

ENGINEERS AND LEADERSHIP

I'm really pleased to be here today to talk with you. As a graduate, it is always a pleasure for me to visit the University of Mississippi and the School of Engineering. Ole Miss was and is a special place for me. Engineering has been a great profession for me. One that has been very rewarding. I'm proud of you and you should be proud of yourselves for pursuing an engineering education. As you certainly know by now, it's a challenging, difficult degree to obtain, but one that will serve you well.

Before long, most of you will enter the engineering profession. It is a noble calling. Here is a tribute to the significance of engineering offered by U.S. President Herbert Hoover in the early 1950's.

“It is a great profession. There is the fascination of watching a figment of imagination emerge through the aid of science to a plan on paper. Then it moves to realization in stone or metal or energy. Then it brings jobs and homes to men. Then it elevates the standard of living and adds to the comforts of life. That is the engineer's high privilege.

The great liability of the engineer compared to men of other professions is that his works are out in the open where all can see them. His acts, step by step, are in hard substance. He cannot bury his mistakes in the grave like doctors. He cannot argue them into thin air or blame the judge like lawyers. He cannot, like the architects, cover his failures with trees and vines. He cannot, like the politicians, screen his shortcomings by blaming his opponents and hope that people forget. The engineer simply cannot deny he did it. If his works do not work, he is damned.

On the other hand, unlike the doctor, his is not a life among the weak. Unlike the soldier, destruction is not his purpose. Unlike the lawyer, quarrels are not his daily bread. To the engineer falls the job of clothing the bare bones of science with life, comfort, and hope. No doubt as the years go by, people forget which engineer did it, even if they ever knew. Or some politician puts his name on it. (My comment, as in Hoover Dam.) Or they credit it to some promoter who used other people's money. But the engineer himself looks back at the unending stream of goodness which flows from his successes with satisfaction that few professions may know. And the verdict of his fellow professional is all the accolade he wants.”

These are inspirational passages for us. But, I take issue to some extent with President Hoover's last sentence. You see, I and others, believe our profession needs to rise to another level. I'm going to call on you, as you enter our profession, to be leaders outside

the immediacy of your professional work, to lead and contribute to society through public debate and community involvement.

So, I'm going to talk to you today about engineers and leadership. But before we get into what I have to say, we are going to have a short quiz first. This one time you probably thought you wouldn't have to deal with a quiz – but, we are going to have one anyway. Participation will be voluntary and there won't be a grade. Let's see how we do.

Question: What percentage of the members of the U.S. Congress (Senate and House of Representatives) are lawyers?

Answer: Approximately 70 percent

Question: How many of the 535 members of the Congress are professional engineers?

Answer: Three. That's less than one percent.

Question: How many of the approximately 5,000 seats of state legislators in 1995 in the U.S. are held by engineers?

Answer: 35. That's also less than one percent.

Question: In the Mississippi State Legislature this year, how many members are engineers?

Answer: Only one out of 174 seats.

OK, if you noticed, everyone who participated in the quiz got a reward whether they had the right answer or not. I want to emphasize that there are rewards just for participation. According to a bumper sticker, "The world is run by those who show up." We'll talk more about that later.

The Need for Leadership

The point of all this should be obvious to you now. The world is not run by engineers. If it is run by any one profession, it is run by lawyers. The problem with this is that lawyers are trained to keep things from happening and engineers are trained to make things happen. How many of you have parents or brothers or sisters who are lawyers? Well, I am not here to bash lawyers today as is so popular right now – in fact, I admire lawyers to the degree that they do take leadership roles and they are very involved in all aspects of our society. We, as engineers, have a significant problem in that regard. We're not "showing up." As I'm going to discuss further in a minute, now is the time for us to begin to assert ourselves.

In his inaugural address a few years ago, Chancellor Khayat said, "The laptop may be to this age what the textbook was to ours." More and more technology is going to be involved in all issues. Involvement from technically trained professionals – including engineers – will be necessary to make informed decisions in all aspects of society.

John Sununu, an engineer, was Chief of Staff for the first President Bush and also Governor of New Hampshire. Interestingly, he was an Associate Professor of Mechanical Engineering and Associate Dean of the College of Engineering at Tufts University. Mr. Sununu made a speech entitled “Engineering and Human Welfare” to the National Academy of Engineering symposium. I’m going to use some of his remarks now.

