INNOVATION:
Breaking down barriers

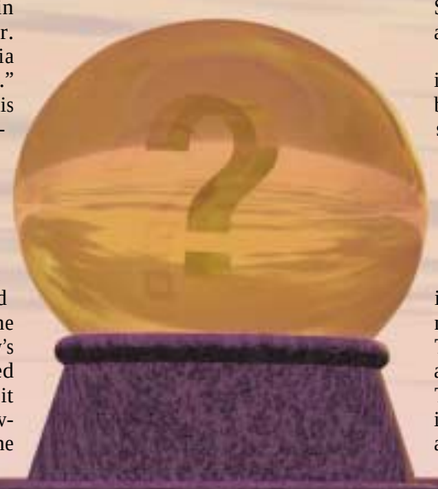
by Dwight Hamilton

"If we do not rise to the challenge of innovation, we will be risking our standard of living and jeopardizing the opportunities of future Canadians." This is the stark conclusion of recent reports on innovation from the Conference Board of Canada. The country's ability to create jobs, its productivity and the wealth of its citizens are more at risk than they need be, because when stacked up against most other industrialized nations, Canada is poor at innovation, the board says. "It is only when a spirit of innovation and entrepreneurialism infuses the aspirations of entire countries that a lead position in the knowledge-based economy can be achieved and sustained. Our innovative capabilities lie at the heart of our competitive performance," it adds.

One of the main themes of the report, *The Canadian Skills Imperative*, was a call for "partnerships and joint ventures, more collaborative processes, and greater focus on creating and leveraging synergies. The vision is to simplify, converge and work together ... to drive innovation in an inclusive and holistic manner. Government, industry and academia must nurture collaboration at all levels."

An attempt by academe to meet this challenge is with the formation of centres of multidisciplinary research. Although they've been around for years, the idea is becoming more and more popular as the lines of traditional scientific disciplines become increasingly blurred. One of the latest examples is the Centre for Cellular and Biomolecular Research (CCBR) at the University of Toronto, the country's largest teaching institution. Scheduled to open in 2004, the university hopes it will help continue its legacy of discoveries and inventions like insulin and the cardiac pacemaker, developed with the National Research Council of Canada under the late Dr. John Hopps, P.Eng.

It's anticipated that the centre's work will be linked to research being done at other Canadian universities and institutes as well as international research networks. Professors and graduate students from the faculties of applied science and engineering, medicine, pharmacy and arts and sciences will be involved. Since 1998, similar centres studying complex living systems have sprung up at U.S. universities such as Stanford, Harvard, Caltech, Chicago and Johns Hopkins.



How does this approach encourage innovation? "You want to organize research by the problem rather than the discipline," says Michael Sefton, ScD, P.Eng., director, Institute of Biomaterials and Biomedical Engineering, and one of those involved in originating the concept of the CCBR. "Universities are set up for undergraduate education, they're divided into faculties and departments. That's great for training professional engineers, but research bears no resemblance to that arbitrary division. The premise here is to mix the disciplines and have people bounce into each other. The view is that it's the best way to get existing problems solved and to foster new interactions that people haven't thought of."

James Friesen, PhD, chair, Banting and Best Department of Medical Research and another of CCBR's founders, provides a tangible example. "The genome sequence projects were giving us mounds of data, but what does it mean? You have a roadmap that gives you a hint where to plan your trip but it doesn't give you any details you will see along the way. It immediately made people think this is just the beginning," he says.

"You have a huge problem with data mining and that's where the electrical engineers and information scientists come in. Then you've got the problem of devising experimental methods so you can approach the subject a genome at a time, instead of one gene at a time. That brings in the mechanical and software engineers who can build the robotic machines, interact with the scientists, and tell them how to increase their through-put to collect data 10,000 times faster than they did a decade ago. It all starts coming together. Sure, that happens all the time, but we weren't set up to exploit it."

