

Acceptance Address to the National Academy of Engineering
on the awarding of the Bernard Gordon Prize

Eli Fromm, Ph.D. - February 19, 2002

President Wulf, Chairman Fisher, Dr. Good, Mr. and Mrs. Gordon, members of the academy, colleagues, family, and friends it is difficult to find words to express the awe and humbled excitement that I feel in receiving this wonderful honor. For an immigrant farm kid who was so poor that college seemed out of reach to be standing here and receiving this crown jewel is more than I could have ever imagined; even more-so as its inaugural recipient.

There are many people to thank for their part in what brings us here tonight. Mr. and Mrs. Gordon for their vision and generosity. Members of the Academy, who together with the Gordon's, have shown the wisdom and vision to recognize and highlight creative, entrepreneurial, and "out-of-the box" thinking as it pertains to the engineering educational enterprise. I thank you not only personally but on behalf of the entire community for bringing this issue to such a high level on the national agenda. Raising the consciousness and awareness of what has been accomplished leads to visions of what can yet be done. It is ultimately through this educational system that we provide the world with the creative talent that drives the economic engine, the betterment of society, and enriches the human condition. Thus in the final analysis the encouragement and stimulus you have rewarded and highlighted is a gift to us all.

There are many others to thank as well. No work encompassing the magnitude of change we have undertaken could have been accomplished without the creative and visionary contribution of many others. I have merely been the conductor of a very multi-disciplinary, geographically dispersed, and culturally diverse orchestra. To my many colleagues at Drexel involved in the early aspects of this work through the E4 program, and especially the late Bob Quinn, I express great appreciation and a strong thank you for sharing the vision and being strong enough to cross traditional collegiate boundaries. As in the popular children's book, we were "The Little Engine That Could" and so became the kernel of something that has grown to be much greater. To my many colleagues in the Gateway Coalition I can only express my deepest thank you for sharing and shaping the vision and contributing your creative talents to an expanded initiative dealing with a broad array of issues. To the visionary leadership at the National Science Foundation, our institutions, and several corporate sponsors a warm thank you for providing the fuel that has fed the engine. I have learned much from working with so many talented people from such diverse institutional cultures. And, finally, thank you to my family and especially my wife of almost 40 years, Dorothy, who insists that I have given new definition to the phrase "I'll be leaving the office soon".

After 25 yrs. of interdisciplinary research in biomedical instrumentation, miniature implantable or ingestible sensors and transmitters I found myself in a position in the mid 1980's of taking a broad look at undergraduate engineering education. That look, and what followed, is what brought me here tonight.

During the decades of the 1950's through 80's the model of our undergraduate educational enterprise had become increasingly analytic and fragmented into a large number of independent

parts; at least to the student they seemed independent. There were those who desired to continually add new technical subject matter, without losing sight of the fundamentals, while others and national reports increasingly called for a more rounded graduate with the ability to function in the socially interactive, communicative, and business climate of modern industry. The exasperated simply said there was insufficient opportunity to "do it all".

We took that opportunity to consider a total restructuring and have evolved a model that does indeed do much more, is functionally more effective and time efficient while addressing issues much broader than curriculum alone. In the model, engineering is the centerpiece while strengthening the relationships to the physical and social sciences. The new structure also permits adding new dimensions such that the whole is greater than the sum of the former independent parts.

Engineering has been brought up-front integrated with the sciences, mathematics, humanities and social sciences into a holistic experience. Integration also provides the opportunity to link the societal and historical perspective while embedding the development of communication, and organizational skills. The inversion also opens opportunity for new approaches in the upper division whether it be greater depth, an introduction to technologies that are just on the horizon, or cross institutional student/faculty teams such as those who conduct concurrent engineering designs. Design, the essence of the creative process, has become a motivator and driver using the tools of mathematics, the hard sciences, and the social sciences to create something new or better. It pushes the higher order vision and creative thinking in our emerging engineering professionals. We merge synthesis with analysis as well as the abstract with societal centered practice. It excites the students, establishes a context for their studies, and gives them the opportunity to be creative and express a vision. In total this creates a student friendly and broad intellectual foundation for which the school of engineering takes leadership responsibility.

These underlying concepts making the professional discipline the centerpiece of the intellectual debate, without loss of the foundation, while interweaving career supportive issues are equally applicable to any professional discipline.

Beyond curricular content faculty are examining educational methods and how we teach as well as what we teach. They are using technologies to make the educational process more effective and rewarding while student professional development addresses not only communication, interpersonal, and team building skills but ethics and societal impact as well. These again are built into an integrated program such that they are dealt with in context and not as independent units of a disjointed program. Finally, our engineering faculty have defined succinct measurable objectives and outcomes with computerized student response data collected, analyzed and fed back for improvement.

Yes, there is indeed a significant and sustainable culture change taking place in engineering education and it has been a rewarding experience to witness.

One contributor to that culture change has been communications technologies, enabling our student and faculty connectivity. In the years ahead we will see even more global cross-institutional linkages. We will see further integration in our educational programs making it ever

more exciting, rewarding, and at the same time technically more intensive while intellectually broadening. As a result our students will be better graduates not only because of the access to far flung facilities but equally important is the intellectual maturity and broader cultural understandings that come from such linkages. Much of that will be technology enabled. Beyond our links across institutions nationally and internationally, envision, if you will, the day when the student (or a practicing engineer for that matter) will have sensory feedback at the keyboard while conducting a remote operation. The human senses can be important to the understanding of real operational characteristics of an experiment or development. Envision, if you will, the possibility of visual, touch, force, and maybe even olfactory sensory feedback from a remotely controlled engineering operation or product development. Or, think for a moment of a web repository, such as the one we are building, as just one of many content seeds for a fabulous digital library environment. Envision for a moment a student working with computer based modules developing solutions to an open ended engineering problem. As he or she works through several scenarios the names of important historical figures or events associated with the concepts, theories, and applications pop up. Now the student can digress for a moment and learn a bit about those individuals and periods. Furthermore, associated with each is a chain of historical, social, or industrial events that preceded, coincided with, or followed this leader's work; each with text, sound, and video to make the setting most vivid. Imagine the wealth of knowledge and worldliness, as well as technical understanding, that this student will gain through such self-driven integration. The evolution will continue as the vision and imagination of our emerging engineering professionals are further stimulated.

Thank you again for this great honor and for sharing this evening with me.