities to HP by fostering university relationships worldwide that integrate investments in research, recruiting, philanthropy and public advocacy. It is the latter which has provided me with a challenge very much aligned to my personal passion.

So, in my new position at HP, I had the opportunity to continue to work with the government of Puerto Rico, where I am based, in multi-sectorial economic development strategies I was engaging in in my previous life.

A knowledge-based economy provides the foundation for a sustained economic development strategy focused on high-technology industries. Human capital formation and innovation provide the bases for a long-sustained wealth creation for any given country in today's strong competitive global interdependent world economy. Supporting research and development (R&D) and commercializing its results is absolutely critical to the industry's success and can increase the number of business formations. Industry's future is heavily dependent on a strong research and development base, collaboration among and between firms, and a constant need to innovate.

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The Department of Economic Development & Commerce of Puerto Rico, and Puerto Rico Industrial Development Company (PRIDCO) understand the need for the development of new world-class research organizations and mechanisms that can anchor and provide a magnet to attract significant talent and resources to the Island. Puerto Rico already has a large presence of multinational corporations within the life sciences industry, serving to attract more research to the Island. Puerto Rico also has the experience and resources in the University and non-profit sectors that enable promotion of research and development activities in the Island. The Commonwealth of Puerto Rico is aware of the need to undertake a comprehensive set of efforts to address the workforce, tax code, financing, R&D, commercialization, and industry facility issues that are important to young, growing corporations.

Thus, partnering with the government to help them develop a strategy was natural. HP was ready. On one side, the local HP site was already engaged in research through a $46 million grant which in two years had yielded 700 invention disclosures and more than 30 patents. Many research projects engaged UPRM faculty and students, bringing unsuspected new opportunities for the school (like Digital Publishing and Grid Computing) thanks to collaborations with HP Labs I was able to facilitate.

After one very successful visit I organized to benchmark Brazil's R&D legislation by Puerto Rico government officials, HP leaders and private investors, the Science and

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Technology R&D Trust Fund was created. This fund will very soon provide grants for both academic and industrial research around Puerto Rico's tech roadmap areas.

In the meantime, HP Labs took notice of what was going on in Puerto Rico and begun conversations with Government officials to consider partnering with academia to establish an HPL hub on the Island. In September 2004, the Governor of Puerto Rico and the Secretary of Economic Development signed an MOU to initiate the process.

My work makes me travel to many Latin American countries. In addition to bringing research and academic opportunities to the dozen schools we've selected to partner with, one of my priorities whenever I visit them is to meet with government officials and share my work in Puerto Rico. As a result, Uruguay and Puerto Rico have signed commercial and scientific collaboration agreements and its leading universities partnership agreements.

In another dimension, I am also assisting Chile, Argentina and Venezuela university-government plans in establishing their National Grids.

Based on my own experience, I am convinced citizen engineers are a critical, powerful force for good in the world. We must claim this role for ourselves, systematically begin to share our stories, strategies and lessons learned, and claim the venues in which we meet over the next year to advance this conversation and our collective strategy and impact.

And now from Isadore Davis:

Internally and externally, 21st century companies are advocating a synergistic vision and approach by deploying principles of diversity, teamwork and communication to develop great people and technology to improve their competitive advantage.

This system engineering approach has been very successful in dealing with community, state and national political, social and economic and workforce issues. For example, as an engineer, I have found that to engage in economic and workforce issues and solutions, the system engineering approach has served the process well by defining listening to the voice of the customer (community), defining requirements, analyzing these requirements, synthesizing and re-synthesizing and formalizing an approach. Simply put, defining inputs (parameters set by the user), conduction process (transfer function) to get desired outputs. Of course. Noise factors (parameters that can't be controlled) and controlled factors are also part of the overall system process.