It is clear to engineers and scientists, and even to those who do not have that kind of education and training, that science and technology – engineering – not only continue to play a role in improving quality of life, creating jobs and providing opportunities for individuals and countries, but also are critical to developing and implementing policy at the national and international level. In some cases, the linkage between technology and policy is rather clear and in other cases it may be a bit more subtle. But the fact of the matter is that virtually no major decisions made by world leaders today can be made without at least a constructive participation on the part of those who can help sort out the difficult technical issues related to virtually any given topic including arms control and international trade. All aspects of public policy that deal with economic progress and potential and the reality of peace are clearly dependent on technology.

Mr. Sununu stresses this point because he is concerned that engineers in general have been negligent in their direct participation in the process of shaping and implementing public policy. In a sense, it is a luxury that the engineering profession can no longer afford. It is a luxury to focus on the fundamental aspects of a profession without having to carry out the ancillary responsibility of interacting with those who are outside of it. It is a luxury because it allows us to say we will not participate in the difficult public debates that must take place. As a profession, and as individuals within that profession, we have an obligation to be more active in that tough arena of making local, national and international choices.

Rich Weingardt is a civil engineer by training. He is president of Richard Weingardt Consultants, in Denver Colorado. Rich Weingardt served as president of the American Council of Engineering Companies (ACEC). ACEC, one of our many engineering organizations, is composed of engineering firms in private practice throughout the United States such as our firm, Neel-Schaffer. The purpose of the Council is to focus on the political and business aspects of our profession. I’m now going to use some remarks made by Rich Weingardt who is a real advocate for turning engineers into leaders. Engineers go out and make other people’s projects run, but we do not run them. Other people – politicians, lawyers, business and community leaders do that. They make the policy decisions. These people are leaders and they control things but they hire us to make sure these things work. We definitely need to change that state of affairs. We need engineers as leaders in society and the only way to do that is to have engineers really get involved in the “big picture” - the broad and general societal issues that are the basis of leadership.

Engineers cannot afford to sit on the sidelines while others shape our physical environment and public policy. By virtue of our training and experience, we are better

qualified to apply innovative problem solving skills in the public arena. Getting involved in government enables us to take the lead in addressing critical quality of life issues facing American communities: crumbling infrastructure, environmental and economic decline, public transportation, hazardous waste and security.

The profession of engineering – indeed, the world at large – has reached a fork in the road, and it is time for engineers to take action.

The first step is for more and more of us to get out of our shells and join the public debate, becoming community leaders influencing public policy and direction. The world is too dependent on engineering to leave it totally in the hands of those who are technically illiterate. As many engineers as possible must take on leadership roles, not just in this industry, but in our communities and in society – at the table where far reaching decisions are made. We must become advocates for the wise investment in infrastructure and plans needed to deal with our environmental problems. We must determine how we can sustain development on this planet so that future generations will not suffer.

To position ourselves to accomplish these things, two significant changes have to occur within the engineering ranks. First, we need to broaden our perspective and become citizens of the world. Second, we need to become more visible and outspoken about engineering and its impact on our communities.

Interpersonal skills, which are often difficult for engineers, are just as critical as problem-solving skills. An engineer's skills in the problem-solving process can be adapted to public service. It is important for engineers who understand technical issues to assist with public policy in the problem-solving area and also to demonstrate to the public that engineering is truly a profession, not just a technical trade. We can elevate engineering in the eyes of the public by learning about and speaking out on public policy issues and by being involved in the legislative process and the community as a whole. America needs our talent and leadership now.

Ours is a wonderful profession. We make dreams come true and help protect everyone's standard of living and quality of life. My concern is that we might be thought of and treated as technicians whose services are selected by low bid. My challenge is that we take leadership roles in identifying the needs of the future and being involved in setting the important agenda for society. In short, everybody already knows that engineers know how to make things run, we need to show the world that we can run things, too.

What is leadership?