Exploiting breakthroughs is the reason why everyone's under one roof and why the office design of the CCBR is as flexible as it can get. "Even in this age of instant communication, a lot of creativity happens because you run into somebody in the hall; with group contact everybody builds on ideas," says Kim Woodhouse, PhD, P.Eng., who teaches chemical engineering and is assistant director of Sefton's biomedical engineering institute. For her research into artificial materials for wounds and skin replacement, she was awarded a PEO Engineering Medal for engineering excellence in 1997. "If you're not all talking together, you can't make the great leaps," she adds, which is the problem with information "siloing."

Information siloing, or a lack of cooperation among scientific disciplines, isn't just a theoretical problem that retards research in ivory towers, it is an issue that can affect us all. Kim Vicente, PhD, P.Eng., a professor of mechanical and industrial engineering who will also be cross-appointed to the CCBR, cites his own area of research as an example. Vicente works in human factors or cognitive engineering, designing equipment that involves complex interaction with the end user.

He indicates this science has been applied in the aviation industry for years, and for a very good reason. "During the Second World War, guys were flying planes into the ground, not because there was anything wrong with the aircraft, but because they didn't know how to work the controls," he says. "And we know that despite September 11, flying is really safe. One reason is that they've paid a lot of attention to designing technology with people in mind."

The counter to that is healthcare, he says. Recent studies in the U.S. have found that between 44,000 and 98,000 people die each year from preventable human error. "If you translated that to the aviation industry it would be like a wide-body jet going down every day and killing everyone on board. No one would get on an airplane," he says. While the sector is slowly changing, he adds, "they have essentially blown off a whole body of knowledge that had been taken advantage of elsewhere." A notable exception is in the field of anaesthesiology where Vicente says the safety level has improved "dramatically," perhaps ten-fold from what it used to be. "But most of medicine has not," he says. "It's a very frustrating example because there's all this knowledge sitting around that could be used to save lives."

With the proliferation of centres like the CCBR, it's hoped such examples will become a thing of the past. Sefton, for one, is optimistic the centre will be a catalyst for his research into building an artificial heart from living tissue, a monumental task. While there is more access to money in the U.S. for such large projects, he points out, it's more competitive. "The ability to collaborate is probably better in Canada," he says.

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Innovation and regulation: a good mix?

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The world has moved into a new era with scientific discoveries such as the Genome project mapping out the genetic code of the human species. The final report of PEO's Bioengineering Task Group cautions that "there are aspects of bioengineering and its related technologies that may be perceived with suspicion by the general population," and as a result, "the additional technological, moral and ethical impact of the practice of bioengineering on the public requires great diligence."