As a citizen engineer in Tucson, I have used this approach to assist our community with its economic and workforce development initiatives and goals. For example, as former co-chair of the Greater Tucson Strategic Partnership for Economic Development Aerospace Industry Cluster, we undertook a project in supply chain management both on

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a local and state-wide basis to link the City Office of Economic Development, the Supply Chain Management Process, and the Arizona Department of Commerce (ADOC) to the private sector. Briefly, proposals were written and presented to ADOC that led to the Southern Arizona Industry Clusters being awarded a grant to proceed with the SCM program. This initiative led to the city of Tucson being awarded a U.S. Department of Commerce five year grant to develop a Supply Chain Management program which partnered with local companies, their suppliers and potential suppliers. Over $51 million were identified in the first stages of this program that was leaving our community as companies used vendors and suppliers outside the region of Southern Arizona. That is, outsourcing from our region. We also developed businesses a 'Statement of Capabilities' to assist in the Supply Chain Management process.

The engineering disciplines are excellent vehicles to get involved with community, national and global issues. Because we bring unique and diverse viewpoints to resolving complex problems, we should get involved in these issues of today and tomorrow. In my strong opinion, the systems engineering approach can be used to solve political, social, legal and economic issues and problems.

As citizen Engineers, we can use our education, training, leadership skills and abilities to assist our citizenry to achieve their educational and economic goals. We should use these talents to assist our community of human beings to improve their quality of life.

And from Tom Roberts:

Engineers by profession and especially engineering faculty immersed in a world of research and teaching are reluctant to be involved in the political process. Typically in the academic community, legislative matters are handled by the University President, Vice Presidents, the Deans (depending upon the institution – Deans are not a part of the legislative process), and sometimes faculty/student senate leadership. In the past, faculty, in addition to being reluctant, have been discouraged from participating in the political process.

However, in times of increasing student tuition and fees, declining support for higher education by state legislators, competition for research dollars, and shrinking political impact due to competition for funding between K-12, community colleges, social services, transportation, and miscellaneous funded / unfunded federal, state, and local government mandates, the need for the engineering community to participate in the political process is growing.

Politically, Universities are at a disadvantage in the state house. For example, in Kansas there are 7 Regents institutions (universities) and 19 community colleges. In addition, there are several private colleges and universities, technical colleges, and other "educational" entities competing for the attention of 20+ state senators and 200 + legislators.

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In addition, local and state governments are more and more focused on low cost bids for technical services rather than qualification based selection of engineering services. With declining populations, the retirement of long-term licensed city/county engineers, perceived "high/costly" (professional) salaries, and the difficulty in finding qualified/licensed engineers willing to replace the retirees; cities, counties, and states are hiring non-technical staff to handle what has been "traditional" engineering assignments.

In short, the engineering profession is getting lost in the political process. In Kansas, there is one legislator that is an engineer! Other states experience the same low-level of understanding of the engineering process.

As a result, university, industry, technical society, and government engineering professionals in Kansas have periodically conducted Legislative Process seminars for:

1. Student / faculty leaders of department/college professional societies
2. Practicing professionals interested in understanding & impacting the legislative process
3. Other faculty / students interested in the legislative process.

The objectives of the seminars are to:

1. Develop a basic understanding of the legislative process.
2. Learn the Local / Kansas / National legislative organizations and ways that engineering professionals are impacted by the processes.
3. Understand basic aspects of legislators (Who are they? Why do they vote the way they do?).

These seminars are usually ½ day in length, involve small group discussion, and include invited speakers. The invited speakers embrace: Deans, university legislative liaisons, current/former politicians sympathetic to engineering causes, engineering society lobbyists/executive directors, and others experienced in the legislative process.

In addition to legislative process seminars, it is important for engineering faculty to interact with practicing professionals. This insures better understanding of each other's often-disconnected workplaces and enhances the opportunity to communicate a "united" voice on key legislative issues. Legislators will hear a more consistent message and are likely to be more focused on fewer issues. In Kansas and Missouri, the Kansas/Missouri Societies of Professional Engineers (KSPE/MSPE), Consulting Engineers Council (CEC), and other technical society groups regularly interact. University relations committees meetings, board meetings, dinners, workshops, and continuing professional development seminars are examples of those interactions.

The bottom line: industry, university, and government engineers must work together to better understand the legislative process and related issues. All engineers, including engineering faculty must become more involved in thoughtful discourse with legislators and their staffs. These interactions are essential for the future of our profession.

