



EVOLUTION OF ENGINEERING EDUCATION IN CANADA *NEW CHALLENGES FOR CANADIAN UNIVERSITIES*

BACKGROUND

The role of engineering in society is changing, placing new pressures and demands on engineering faculties. In Canada, while these faculties have a fine record of accomplishments and have adapted well to rapid changes in science and technology, the new millennium presents them with increasing pressures and challenges arising from a broadening of the roles that engineers fill.

These broader roles for engineers occur in emerging engineering disciplines, in innovation and entrepreneurship¹, in international markets, in team leadership and interdisciplinary activity, and in protection of health, safety and the environment. Graduates of engineering faculties are needed to serve society, not only in the traditional technical capacities which they need to master well, but increasingly in non-technical leadership capacities.

Broader roles for engineers bring new challenges

Accordingly, in 1998 the Canadian Academy of Engineering established a task force to study and make recommendations on the roles in which engineering faculties are or should be involved. The conclusions of this Task Force are presented in the Academy report, *Evolution of Engineering Education in Canada*, published in December 1999. While a number of important roles were identified, this report focuses on education-related aspects and on establishing general directions for the future evolution of engineering education in Canada.

The fundamental thrust of the report is toward further broadening of engineering education. However, there is little flexibility to accommodate this broadening and to incorporate the continual expansion of relevant technology within the time and resource constraints of the current undergraduate curriculum.

PREMISE

The evolution of engineering education developed in this report is based on the definition of engineering adopted by the Canadian Academy of Engineering:

The central focus of engineering is design

Engineering is a profession concerned with the creation of new and improved systems, processes and products to serve human needs. The central focus of engineering is design, an art entailing the exercise of ingenuity, imagination, knowledge, skill, discipline and judgment based on experience. The practice of professional engineering requires a mastery of engineering methodology, together with a sensitivity to the physical potential of materials, to the logic of mathematics, to the constraints of human, physical and financial resources, to the minimization of risk, and to the protection of the public and the environment.

RECOMMENDATIONS

The report contains five recommendations which call for fundamental evolutionary changes to ensure that this broadening will actually take place:

1. Engineering faculties should ensure that breadth of learning, beyond the technical aspects of the specialist engineering discipline, is a major thrust in engineering education.

The most important and fundamental role for engineering faculties is to prepare young people to work in various capacities in an evolving world, providing them with an education which is technically focused and has adequate breadth. Society requires that engineering graduates be broadly educated, that they be knowledgeable about the society in which they live and work, that they be sensitive to the economic, social, political, environmental, cultural and ethical dimensions of their work.

The undergraduate curriculum should emphasize problem solving and design. Increased postgraduate opportunities plus an emphasis on lifelong learning² can provide both specialist information content and further broadening.

***Engineering students
need a broader education***

2. Engineering faculties should emphasize the development of the learning skills of their students.

A high priority should be placed on “learning how to learn”. Acquisition of the skills of self directed learning is important in preparing for life after leaving the university.

3. Leaders of engineering faculties should ensure that their faculty members have the vision, values and behaviours needed for their evolving role in preparing undergraduate and graduate students to function effectively in our rapidly changing world.

***Engineering faculty
will need new education skills***

This broadening of engineering education should be provided largely by the mainstream engineering faculty and should permeate each component of the program. Courses from other parts of the university are a short-term measure at best, and part-time faculty will be seen as marginal to the mainstream. This broadening requires the active participation of the permanent faculty in developing their skills in education and in developing suitable educational experiences for their students.

Criteria and practices on tenure and promotion must encourage these broadening activities. Faculty must be assured that their efforts in these directions will enhance rather than impede their career progress.

Research and design enhance learning

4. The original creative work done in engineering faculties, namely research and design, should be characterized by excellence, by relevance to industrial and social issues and by concern for the life preparation of the graduate students involved.

Conducting quality research and design enhances the learning of both faculty and students and contributes to the innovation base for industry and society. Beyond the

intrinsic value of the research results and the designs created, there is a need for increased recognition of the value to employers of the research and design experience of the graduate students.

Improving our technological literacy

5. Engineering faculties should reach out beyond their own students and help in providing a modern liberal education for all university students. They should also help in improving the technological literacy of all university graduates as well as the general public.

In a society which is so profoundly influenced by technology, the technological literacy of many university graduates is open to question. Engineering professors regularly deal with the interface between science and society and are well-qualified to contribute to the liberal education of students and the public at large.

IMPLEMENTATION

Implementation of the directions charted in this report will be a challenge in itself. The key players are the leaders — the engineering deans who have direct responsibility for leadership in engineering education, and leaders in Canadian industry, business and government — who have the responsibility of emphasizing the importance of these directions to the health of the Canadian economy and society, and ensuring that the necessary resources are allocated to them.

REFERENCES:

1. *Wealth through Technological Entrepreneurship*—Canadian Academy of Engineering, March 1998
2. *Lifelong Learning for Professional Engineers*—Canadian Academy of Engineering, October 1997

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