FINAL REPORT OF EMERGING DISCIPLINES TASK FORCE TO COUNCIL

Summary

The profession of engineering is in better shape nationally to respond to the ever-increasing body of knowledge and emerging disciplines. Since 1999, the Research Committee of the Canadian Council of Professional Engineers has been doing an annual scan to detect potential new disciplines, which are then evaluated in more depth to determine which ones will ultimately become accredited degree programs. While it still takes a significant length of time to reach an accredited program and to register the first practitioner, the time has been significantly reduced. When asked the question of when the first software engineer would have been registered if we had this process in place thirty years ago the answer was "probably the mid-80s". Without this process it took until 1999 to register the first software engineer in BC.

The process could be further improved to recognize that it is a joint process between the Canadian Council of Professional Engineers and the Constituent Members, not just a process run by CCPE on behalf of the Constituent Members. There is a role for the Constituent Members to play in both the discovery phase and the implementation phase. This role needs to be defined and recognized.

Further work could be done to decide if it is possible to bring in potential new disciplines prior to the existence of an accredited degree program.

Context

Since the Engineers Act was enacted in 1920, many things have changed in the world around us, including the expansion of the body of knowledge in scientific areas, the development of a number of new technologies, an increasing pace of change and a greater pervasiveness of technology in everyday life. Interestingly, the definition of engineering disciplines listed in the *Engineers & Geoscientists Act* uses exactly the same words as the 1920 version of the Act, with the addition of words to the effect that Council may also approve new disciplines that are accredited by the Canadian Engineering Accreditation Board or an equivalent body.

There are three main components to consider that affect the self-regulating professions of engineering and geoscience – the development of new technologies and disciplines, the way technology, in general, is embedded in our daily work as engineers and geoscientists, and the increasing adoption of sophisticated technologies by the general public.

Over the last 86 years we have seen the development of entirely new technologies and their related engineering disciplines, as well as exponential growth in many traditional bodies of knowledge. Take one example, computer science, communications and software. The British used the first computers for code breaking during World War II. Bell Telephone Laboratories developed the first transistor in 1947. Texas Instruments and Fairchild semiconductor both announced the integrated circuit in 1959. The IBM 360 was introduced in 1964 and the Apple II personal computer in 1984. The Internet began life as ARPANET in the late 60s, with email as it's first application in the early 70s, although researchers at universities and in government

were the primary users for the first 20 years. The general public now has high-speed Internet access, web browsers, commercial email and office applications. It is difficult to do business or live everyday life without these technologies. This is just one example. A similar description of the new knowledge in cell biology, seismology or nanotechnology would be equally impressive, both for the new discoveries and the pace of change.

Technology is embedded in the daily work of engineers and geoscientists, ranging from sophisticated Computer Aided Design (CAD) tools for civil engineers to complex mapping tools for geological surveys. This technology is designed in part by software engineers, who until very recently (1999) were not recognized by the professional bodies in Canada. If the failure of a CAD tool causes a faulty design, where does the fault lie, with the software designer or the civil engineer using it?

The public is adopting new technology faster than ever before. According to a recent IPSOS survey, over two-thirds of global Internet users access the Internet through a high-speed link. An OECD study notes that there is a high-speed connection for 25% of the population of countries like Denmark, Canada and South Korea.

Implications for the Professions

Most people now agree that the engineering profession did not respond quickly enough to emerging disciplines in the past. Although we now have processes in place to keep a watch on new developments, they may still not be responsive enough. A slow response potentially endangers the public (if there are few other regulations in place to protect the public), and makes the profession less relevant as time progresses. Today, even after recognizing a new discipline, it can take up to ten years to register the first professional, since our system relies on having an accredited engineering degree program in place before the first practitioner can be registered. As an example, we have registered software engineers in BC since 1999 and have 43 registered in this discipline (and 125 in computer engineering), but we have 270 registrants who declare software engineering as their primary expertise and a total of 581 registrants with a declared primary expertise in computing or software.

Duties of the Association

Our primary duty is to protect the public and serve the public interest by licensing competent and ethical individuals in engineering and geoscience. Our secondary duty (where it does not conflict with our primary duty) is to promote the professions. In some areas of practise (primarily consulting), we are the primary or sole protection for the public. In some areas of consulting there is an additional (but recursive) requirement for a qualified person (often a professional engineer or professional geoscientist) to perform a specific function. In other areas (primarily industry), there are additional regulations and laws that provide some level of protection of the public (product safety standards, industry specific standards etc.). The *Engineers & Geoscientists Act* requires that everyone practising engineering independently be registered.