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Finally, from me, and then a wrap up.

After graduating from the University of Chicago with a degree in theology and comparative literature, I became a full-time activist in the Peace, Civil Rights and then Women's Movements. I wrote the first feminist newspaper column in the country, became an equal rights investigator, an actress in the radical street theater movement, directed the most radical women's center in theological education, and did a dissertation in organizational psychology on revolutions and how they can succeed. I came to HP because I wanted to explore a hunch that the corporate sector was the most powerful underleveraged agent for change on the planet. Twenty years later I am still exploring, and am more convinced than ever that it's true.

At H-P I developed methods to surpass our unmet diversity hiring targets, both at the division level as a staffing manager, and later as the head of recruiting for the company. I organized others and together we turned around state legislative policy and the company's decision not to offer domestic partner benefits. As a personnel manager at HP Labs I pioneered a program that came to include a hundred projects aimed at making our industrial research lab not only the best IN the world, but the best FOR the world. Out of that work came our one mile 'Walk Through Time', a traveling environmental exhibit on the history of life 'from star dust to us' that has now been experienced by millions around the planet, and our e-Inclusion business, an initiative aimed at profitably bringing the benefits of the internet to the 4 B at the bottom of the economic pyramid. Based on my experience, I, like Isidore and Lueny, at Raytheon and HP, see enormous untapped potential for engineering education both in the U.S. and globally, as engineers in academia move the curriculum to serve the world, and as engineers in corporations invent for the world, and as citizen engineers advocate for k-16 in ways that the schools, colleges and universities cannot.

But just as industry-academic relationships need to move from sponsorship to partnership, so inside the corporation we will also need to change. Focusing on the U.S., a big change in hp occurred as university relations and government affairs, traditionally fairly silo'd functions, began to work more closely together. We have had 3 meetings between the two functions in the last year, and now have a liaison going both directions between the functions. As a result, University Relations has been solicited by HP federal government affairs for inputs to lifting the H1 visa restrictions, for insights into the outsourcing push-back; for behind the scenes lobbying against the reductions in the NSF budget; for membership in a regional nanotechnology initiative sponsored by regional congressional representatives; and for agenda items to go after in 2005. In all cases we have provided inputs from university partners to our company federal and state policy makers.

Work goes on at the state level in every state in which there is a major hp presence. In California, for example, University Relations is working with other corporate and non-profit members on the advisory board of the Center for Underrepresented Minorities at UC Berkeley to explore how we can more effectively deal with proposition 209, which

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prohibits any state-funded school from targeted minority outreach or admissions. A first step for us at HP is to engage with our state government affairs office to see where we stand and how hp might help California universities with living with or changing or repealing this proposition. A next step will involve tapping other corporate advisors to Berkeley to see how we might have a collective impact.

In addition to closer relationships between the functions inside the corporation for greater impact on engineering education, we also need closer ties between k-16 functions at different companies, on behalf of more influence and greater impact. Recently, our vp of university relations contacted his counterpart at 4 other companies, and together they offered a technology package to all winners of recent NSF grants who incorporated service learning into their reforms. It was very unlikely that one company alone would have stood up, in a timely fashion, to provide these packages, but together, it happened. The impulse to do so come from university partners working at curriculum reform along the lines of the new ABET criteria, including service learning.

Wrapping up:

Several themes emerge:

(1) The systems thinking of engineers offers powerful, unique contributions to solving complex problems;
(2) there is enormous untapped potential for urgently needed reforms, through engineering students, faculty and corporate partners;
(3) in the universities, needed are changes in engineering curriculum to cultivate citizen engineers;
(4) in the corporations, needed are closer partnerships and greater synergy between silo'd functions like university relations, recruiting, and government affairs;
(5) between corporations, needed are closer relations between companies on behalf of engineering education;
(6) at the asee level, needed is a move from sponsorship to partnership between the corporation and the universities on behalf of engineering education reform
(7) again at the asee level, to paraphrase an hp truism: if hp only knew what hp knows' we might say, 'if asee only knew what asee members know about legislative activism and reform…'. An implication is that we must find a will and a way to know….and we must continue this conversation and grow it.

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