*Global J. of Engng. Educ., Vol. 3, No.1*
*Printed in Australia*


# Quality Engineering Education: Faculty Experiences

**Clifford V. Smith, Jr.**
*Corvallis, Oregon, United States of America*

The quality of the faculty determines the greatness of a university. Since engineering is a profession based on science and art, the ideal faculty person is one who combines formal academic training together with practical experience. The practical experience can be gained at the undergraduate or graduate level as well as after receipt of a degree. Experience as a practising engineer enables faculty members to make better curriculum decisions and to bring the real world into the classroom.

## INTRODUCTION

It has often been stated that the quality of the faculty determines the greatness of a university. This is so because, even with excellent students and state-of-the-art laboratory equipment, it is the faculty who establish the curriculum and the academic standards that students must adhere to. It is also the faculty who provide the instruction and direct the research of students. Because of this, it is important for any institution to pay the greatest attention to the quality of its faculty.

This quite naturally raises the question of what kind of experience is ideal for an engineering faculty member. To answer this question we first need to remember what engineering is. There have been many definitions over the years, but one that was first put forth in the USA some years ago seems most appropriate:

> *Engineering is the profession in which a knowledge of the mathematical and natural sciences gained by study, experience and practice is applied with judgment to develop ways to utilise economically the materials and forces of nature for the benefit of mankind.*

Note that this definition stresses study, experience, practice, judgement and economics. In essence, engineering is a profession based on science and art, just as medicine is. Clearly the ideal engineering faculty member is one who combines appropriate formal academic training through the graduate level, together with practical experience.

## FACULTY EXPERIENCE

It is very difficult to *profess* engineering if one has not had real experience practising the profession. As an example, a person graduating from one of the finest institutions in the world with a PhD in engineering with a specialty in bridge design is still not prepared, at that point, to embark upon designing a major bridge across a significant waterway. This person would still have to undergo an apprenticeship to experienced bridge designers to fully comprehend all that is involved in designing a safe and economical bridge, even though they have a PhD in the field. There is a great deal of art involved, based on experience and empiricism, which is difficult to teach in the classroom. Any professor or faculty person teaching bridge design would clearly be a better teacher if they had real experience in designing bridges.

Appropriate experience can be obtained in many different ways. At the undergraduate level, many engineering students have the opportunity during the summer to work as interns in major corporations or in consulting engineering firms or on construction projects where they gain some real, practical experience concerning the profession of engineering. If a student has the opportunity to work during the summer as an apprentice engineer for the three to five years while he or she is in engineering school, this will certainly benefit them, not only in their studies, but it will make them more valuable to prospective employers or to graduate schools when they graduate.

In addition, at the undergraduate level many universities have co-operative programmes in which undergraduate engineering students have to spend significant parts of the year working full-time for various types of engineering organisations in the private and governmental sector. Co-operative programmes usually follow a schedule of academic studies for six

months and then a period of six months actual work as a paid employee for a governmental or a private firm working in the area of engineering. While students in co-operative programmes take a little longer (five to six years) to complete their undergraduate studies, by the time they do finish, they will have significant experience in performing as an engineer and will really understand the world of work and how their engineering education can be applied to solve practical engineering problems.

Undergraduate engineering students can also gain valuable experience by participating in undergraduate research programmes, if available, right on their own campus. This means that the undergraduate engineering student is part of a team, usually directed by a senior graduate student or a major professor and, thus, participates in research on significant issues.

As a graduate student, if the schedule allows, opportunities are available to gain experience by doing consulting work. In addition, most graduate students work full-time on their research programmes under the direction of their major professor and this also gives them an opportunity to gain experience as to how to translate their engineering education into designing experiments to seek answers to problems for which, heretofore, solutions were unknown.

After a student completes his or her graduate degree, there are several different directions in which the individual can go. One option is certainly to seek full-time employment as an engineer with a private or a governmental organisation and work for three to five years before pursuing an academic career as a professor or teacher. Some engineering graduates may desire to immediately seek an academic position at a university and then obtain their practical experience by either working in the summer for governmental or private organisations as an engineer. As the years go on and they gain more experience, they may decide that during the summers and during the academic year they will consult for private and governmental entities on engineering problems that are within their realm of expertise.