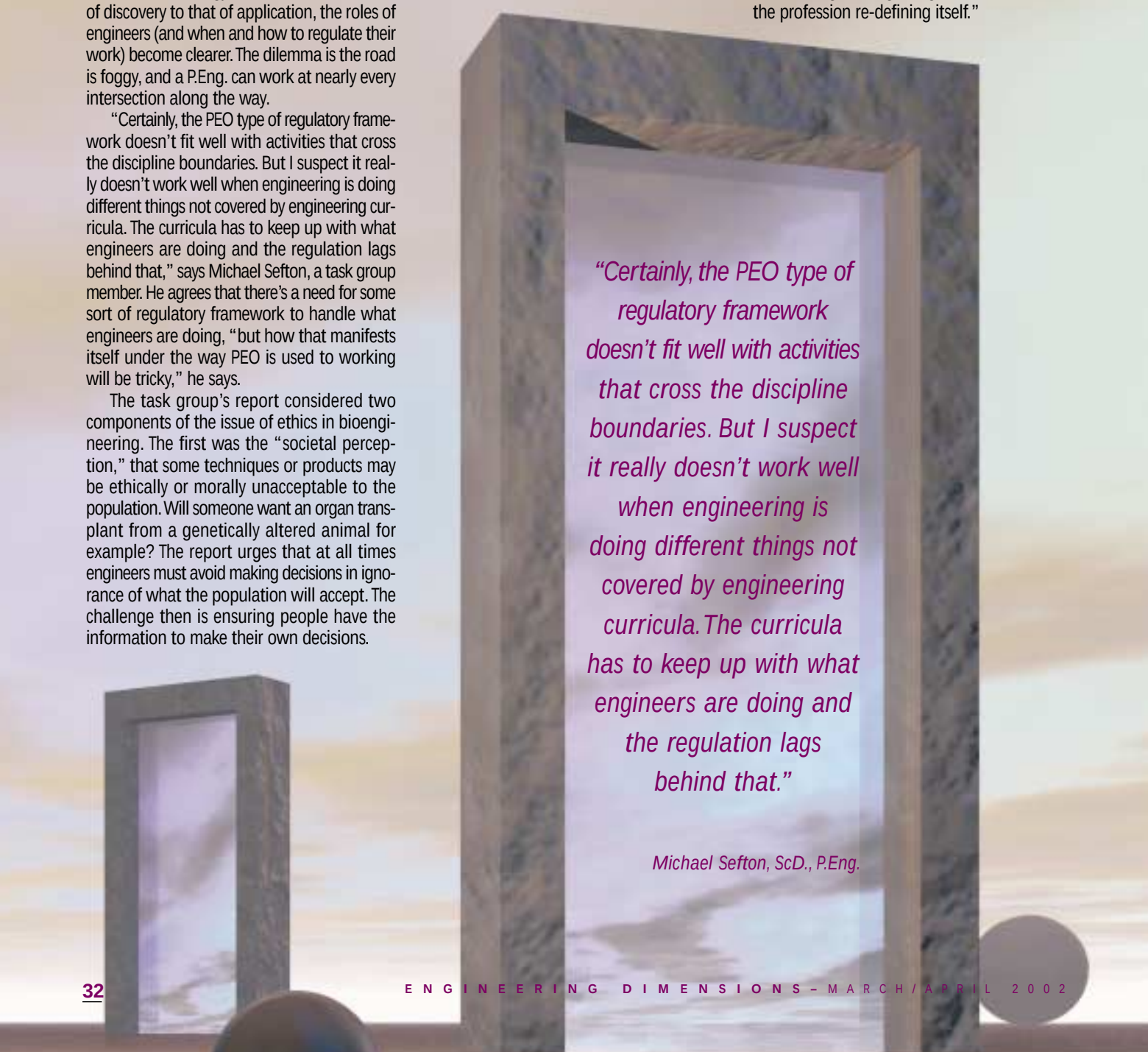
As biotechnology moves from the science of discovery to that of application, the roles of engineers (and when and how to regulate their work) become clearer. The dilemma is the road is foggy, and a P.Eng. can work at nearly every intersection along the way.

"Certainly, the PEO type of regulatory framework doesn't fit well with activities that cross the discipline boundaries. But I suspect it really doesn't work well when engineering is doing different things not covered by engineering curricula. The curricula has to keep up with what engineers are doing and the regulation lags behind that," says Michael Sefton, a task group member. He agrees that there's a need for some sort of regulatory framework to handle what engineers are doing, "but how that manifests itself under the way PEO is used to working will be tricky," he says.

The task group's report considered two components of the issue of ethics in bioengineering. The first was the "societal perception," that some techniques or products may be ethically or morally unacceptable to the population. Will someone want an organ transplant from a genetically altered animal for example? The report urges that at all times engineers must avoid making decisions in ignorance of what the population will accept. The challenge then is ensuring people have the information to make their own decisions.

The second aspect considered was the cluster of "technical realities" accompanying the practice of bioengineering that may produce unexpected, negative outcomes. Bioengineers "must exercise explicit and proactive thought on the potential consequences of their work" the report states. With this, the report draws a parallel with software engineering and the "glitches" due to badly written code that appear after the product is launched. Therefore, it concludes, a key to good bioethical practice is the idea of testing under a controlled environment.

No matter where along the scientific spectrum P.Engs work–whether closer to pure science or nearer to technology–they are still bound to PEO's Code of Ethics. "The impression I had from the task group when it was wrestling with this problem was that it wants to be supportive and didn't want to become a regulatory barrier. That was the intent, so from that perspective I'm not afraid of it," says Sefton. "But it's going to take a big learning curve from all parties to figure out how best to deal with things. Software engineering and now bioengineering are good test cases for the profession re-defining itself."



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