

The fourth recommendation is that argument: pre-college math and science education has to be dramatically improved in this country. That, I think, is a commonly accepted conclusion. It's particularly important to say that in engineering, however, because without the requisite math and science competence coming into the colleges, the student considering an engineering career is at a very extreme disadvantage and may not succeed. In effect the pool of possible engineering talent is constricted if you don't allow students the right kind of education in science and math before they enter college.

Another recommendation was made to develop a firmer factual base on which the issue of the quality of engineering education, and what might happen to it as a result of foreign presence, could be judged. We need more hard data. We also need more hard data on whether or not there is a difference between foreign engineering faculty and teaching assistants and native born faculty with respect to their performance in the classroom, their ability to communicate with students, their attitudes, and whether the foreigners are more likely to turn off women and minorities.

Finally, there is a need to examine more extensively the characteristics of engineering education and how it might be influenced by the increasingly important role that's played by foreign faculty. As I mentioned earlier, the issue of the character of that education raises fundamental questions and goes beyond just the foreign born questions.

Foreign Engineers--Implications for Transportation Engineering:
An Academic Perspective
by
Lester A. Hoel
University of Virginia

Judging from the composition of the panel, each of us is to respond to this issue from his own perspective: that of the university, the consultant and the state DOT. In preparing my comments for this session, I identified a few questions and then tried to answer them.

My first question as an educator is, "Why are we seeing so many foreign-born students in our engineering programs?" Note, this phenomena does not exist to the same extent in other professional fields.

Part of the answer is in the nature of engineering as a profession. In the United States this field has historically attracted the sons and daughters of blue collar workers, because it was perceived as an entry into the world of leadership and decision making, where scientific and mathematical skills coupled with understanding of technology, are the prime requisites for respect, financial reward and advancement. Engineering has traditionally been a "boot strap" route from the factory to the board room. It provided a route for an individual with little in the way of cultural and social advantages to practice professionally as an individual, or head a government bureau or a division in a private corporation. Other professions like law, medicine and business typically require more financial support and a greater number of years of education to be qualified, and often required a network of connections for admittance to the better schools and development of a successful practice. The culturally or economically disadvantaged had a much greater probability of success in engineering than in these other professional fields.

Today the disadvantaged blue collar worker's son or daughter (many from emigrant backgrounds) no longer exists in large numbers. This group is being replaced by bright foreign students who see the opportunity for "making it" in this country by pursuing an engineering career. The opportunity is further enhanced because most U.S. born undergraduates are electing to join the work force upon graduation rather than pursuing advanced degrees. Thus, places in

our professional transportation programs have become available that might not otherwise be there if a larger number of U.S. students pursued advanced studies. The foreign born continue to study because they know that in engineering, "knowledge is power," and if they out perform others in technical areas, there are no other mitigating qualifications that will limit them from being competitive.

While our U.S. students go elsewhere for higher salaries or decide not to pursue advanced studies because salary incentives are lacking, the foreign student continues, knowing that by so doing, job opportunities are assured and salaries will be more than sufficient, particularly in comparison with their home country.

The next question is, "What is the implication for our engineering programs?"

There are two major problems that exist when attempting to educate foreign-born engineering students. The first is deficiencies in understanding, expression, and communications, and the second relates to assimilation into a different cultural environment.

Because foreign-born students are usually highly proficient in math and science, these skills tend to be emphasized in classes and curriculum development. Less attention and expectation is placed on writing, oral and interpretive skills. The engineer that we produce is probably good at traffic flow theory, but does not understand the basis of travel demand. He is probably capable in engineering economy, but does not understand the political and budget process behind transportation decision making. When he leaves the "halls of ivy," he will require considerable additional training and practice before becoming a truly well rounded transportation engineer. Some of you may recall the TRB Conference on Transportation Education and Training, sponsored by this committee, and the conclusion of the conference that transportation engineers should have a broad based education, which in addition to basic computer and analytical skills, also included training in communications and management that provided perspective, a global outlook and a feel for entrepreneurship. Quite frankly, this is a tall order under any circumstance but difficult, if not impossible, when dealing with students who have not articulated in the secondary schools and colleges in this country.

