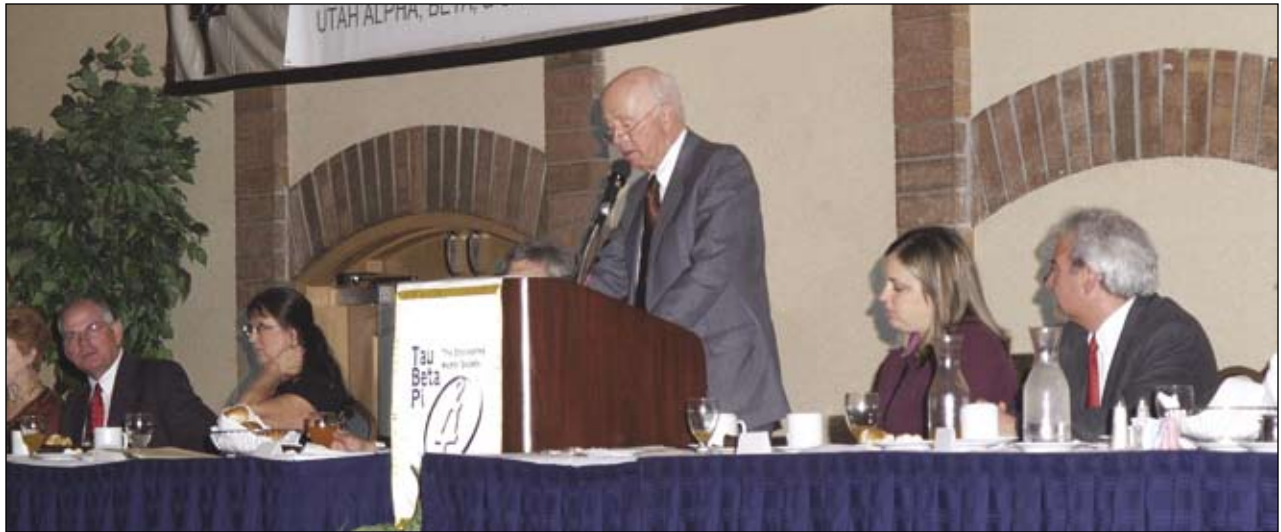


Challenges for Engineers

by Stephen D. Bechtel Jr., P.E., *Indiana Alpha '46*



In an historic moment for Tau Beta Pi, Stephen D. Bechtel Jr. addressed the 100th Tau Beta Pi Convention October 6, 2005, in Salt Lake City, UT:

I AM HONORED TO BE INVITED to join our nation's premier engineering students on the occasion of the 100th Convention of Tau Beta Pi. You have an interesting, constructive program organized for you here in Salt Lake City. Engineering offers you some very interesting and challenging years ahead.

You should take great pride in the professional path upon which you are embarking. Engineering has been pivotal in shaping this nation's industrial capabilities and making us the world's premier economy. More significantly, engineering's accomplishments over the past century have utterly transformed the world and greatly improved our standard of living.

Recently the National Academy of Engineering, in collaboration with the major professional engineering societies, selected the most important engineering developments of the last century and published a book about them, *A Century of Innovation*. A copy is available for each Tau Beta Pi chapter after dinner. It is a wonderful review of the most important engineering accomplishments of the 20th century.

These engineering achievements extend from the more notable today: computers, the internet, and what to us is commonplace, electricity. The list goes on to the airplane, water distribution, household appliances, travel in outer space, and on to some that don't as readily come to mind, such as agricultural mechanization and high-performance materials.

Unfortunately, and taken for granted, technological

innovation has become so commonplace that, regretfully, engineers are not appreciated and adequately recognized by our society for their contributions to our standard of living. Also I believe there is a lack of appreciation by most young people of the tremendous value of an engineering undergraduate education, no matter what alternative career one eventually might wish to pursue, such as medicine, law, or business. Half of Fortune 500 CEOs are engineers.

But all of that is in the past and the present. We should think and talk about the future. I believe that, without question, the future for engineering is bright. There are many exciting and demanding challenges ahead for engineers.

In the energy field, there are alternative/advanced electricity generation technologies. There is the move to the hydrogen economy. There is expanding energy availability with access globally, while minimizing the adverse environmental and social impacts.

In medicine, there will continue to be new medical testing and treatment equipment, such as prosthesis integration with the human neural system and medical application of nanotechnology to limit invasive treatments.

In the environmental area, there is the challenge of limiting or reversing the impact of human existence in an economically viable way. And there's moving the Third World toward a First World standard of living in a sustainable, environmentally sensitive manner.

But the future will have major complications. The nature of engineering, or at least engineering performance, is changing dramatically with challenging new technologies to be deployed in increasingly demanding environments—from sub-microscopic to mega projects and from the interior of the human body to the remotest regions of the world and beyond to the surfaces of the Moon and

Mars—and with competition and interaction on an increasingly global basis.

Of interest, Bechtel is completing the \$4 billion Nanhai petrochemical project in China. We are teamed with a British and a Chinese firm working for a client who is a Dutch-Chinese consortium. The project involved a total of 23 companies from 12 countries supplying equipment, materials, and services. Overall, about 50% of Bechtel's non-U.S. governmental work—measured both in revenues and job hours—is being done outside the U.S.