For his book, "Leaders," Warren Bennis spent several years interviewing and studying leaders. Bennis said the following about leadership: "It is not a rare skill – leaders are made not born. They are not necessarily charismatic, (there is hope for the engineer yet), leadership does not necessarily exist just at the top of an organization, and most important, all leaders have strong people skills and can communicate and motivate their

followers.” Engineers tend to make great managers, but have limitations when it comes to leadership roles in society. As Samuel Florman, author of “The Introspective Engineer” and “The Civilized Engineer” says, “One of the failings of engineers is they overestimate the power of logic and underestimate the power of emotion.” For example, he notes you can not simply convince people of the safety of flying or nuclear power only by quoting statistics. You must reach them emotionally as well.

Why Engineers?

Engineers bring to the policy-making process a great capacity to solve problems. There are not many problem-solving professions in this world, and unfortunately, most professions involved in policy making are not part of that set. The fact is that engineers have been reluctant to get in and mix it up with the lawyers and others in the process. Engineers have not just the right to do so, they have responsibility to do so.

Sununu thinks the engineering profession brings a sense of balance, a sense of what a problem’s solution should look like and a sense of moving toward results that can achieve the goal rather than merely being something that people can talk about.

Another quality that engineers bring to policy making is an intuitive understanding that there is a true difference between those solutions that are valid in the ideal world and those solutions that are valid in the real world. The biggest problem in policy making today is not understanding that distinction. No other profession better understands that its integrity, its quality of performance, is measured in the real world. If you design a car, the consumer will tell you whether it works or not. Remember President Hoover’s remarks. Engineering is, as a profession, sensitive to what has to be done to achieve a result and sensitive to the reality that engineering performance will be measured in the real world.

Developing Leadership Skills

Engineers are educated and trained not to make decisions without all the facts. And, in many situations, you never get them all before you need to make the decisions – in politics for example. In these cases, judgment is crucial and engineers are educated narrowly. We must consider ways to broaden our perspective and stretch our imaginations. We must hone our natural talents and leadership. We should take classes or seminars in communications, public speaking, and writing. Whatever may be stopping us from speaking out, we must overcome in whatever way we can. Somewhere, we need to develop an understanding of history, geography, political science, psychology, literature, economics, and the arts and become experts on something outside of engineering. Once we look like leaders – dress, walk, talk, write, think, and act like a leader – we are ready!

For what? I suggest Engineers get involved in the following four areas:

- Community/civic organizations. Chambers of Commerce, neighborhood building committees, planning boards or even service groups. Like Kiwanis or Lion's Club.
- Education. School boards, college advisory boards.
- Politics. We must get government and legislation out of the hands of lawyers and professional politicians. Interact and communicate with government officials. Serve on public boards and for goodness sakes, consider serving in public office.
- Public Communications. Engineers should become spokespersons for the engineering profession and get the attention of the media. We should not limit ourselves to engineering problems. After all, engineering affects everyone's way of life. – clean drinking water and safe highway to name two.

Engineering Education

I received a Bachelor of Science and Master of Science in Civil Engineering from The University of Mississippi. There is always great debate about the quality of engineering education at various universities throughout the country and even within our own state. I have practiced engineering for over 30 years and I can say without reservation, the technical education I received here has never failed me. It has enabled me to meet every technical challenge I have encountered. So, you are getting an excellent technical education – one that will serve you well.

On the other hand, I can also candidly tell you that my college education did not prepare me adequately for the most challenging situations I have faced in my career. These challenges were not technical ones. They involved finance and economics, communications, human relationships, marketing, and politics. The University of Mississippi teaches all of these things very well; however, they were not included in my engineering curriculum.

For my Master's Degree, I took courses that involved such topics as Non-Linear Structures and Dynamics of Foundations.

I can tell you that I have never used for one minute a single thing that I learned in any of those two courses. It's not that they were not taught well or that they are not relevant. Certainly for some people in their engineering career paths they would be relevant – but, not for me. However, I was very fortunate in graduate school in being able to teach classes for two semesters. What a wonderful experience that was for me. It taught me how to organize material, think on my feet, and deal with questions from students. It also taught me something about human relationships in dealing with problems that came up with certain students.

