

# Water Resources Education for Civil Engineers

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## Introduction

The 20th Anniversary Specialty Conference of the Water Resources Planning and Management Division of the American Society of Civil Engineers, held in May 1993 in Seattle, included a technical paper session that served as both a retrospective and a look forward for the education of civil engineers in the water resources specialty. This paper is a summary of the presentations and the spirited discussion that followed this session.

A task committee formed to recognize the anniversary event sponsored the session. Companion sessions included similar discussions on research and computing. The proceedings of the conference (Hon 1993) contain extended abstracts of two of the three presentations.

## Retrospective

Professor L. Douglas James of Utah State University drew upon history to trace the development of society's needs and motives to learn about water, citing love of learning, practical politics (theologies such as navigation, reclamation, and environmental protection), and personal self interest.

A professional education in water resources combines courses that apply sound science to meet popular needs with general knowledge on how society uses and views water. The graduate has the specializations, understands social preferences, and is able to serve the public while pursuing a rewarding career.

The water resources discipline offers several examples of ying-yang dichotomy: classical and theoretical, practical and empirical, populist and elite, and technology and science, to name a few. Water resources planning has its own ying and yang when emphasis changes from basic investigation and objective decision-making to running the computer models correctly and reacting to the warnings of the agency attorney.

James identified nine principal themes of water resources education:

- ◆ Engineering — building facilities to operate properly
- ◆ Hydrology — sizing the facilities
- ◆ Water quality — protect public health and the environment
- ◆ Engineering economy — selection between alternatives

- ◆ Economics— water resources within the national economy
- ◆ Planning— multiple means to achieve multiple objectives
- ◆ Systems — interactions among components and uncertainties
- ◆ Environmental impact — requiring cause and effect modeling
- ◆ Social impact —protect the values that people hold dear

As time passes, different themes require emphasis, but all are essential. Educators must train specialists to be knowledgeable in all nine themes. The general public must recognize and accept the balance between gainers and losers when decisions and allocations must be made.

*Dr. James' paper, "An Historical Perspective on Water Resources Education" appears in its entirety on page 19 herein.*

## A Practitioner View

Recognizing that education is too important to be left to the educators, a civil engineer in private practice, Walter M. Grayman of Cincinnati, stimulated discussion with a cartoon presenting contrasting statements of expectations from students, professors, educational institutions, and industry.

Students: We're the 'me' generation — products of the 80s. We watch TV and play video games. We expect instant gratification. Don't bore us with that theoretical junk. Just tell us what buttons to push on the computer.

Professors: We want students to receive a balanced engineering education that will prepare them to face the increasingly complex needs of the 21st century global economy.

Educational institutions: We're caught in the middle. We must tailor our programs to attract the students and educate the student so that they can get a job when they finish.

Industry: It's a tough world out there. We need engineers who finish school and can step right in immediately and do the job. We don't have time to show them what to do. Remember, the bottom line is all that counts.

While some in the audience denied these stereotypes

in their personal opinions, most recognized that the three statements probably reflect prevailing views in the three groups.

Grayman defined fundamental educational needs in four general competencies:

1) Traditional civil engineering subjects, to include basic science (physics and chemistry), mathematics, soils, structures, materials, hydraulics, environmental, thermodynamics, electricity, and dynamics, all with emphasis upon the science of water (hydrodynamics);

2) A broad exposure to related fields, such as economics, systems analysis and computers, political science, biology, and law;

3) Basic humanities, such as history, English, and psychology; and

4) training in communications (both speaking and writing) and engineering ethics.

Display of a newspaper advertisement offering “. . . a MS in engineering without a B.S. in engineering . . .” stimulated heated discussion that yielded no clear consensus on the value of such degree programs. A senior manager of a major consulting firm reported that his observation of many such masters graduates found them clearly inferior to engineering B.S. graduates in engineering abilities and judgment. Several educators rose to defend their programs, citing strict course requirements and success of their graduates. While neither view prevailed, a controversial issue was aired and thought and discussion continued after the session ended.

### The Future

The Dean of the College of Engineering at Valparaiso University, Stuart G. Welsh, challenged civil engineers to look to the future.

Water resources education at the undergraduate level must change to properly educate professionals for the 21st Century. While few changes are needed in technical content, graduates must be explicitly prepared to function as a part of a much more heterogeneous work force and to thrive within a global economy.

Data on the composition of new entries to the U.S. work force in the last decade of the 20th century show that two-thirds will be non-white, female, or immigrant. Nearly one in three Americans will be from what we now consider an ethnic minority by the year 2000, and the proportion of older Americans in the work force continues to grow (United Way 1988). Engineering colleges must recognize these

fundamental changes and change their programs, recruiting, attitudes, and styles to serve these workers. Schools must also examine current educational patterns emphasizing individual work and competition, with attention to emerging patterns of teamwork and interdisciplinary problem solving.

Modern communications and transportation have already opened the doors to international competition for engineering services. Civil engineers must have the cultural and language training to compete in the world marketplace. Our schools must provide diversity in both classroom and outside-of-class experiences to meet such needs.

While technology is obviously rapidly advancing in all engineering fields, undergraduate civil engineering colleges must continue to emphasize the fundamentals and educate, not train, their students (Welsh 1988).

### Conclusions

The incumbent Secretary of Labor, Robert Reich (1990), identifies specific symbolic skills necessary for global competition in the years to come: abstraction, system thinking experimentation, and collaboration. This list is basic civil engineering. Progressive engineers who recognize the need for change, and take action, have a promising future.

### References

Hon, K. (Ed.) 1993. *Water Management in the '90s: A Time for Innovation*. Proceedings of the 20th Anniversary Conference, Water Resources Planning and Management Division. New York: American Society for Civil Engineers.

Reich, R.B. 1990. *The Work of Nations*. New York: Knopf.

United Way. 1988. *The Future World of Work: Looking Toward the Year 2000*. Washington, DC: The United Way.

Welsh, S.G. 1988. “Microcomputer Capability: Practitioners Perspective.” Proceedings of the Hydraulic Engineering Conference, Colorado Springs. New York: American Society of Civil Engineers.

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