We have engineering execution offices in Canada, England, Australia, Chile, Saudi Arabia, Taiwan, India, and China. Other major U.S. engineering-construction firms with engineering offices overseas include Fluor, Jacobs, Washington Group, and Black & Veatch. We are increasingly competing against, as well as sometimes teaming with, Asian, U.S., and European firms for major international projects.

Further, globalization is not limited to the engineering and construction industry. You may know that Boeing has outsourced engineering and manufacturing of its 7E7 special composite wings to Japan and a portion of the fuselage to Italy.

GE has Jack Welch's "70:70:70 rule." That is: 70% of business processes, including engineering, are to be outsourced. Of this, 70% is to be sent offshore, and of this, 70% will be sent to India. And GE is also looking at India as a manufacturing hub.

After World War II, GM invested in Opel of Germany and began importing Opels into the U.S. GM is currently outsourcing \$120 million of auto parts and expects to increase this outsourcing eight-fold within three years. GM vehicle sales in China grew 27% in 2004 to a 9.3% market share, and the firm may shortly begin importing Chinese-made Buicks into the U.S.

IBM has major research, engineering, and manufacturing facilities in Europe, Asia, and South America. In early 2004 the company forecasted shifting 3,000 programming jobs to India, China, and elsewhere, but, interestingly, it also forecasted that U.S. hiring would outpace its hiring elsewhere in the world.

Other challenges, facing engineers of the future, in addition to globalization, economical sound environmental protection, and rapid technological advancement, are national security needs and an aging infrastructure.

So, what impact will these changes have on the role of U.S. engineers of the future and you as Tau Beta Pi members in particular? Despite globalization, I believe there will be more than enough work to keep good U.S. engineers fully engaged. Domestically, we must continue the technological improvements that will make us more productive and maintain our technological and economic preeminence. But more broadly, the rest of the world will need engineers to transform the global economy the way that U.S. engineering transformed the nation's economy in the 20th century. We American engineers can play a leadership role in this global transformation.

In order for us to do so, however, U.S. engineers must continue to be innovators, remaining out front on important new commercial technologies. We must retain the ability to pioneer "first of a kind" products and facilities. The National Council on Competitiveness stated: "Innovation will be the single most important factor in determining America's suc-

cess throughout the 21st century."

American engineers must be leaders. We must be able to manage and integrate globally constituted, multi-cultural teams that design and procure equipment, materials, and services internationally. We must continue to have the ability to see the big picture. That ability has been the hallmark of American engineers. It has enabled us to successfully manage extremely large and complicated engineering and construction projects and other complex developments any place in the world.

We must be forward thinkers, that is *visionaries*. More than ever, we must help to shape the issues and define the challenges that must be addressed, not merely detailing concepts developed by others.

We must be communicators and teachers. We must ensure that all segments of the public are aware that engineers are helping to shape this nation's industrial capabilities and that we are contributing to the world's economy, health care, and quality of life, and, in the process, we will be making engineering, as a career choice, much more attractive.

So how do you prepare for this new broader role? You must be technically competent, of course. But also you must be highly effective communicators, especially cross-culturally. You need to know the world and the other people who work in it.

You must acquire more interdisciplinary knowledge and continue to learn and improve throughout your career. You must have the ability to acquire new knowledge quickly and apply it to emerging problems. You must be open minded and objective.

You must be involved and committed to the interest of the public as well as to the interest of our profession. You must be persistent and tenacious. You must have integrity and discipline. And you must retain a sense of curiosity and wonder.

You face a very exciting and challenging future. America's ability to retain its technological and economic preeminence, in large measure, rests with you and other engineers like you. Your engineering education leaves you well prepared to take up these challenges, and in meeting these challenges you should benefit from a very satisfying and rewarding career. Have at it. Good luck!

STEPHEN D. BECHTEL JR., P.E., is chairman emeritus and a director of Bechtel Group, Inc., and of the Fremont Group. Former president of Bechtel during 1960-90 and chairman in 1973-90, he also served as chairman of the National Academy of Engineering, the Business Council, and the Conference Board, Inc. From 1967-74, he served as a member of six national committees under three U.S. Presidents.

Winner of the 1991 National Medal of Technology, Mr. Bechtel earned his bachelor's degree in civil engineering at Purdue University and a master's degree in business administration at Stanford University. He has received honorary doctorates from Purdue University and the University of Colorado. He received the 1980 Herbert Hoover medal and the 1985 Washington award from seven engineering societies for "his skillful, foresighted, and efficient leadership in construction engineering worldwide and for his dedication to the engineering profession and to education." He is a member of Chi Epsilon and the United Kingdom's Royal Academy of Engineering, a fellow of the ASCE and the American Academy of Arts and Sciences, an honorary fellow of the U.K. Institution of Chemical Engineers and Institution of Civil Engineers, and a former director of General Motors Corporation, IBM Corporation, and Tenneco, Inc., among other firms.