AEESP Workshop – Sunday July 29, 2007 Addressing the Shortage of Environmental Engineers in the Professional Pipeline

SUMMARY DOCUMENT

Motivation

A joint survey conducted by the Water Environment Federation (WEF) and the American Water Works Association (AWWA) and presented at the 2003 AWWA/WEF Joint Management Conference determined that within the next 10 years almost 80% of the professional workforce associated with public water and wastewater utilities (somewhat vaguely defined) will be eligible to retire. In the March 21, 2005 issue of Fortune magazine, an article entitled "Hot Careers for the Next 10 Years" suggested that there will be a 54.3% increase in the number of environmental engineering jobs over the next 10 years, the highest of all the listed professions and well above that predicted for careers such as network systems and datacom analysts, software engineers, and biomedical engineers. Other publications have indicated similar trends. National and regional conferences of trade organizations that incorporate the Environmental Engineering field have also targeted this issue recently with numerous workshops and technical sessions dedicated to the changing workforce, succession planning/management, retirement of the baby boom generation, etc. It is becoming clear that the retirement of the baby boom generation will have a dramatic impact on the environmental engineering profession, perhaps more so than other engineering fields. This is likely due to the significant recruitment of baby boomers into the environmental engineering field in the 1970's at the time when major federal environmental laws and regulations were promulgated. With the commonly reported saturation of the Environmental Engineering field in the 1980's and 1990's and the emergence of the information technology boom, it seems that the baby boom generation represented the backbone of the professional environmental engineering workforce during this time, with proportionally much less recruitment into the field as compared to other engineering disciplines. Although some of these predictions for the Environmental Engineering profession are quite speculative, the trend is apparent – there will be a significant demand for technically qualified Environmental Engineers over the next 10 to 20 years.

This demand will likely far outpace the pipeline of students being educated as Environmental Engineers. Mid- and entry-level environmental engineers with a sound technical base are already in short supply, and what seems to be a considerable increase in starting salaries offered by engineering consulting firms in the last two to three years is apparent. There is currently a tremendous demand for entry-level environmental engineers, although most are actively seeking employees that have obtained a Masters degree in this field. The environmental engineering field has moved to a point where a Masters degree is required to be a competent practitioner, and the Ph.D. is obtained by someone who is looking to significantly advance the profession. At the same time, however, it is clear that fellowship/assistantship funding particularly at the Masters level is becoming quite limited. It is also apparent that more students should be recruited into the field of Environmental Engineering at the undergraduate level.

Workshop Agenda

Workshop Organizers: Dr. Charles B. Bott, VMI Dr. Nancy G. Love, Virginia Tech Dr. Glen T. Daigger, CH2M HILL

8:30-8:40 am	Introductions and Expected Outcomes by Drs. Charles Bott and Nancy Love		
8:40-9:00	"Defining the Problem" Mark A. Haley, Hopewell Regional Wastewater Treatment Facility		
9:00-9:20	"A Consultants Perspective" Glen T. Daigger, CH2M HILL		
9:20-9:40	"Recruiting Undergraduates into the Field" Matthew J. Higgins, Bucknell University Kimberly L. Jones, Howard University		
9:40-10:00	Break		
10:00-10:20	"Supporting Graduate-Level Training in Environmental Engineering and Science: How Do We Fill the Funding Pipeline?" Nancy G. Love, Virginia Tech		
10:20-11:30	 Panel Discussion – What do the employers want, and what are their expectations? Glen T. Daigger, Moderator Barbara Wunder, Merck Brian L. Ramaley, Newport News Waterworks Clyde Wilber, AWWA & Greeley-Hansen C. Dale Jacobson, ASCE-EWRI & WEF & Jacobson Helgoth Consultants John H. Koon, Malcolm Pirnie Mark A. Haley, Hopewell Regional Wastewater Treatment Facility Michael W. Selna, E2F & Los Angeles County Sanitation District William D. Bellamy, CH2M HILL 		
11:20-11:40	Break		
11:40-12:00	"Tuning Environmental Engineering Education to Meet Future Demands" George Tchobanoglous, University of California at Davis		

12:00-12:30 Guided Discussion by Drs. Charles Bott and Nancy Love

Workshop Outcomes

Definitions:

Traineeship (1970's terminology) = Fellowship (today's terminology)

Internship = field experience during time in school, leading to a masters degree. For international students, need to consider OCT (??) requirements and visa issues.

Research assistantship = funding from research agencies and work is done while in school, typically laboratory

Generation	Population Size	Birth Years	
Traditionalists:	75 million	Prior to 1946	
Baby Boomers:	80 million	1946 – 1964	
Generation Xers:	46 million	1965 – 1981	
Millennials:	76 million	1982 - 2000	
(from presentation by Mark A. Haley, City of Hopewell, VA)			

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Education and Employment:

- Need to develop the social science (economics, psychology, sociology, communication) side of engineering. This should not come at the expense of ensuring a solid background in the technical fundamentals. Also, this cannot be achieved strictly through requiring classes in other colleges. Colleges/Schools of Engineering need to take some control of implementing this in a relevant way. Internships should play a role in developing the social science side of engineering
- Consider a program for retiring baby boomers and traditionalists to step into pre-college and college/university classrooms to assist with the educational process (including technical and social science skills)
- Consider working to enhance professionalism among engineers. This will lead to increased respect for the engineering profession and, over several years, will increase the attractiveness of the engineering profession to students.
- Panel Question 1: Key discriminators to consider when hiring one person over another: good technical preparation (including MS degree), good communication skills, good skills/character for a business climate
- Panel Question 2: What can universities do uniquely well to prepare students for a good successful career? Encourage graduate education; stay focused on the technical fundamentals; good balance of practice and theory so that graduates are prepared to solve

real world infrastructure problems as well as to deal with more global issues; enhance communication skills development; leadership development