The thing I dreaded most in getting a Master's Degree was that I had to do research and write a thesis. However, that was also a wonderful experience and one that has served

me well. It again taught me how to organize material not for oral presentation, but for a very detailed written report. It taught me how to write clearly, concisely, and correctly. It taught me a lot about the problem-solving process in doing research. So, those two experiences, teaching and writing a thesis, were probably the most beneficial educational experiences I received in my entire engineering education. In short, they taught me how to think, read, write, talk, and deal with people. Things that have been the focus of my professional career for quite awhile.

A bipartisan group of more than 120 members of Congress, top business executives and leading educators recently proposed an action agenda to enhance U.S. economic competitiveness in international markets. One of their recommendations was: Require a broad education for college students. Engineering education should include a greater emphasis on the liberal arts.

At the installation of Chancellor Khayat several years ago, Father Malloy, President of Notre Dame, emphasized in his keynote address that college education should include a sweeping curriculum for professional students. The specific things we teach to professional students tend to get outdated quickly today. Universities should teach students things that encourage a life time of learning.

Stuart Walesh, author of “Engineering Your Future”, states that the root cause of the lack of leadership problems we engineers face is the way we educate engineers.

A report published by the Association of American Colleges charges that engineering students receive an incoherent and inadequate liberal arts education. Undergraduate engineering students may be well trained, but according to this report they may not be so well educated. Liberal Arts courses, in short, largely define the engineers’ opportunity to acquire the knowledge, skills, and habits of thought necessary to learning throughout life. According to the study, a balanced curriculum should embrace liberal education not as an afterthought, but as a vital component of professional study. It is not well enough that tomorrow’s engineers be well trained, they must also be well educated.

Many observers believe a BS Degree in engineering is inadequate academic preparation for a professional career. It is interesting to note that, in surveys of engineering graduates, recent grads wish they had taken more technical courses in college. After ten years of experience, they regret not getting more schooling in business and management. After 20 or more years, they are likely to say they wish they had studied more literature, history, art and philosophy.

Walter Moore, Jr., professor of the endowed Thomas Bullock Chair for Leadership and Innovation at Texas A&M, believes engineering education should be modified to be more in line with the schools of architecture, law, and medicine – a four year undergraduate degree followed by a two-or-three-year professional degree in engineering. In his opinion, it would certainly turn out engineers much more in tune to the world around them, which is an advantage young architects and lawyers have over engineers.

Norman Augustine, former CEO of Lockheed Martin, remarked on this subject in his Centennial address that one needs more training to give his neighbor's basset hound a vaccination than one needs to design a structure upon which the safety of thousands of people depend.

Anthanasios Moulakis, who heads a special Humanities for Engineers program at the University of Colorado and author of "Beyond Utility" proposes that an engineer who has enjoyed a broad exposure to liberal learning and who has the opportunity to lay a solid foundation in the humanities, will be 1) a fuller and richer human being; 2) a better citizen; 3) a more useful, effective and successful person; and finally, perhaps surprisingly, a better engineer.

At an annual meeting of the Accreditation Board for Engineering and Technology, a few years ago, the major players were repeating the same message about engineering education – change. Speakers from every facet of engineering hold that in order to prepare for a changing and dynamic career, graduates will need, along with the solid core of technical knowledge, more training and development in several key areas:

- **Soft Skills** – New engineers need a strong base in “soft skills” such as communications, leadership and teamwork. Engineers need to learn communication skills not only for the company’s sake, but also for the benefit of their own careers. Engineers who can absorb and articulate non-engineering issues are of great value. Soft skills make the difference between stagnation and growth in an engineering career.
- **Generalist Approach** – Engineering graduates must learn to take a general, systems orientated approach to solve engineering problems. In order to identify and solve problems within a system, engineers must gain a broad view of how the entire system works. Engineers must be more aware of the outside world and take into account how their solutions will affect its users and the environment. Many companies are already giving their engineers responsibility for the entire process rather than just an isolated, technical part. AT&T Bell Laboratories uses a product realization process through which engineers bring a product from cradle to grave. Product designers must analyze a host of factors that influence their design such as cost, quality, customer demands and the manufacturing process. As you can see, a lot of these things have nothing to do with engineering or technical issues.
- **Changing Work Force** – Engineers must learn how to work in a demographically changing work force and to participate in a global economy. Sensitivity to and appreciation of different approaches and points of view are imperative in today’s work force. “I do not want every engineer who graduates to be exactly the same as everyone else.” says Stephen Bomba, Vice President of Technology for Johnson Controls, Inc. We try to recruit for talent, not position. As a result, some of the company’s top producers come from unconventional backgrounds. Although sensitivity to other cultures and points of view are important, it is also a

vital part of communicating and working with anybody. Diversity is something to be celebrated. Bringing a group of people with different ideas to the table and getting them all out is one of the best ways to solve problems.