A natural response might be, well why not limit their admittance only to bright students with the requisite linguistic and cultural backgrounds? The practical answer is, the professors who need these students to do their research would (and do) object, because the skills and willingness to work long hours under direction, is exactly what is required to do high-quality research. In Virginia for example, admittance of international students has been limited to 15-20% of the graduate students in engineering, and TOEFL language score minimums have been raised from 550-600 actions which have not met with enthusiastic support from the faculty.

A second issue is the use of foreign graduate students as teaching assistants. This TA route has been a traditional way of providing financial support to graduate students, and again we have often let expedience guide our decisions, to the detriment of our educational product. Teaching assistantships not only help to attract students, but they provide assistance to relieve the faculty from doing what the outside world thinks it should do (i.e., teach), so it can devote its energies to what the administration really wants it to do, namely attract research funds and do scholarly work. The reward system in any major university is biased toward research (although some schools do more than just lip service for teaching) and any professor who wants to get ahead will look at the short run benefits (i.e., his tenure and promotion) of employing a foreign graduate student over any long term national impact that may result from this action. In this arena, it is the administration that must establish guidelines to assure quality education and to certify that the graduate student is in fact capable of communicating with those undergraduates under his control.

To do less is to short change the students who have enrolled in engineering and to enhance the possibility that they may seek careers elsewhere.

A third question is, "Why are there so many foreign-born professors at our universities?"

The answer is twofold. First, many foreign engineers view university teaching as a high-status profession and second, the criteria for selection and promotion of university faculty are consistent with the achievements of this group. While the preponderance of young native-born engineers does not aspire to teach, this is not the case for the foreign engineer. Those of us who have recruited engineering faculty know this to be the case, as we are accustomed to receiving many more applications for teaching positions from non natives than from our own countrymen.

We also know that when we examine credentials carefully, particularly at the non-entry level, we find that often the top candidates, in terms of research grants awarded, papers written, and external recognition, were born in other countries. Thus it shouldn't be surprising that a large fraction of engineering faculties in transportation and other disciplines, consider English to be a second language. (In my department, for example, of 16 faculty, over 25% were born outside the U.S.) Furthermore, those of us who have been involved in hiring very senior faculty - at a "Chair" level, know that the best and most sought after candidates are often foreign.

Finally, let me address the question, "Is there a problem and if so, what should we do about it?"

First, my bias. Philosophically I support the American system which promises opportunity for anyone in this country who is legally able and willing to work and wishes to advance himself. As the son of an emigrant, I applaud and welcome all those who are here, and wish them success in their endeavors. I believe that our country is stronger and more prosperous because of the infusion of talent, energy, and risk taking by those who come to the U.S. from other lands.

I do believe, however, that we can do more to strengthen our system of professional education in transportation and the production of professionals in transportation.

First, we can raise compensation levels which recognize advanced training. This should result in a larger number of U.S. students in our graduate programs.

Second, we could provide financial support to those citizens who intend to pursue careers in teaching, as well as for highly qualified students who wish to pursue an advanced degree.

Third, we could include requirements that focus on communications, policy and an understanding of the context within which transportation operates.

Fourth, a greater emphasis could be placed on teaching skills in hiring and promotion decisions.

Fifth, we should strive to advance the image of engineering as a profession.

In summary, the presence of foreign engineers in our midst is both an opportunity and a challenge. The climate exists such that today this group is prominent both in engineering practice and education. They bring enormous benefits to the U.S., and we are a stronger nation because they are here. Transition and adjustment are required on both sides, but this has been the American story since its founding. Our ability to resolve differences and problems will assure that the final result is better transportation for our nation.