Engineering faculty must stay involved with the best practices in their profession by attending professional meetings, short courses and participating in professional engineering organisations. Because science is changing so rapidly, the practice of engineering is also changing rapidly and there is simply no substitute for continual education if one wishes to stay up-to-date.

## CONCLUSION

In summary, experience as a practising engineer enables faculty members to make better curriculum decisions and to bring the real world into the academic classroom. This in turn enables the faculty member to better prepare their students for the practice of engineering.

Many different ways have been discussed to gain experience and there are advantages and disadvantages to each of the methods mentioned, but what is most important is that all engineering faculty gain some experience practising engineering and that they remain current in their specialty by participating in continuing education programmes.

There is a fine balance that has to be found between teaching the fundamentals of engineering science and the art of engineering. Schools of engineering need to guard against overemphasising the *how to do it* so that their graduates are immediately valuable when they graduate, as compared to those who finished undergraduate curriculums that are very strong in engineering science, but weak on the practical aspects of engineering.

The relentless march of change in science will continue to be with us forever and it is imperative that engineering graduates gain at the undergraduate level a strong foundation in the basic sciences so that they are equipped to stay abreast of the changes that are bound to come. Such an education will also give them the ability to move in different directions, including different career disciplines. With the emphasis today on teamwork and integration of the various aspects of engineering, it is most important to have a strong fundamental understanding of the engineering sciences that cut across specific specialities.

This does not mean that it is not important for engineering faculty members to have practical experience. Indeed this is an even stronger reason why they should have practical experience; if their experience has been appropriate, they will be better able to draw a balance in the curriculum between basic fundamental studies and applied engineering specialty courses.

## BIOGRAPHY

Dr Clifford V. Smith, Jr. was President Emeritus of the General Electric Foundation (1990-97) and Chancellor Emeritus of the University of Wisconsin-Milwaukee (1986-90). Prior to his Wisconsin position, Dr Smith held several positions within the Oregon State System of Higher Education. There he served as Special Assistant to the Chan-

cellor of the State System for Science Technology and Economic Development. He also served as Vice-President for Administration at Oregon State University, where he also held joint appointments as Director of the Radiation Center, Director of the Institute for Nuclear Science and Engineering, and Head of the Department of Nuclear Engineering.

Dr Smith holds a BSc in Civil Engineering from the University of Iowa, a MSc in Environmental Engineering from Johns Hopkins University and a PhD in Radiological Science from Johns Hopkins University. He is a registered professional engineer and the author of many articles in the technical literature. He is currently a member of the Board of Trustees for Johns Hopkins University, the Board of Directors for the University of Iowa Foundation, the Board of Trustees for the Institute of International Education, the Board of Trustees for the Eisenhower Exchange Fellowships and a member of the UNESCO International Committee on Engineering Education.

## Proceedings of the 1st Asia-Pacific Forum on Engineering and Technology Education

edited by Zenon J. Pudlowski

The *1st Asia Pacific Forum on Engineering and Technology Education,* held at Monash University, Clayton, Melbourne, Australia between 6 and 9 July 1997, heralded a promising new phase in the development and delivery of engineering and technology education in the Asia-Pacific region. Close to 100 participants from 23 countries from Asia, Europe, Africa and the Americas attended the Forum. Over 80 paper presentations were made, 78 of which are included in this volume of Proceedings.

As an activity of the recently established Asia-Pacific Higher Education Network, Engineering Education subnetwork (APHEN-EE), a primary purpose of the Forum was to bring together academics and individuals concerned with engineering and technology education in the region for discussion and the exchange of information, and the formulation of an action-oriented agenda for the network. The papers included in the Proceedings superbly indicate the fertility and dynamism of prevailing discourse from which the way forward will be determined.

Papers were presented in one of six so-called Asia-Pacific Forum sessions covering the diverse and significant issues of *International Collaboration, New Methods in Engineering Education, Information Transfer and Multimedia, Learning Styles in Engineering Education, Industry/Academia Collaboration* and *Issues Concerning the APHEN-EE*. The proceedings should prove to be a valuable resource for some time to come for those involved with engineering and technology education.

To purchase a copy of the Proceedings, a cheque for $A100 (+ $A10 for postage within Australia, and $A20 for overseas postage) should be made payable to Monash University - UICEE, and sent to: Administrative Officer, UICEE, Faculty of Engineering, Monash University, Clayton, Victoria 3168, Australia. Tel: +61 3 990-54977 Fax: +61 3 990-51547