- Panel Question 3: What can employers do to increase the attractiveness of our profession? Hire the professors to give them relevant experiences that will enhance student experience and take advantage of the skills of the professor; **meaningful** internship programs; support E2F-like programs; support university requests for practitioner participation in student education and service activities (support design classes, support student-run professional organizations within the framework of university life); consider faculty internship experiences for tenured faculty to help them bring experiences back into the classroom in a relevant way.
- Encourage student leadership development through extracurricular activities and provide the leadership training that needs to go with it.
- Need to improve Environmental Engineering retention through better curricular programs. Some universities lose 50% of engineering students during college. The previous concept that courses in calculus, physics, chemistry, etc should be used to "weed out" the weaker engineering students should be avoided.

Pipeline:

• Definition of the generational demographic that we face today. What will industry do if faced with a shortage of environmental engineers?



• MS enrollment is less than $\frac{1}{2}$ of what it was in the 1990's:

Figure 1. Declining Enrollment Master's Degree Level (MSEE = MS in Environmental Engineering) Used with permission from: Selna, M.W., Glaser, H.T., Trussell, R.R., Chan, G.R., and Sullivan, M. 2006. Declining Enrollment has Water and Wastewater Professionals Concerned. *Proceedings of the 79th Annual Water Environment Federation Technical Exposition and Conference* (*WEFTEC*), Dallas, TX October 21-25, 2006, 4108-4123.

- Universities are trying to increase their Ph.D. productivity while industry needs more MS students (Opinion of one panelist the private sector needs *lots* more MS graduates compared to PhDs as a guess we need one Ph.D. per 50 MS students). Therefore, the MS funding pipeline needs to expand. A new era with traineeships is needed. For example expanded E²F program, possible NACWA funding, etc.
- Funding pipeline lags the demand. Federal fellowship funding is, at best, 15% of the students graduating from environmental engineering programs. Research funding is decreasing. TA funding is decreasing. How do we fill in the gap?
- Millenials want to collaborate and can't seem to work alone; must know big picture and their role; want to hear opportunity; crave positive feedback; shocked at negative feedback; sometimes sleep in (but may be because they work all night). Millenials will leap over x-gens and take over most of the leadership jobs currently handled by the boomers.
- Rising conflict between number of international students wanting to get green cards in the US and number of H1B visa slots available. In 2006, could only complete about 50% of applicants; those who didn't get in and ran out of time had to leave the country.
- Need better statistics that encompasses all environmental engineers in the pipeline and the needs of the profession in the future.

Recruitment:

- Our field has not done a good job with public relations about what we do, and it may be impacting our ability to recruit students and funding.
- Need to find ways to instill enthusiasm about our profession. For example, faculty internship/sabbatical options to give faculty tools to support this.
- Sustainability is the means whereby we improve our public perception and recruit students. Through sustainability, we become identified as part of the solution as opposed to the problem.
- The Professional "first job" is critical. Students often focus on salary and location. Faculty need to encourage students to focus on good mentorship. Coordinated national mentoring network with impartial mentors?
- Industry and the engineering process have moved to "craftsman model", also called "web of inclusion" leadership model. These are in contrast to "command and control" leadership model that became popular during World War II and remains popular in some engineering circles today. Universities in general remain "stuck" in the "command and control" model. Yet, university professors are supposed to teach in context of the new industry model that they, themselves, are not immersed in conflict.

• There is a clear positive impact of middle and high school programs on recruitment for Environmental Engineering. We (universities and practitioners) need to get involved early on to improve the numbers of students exposed to and entering engineering.

AEESP Actions

- Coordinate with AAEE on actions
- Work with E²F program to solicit other funding partners assist with the growth of this program and/or others like it
- Attempt to place an AEESP member on the board that advises NSF (Crittendon is on this board now)
- AEESP should work with NACWA who is lobbying congress to establish a water trust fund to include dedicated funds for research to support faculty careers and funding for student education. The reinstatement of the equivalent of the EPA traineeships of the 1970's as an element of this program should be considered. A national trust fund for water infrastructure, however, is not universally supported and is currently the source of some disagreement between the national water and wastewater organizations. NACWA thinks it a great idea, but AMWA has not demonstrated similar interest in this program. Working with NACWA alone on this on this issue may not gain the broader support we need. A broader coalition and a more stand-alone vehicle would work better – again reinstatement of the equivalent of EPA traineeships sponsored with federal funding.
- Interface with AEESP committee addressing AEESP responsiveness to non-Ph.D. granting universities. Can we also coordinate this with a survey of MS versus Ph.D. demands and how universities are addressing them? How does this link with demands that will come from Body of Knowledge (BOK) implementation?
- AEESP needs to play a role in developing pre-college (grades 6-12) programs to generate interest in environmental engineering and science.
- AEESP needs to implement a program to help make environmental engineering "sexy" and exciting, like it was in the 70's. Sustainability is one way, but need a concerted effort and public relations campaign. NSF suggests the environmental/civil engineering version of CSI or a reality show.
- Make faculty aware of H1B visa issue for our graduating international students.
- Encourage professors to consider employment in industry during sabbaticals and set up a mechanism through AEESP to link employers and professors. (Perhaps start with AEESP Sustaining Member employers because they are already connected.)