- Lifelong Learning – Graduates must develop an interest in life long learning and an ethical approach to the work. An astonishing degree of technology has made its way into our lives – one may wonder, how is a poor engineer going to keep up? The answer is continuous education supplied not only by universities, but also by associations and even licensing boards.

Now, this has been a rather long and seemingly critical analysis of engineering education. All of you sitting here are pursuing a technical education. As I said at the beginning of this talk, you are receiving a wonderful education, one that will serve you well and one which you should be proud of. That is still very much the case.

Certainly I am not trying to be critical of the engineering education you are getting here. Actually, because of accreditation requirements, I doubt that the engineering schools have too much leeway in their curricula. I am one of those people who do firmly believe that engineering education should be broader in nature and include more from the liberal arts and business schools. Of course, being in private practice, that type of education would probably benefit me more than someone who went to work and designed airplane engines their entire career.

The last thing I want to do is burst your bubble. You may be thinking, so now that I'm getting my engineering degree, what does all this mean to me? Well, what I think it means is that your education is far from being over. For one thing, many of you may have the opportunity to obtain a graduate degree. I would suggest to you that it may not need to be in engineering for some of you. Why not consider a Master of Business Administration? Why not consider law school? Why not consider just taking some liberal arts or business courses at night once you begin your engineering career?

What about those soft skills we talked about a while ago? You can develop those by being involved in organizations and by taking an active leadership role in those that will force you to read, write, talk and communicate with others. Certainly, there are a myriad of engineering organizations in which you can begin to develop these skills. Broaden your perspective. Develop hobbies that, if nothing else, simply give you topics for conversations. Read. Travel. There is a world to be learned from traveling and I don't necessarily mean the Rendezvous in Memphis or Destin. Travel to different places where people, thoughts, ideas, religions, food and architecture are different. In short, make yourself into a well-educated, well-rounded person. It will serve you well both in your professional career and also in your personal lives.

Conclusion

There is nothing more gratifying than being able to make changes in important issues that affect the lives of many people. So, my plea is that we, as a profession, come to understand our obligation to the policy making process and communicate the need for that kind of participation. Moreover, I suggest that not to be involved is to miss something that is fun, worthwhile, satisfying, gratifying, and also absolutely necessary. This world will continue to become more complex and issues will continue to become more difficult to separate and resolve. And as that happens, the need for engineers to make their voices heard becomes more and more critical.

As Rich Weingardt says, we could be moving forward with many advances, if public support for them – like the Kennedy-inspired moon landing – could become a reality. We have the technology to send people to Mars, to construct a bridge between Alaska and Russia, and to make a supersonic jet transport superior to the Concorde. Likewise, we could substantially increase the output of America's energy from nuclear power, creating a steady stream of safe, non-polluting power for this country, as is being done today in Europe and Japan. But, too many organized groups in the U.S. resist it and will continue to block the use of nuclear power. Similarly, we could open new oil fields in Alaska or off-shore, but, there is public resistance to that as well. The engineering know-how is there, but not the political will.

The public must be convinced there is a need for (and willingness to fund) such things. And engineers should be leading the debate on whether any or all of them are beneficial to progress. Are they safe? What impact will their development, or lack thereof, have on quality of life. Some – maybe many- from our ranks are required to be in the thick of things, leading the public debate on these issues.

The more people hear what and how engineers think, the more powerful our comments and opinions will be – grassroots activities are the catalysts for many social changes. If we get involved in solving big picture problems, we can sow the course of history and control our own destiny. Society needs our talents and our problem solving skills.

As we begin the 21st century, engineers must lead their profession and society with a rich legacy of public leadership – a strong spring board from which to build a better world. The legacy of engineers is everywhere. Its destiny must be in leadership. So, my charge to you is to get prepared, get educated, be visible, show up and lead!