Models for Emerging Disciplines

There are several models for the emergence of new disciplines.

In some cases an entirely new discipline develops. An example of this might be nano-technology, which is based on a knowledge of physics at the atomic level and its rapid development has been enabled by a progress in a number of other unrelated areas such as capture (and manipulation) of vast amounts of data from modern electron microscopes using today's computers. Nano-technology is an entirely new discipline that impinges on physics, chemistry, materials science, and manufacturing. This model for a new discipline is relatively rare, with another example being software engineering.

Another model that is more common is the one where the body of knowledge in an existing discipline extends rapidly and essentially spins off new specializations. For example, Computer Engineering developed out of Electronics, which, in turn developed from Electrical Engineering. Many people working in software and computer science in the 80s had degrees in Electrical Engineering (and occasionally Applied Physics or Applied Mathematics). They took their engineering training and applied it to a new body of knowledge.

In some cases two (or more) disciplines merge to create an entirely new discipline. An example of this would be new degree programs in Mechatronics (a combination of mechanical and electronics) or Bio-medical engineering.

There are often a number of external triggers for a new discipline. In some cases there is a demand (often in legislation) as in the environmental area, which probably stimulated the formation of environmental engineering as a discipline (as well as environmental geoscience). Practitioners in these areas tend to come from a variety of backgrounds such as chemical, mechanical, civil, or geoscience. Practitioners can also come from other professions such as biology and agrology. Sometimes the trigger is the development of a specialist sector such as wireless communications, which has driven demand for specialist engineers.

Many practitioners in newer disciplines work in multi-disciplinary teams and will often have two degrees, such as medicine and engineering.

Process

There are four distinct phases to the recognition of a new discipline: discovery and identification, definition, evaluation and legislation. At each transitional point to the next phase there are a number of questions to be answered.

The Canadian Council of Professional Engineers has given a watching brief on emerging disciplines to its Research Committee (amongst other tasks). The Research Committee does an annual qualitative scan via a questionnaire that is sent out to various groups within the profession once a year. In addition, regular monitoring of other identified groups occurs throughout the year. At each meeting of the Research Committee, several criteria are used to prioritize follow-on activities:

1. What is the estimated level of immediate risk to public safety in this area of engineering?

2. Is this a distinct area of practice or specialization within an existing discipline of engineering?
3. Are governments or other organizations raising concerns about this particular area of science or engineering in Canada or in other countries?

The Research Committee further researches the high priority area(s) and technical papers, as necessary, are written each year to further define the engineering work being conducted in the new areas. The technical paper(s) are written by researchers or consultants commissioned by the Research Committee and reviewed by the Canadian Engineering Qualification Board's Executive Committee before presentation to the Board of Directors (and thus to the Constituent Members). Details are summarized in the Research Committee 2006-2008 work plan (attached).

Recommendations

The Task Force recommends that:

1. ***The Association (via the Director of Registration and it's member on the Research Committee) work with the Research Committee to refine the Emerging Disciplines process and roles and responsibilities. The process needs to be jointly owned by the Constituent Members and the Canadian Council of Professional Engineers. Specifically -***
    a. ***The role of the Constituent Member in recognizing the emergence of a new discipline is strengthened since they are likely to see something happening first.***
    b. ***Quantitative measures (such as patents, papers, conferences) are considered to augment the existing qualitative measures.***
    c. ***A clearer flow chart that breaks out the key stages (discovery and identification, definition, evaluation and legislation) and the roles and responsibilities be developed.***
    d. ***The final stage, which is owned by the Constituent Members is defined (how we define any legislative changes including regulation/bylaw changes and process/procedure changes).***
2. ***The Director Registration distributes the annual report of the Research Committee work plan to Council.***
3. ***The definitions used in the Engineers & Geoscientists Act are updated to the soon-to-be-released new definition of engineering being worked on by the Canadian Engineering Qualifications Board. This will require consultation with other professions.***
4. ***The Association examine whether the Limited License can be used for a limited recognition of emerging disciplines in the pre-accreditation stage.***
5. ***The Association encourage an annual update of expertise records by members.***