Thought and arithmetic

In response to Professor Thomas Fahidy, P.Eng.'s, letter to the editor in the January/February issue (pp. 7-8), in which he says I appear to believe that "the knowledge of mathematics thwarts engineering reasoning, especially in production planning and control," I have this to say:

Fahidy should take comfort. What he read into my article, "Production planning and control–a job for the engineering mind" (November/December 2001, pp. 21-22), was much more than what I said. If I seemed to give the impression in my article that I bear a grudge against recently graduated engineers, I must certainly apologize.

I am glad Fahidy agrees that attributing delivery speed (cycle time) to plant loading is nonsense. I would suggest that he ask some engineers involved in marketing functions whether they think this is true. He would find that many such engineers believe it. Reciprocally, no production planning course at the university/college level, many of which I have both taken and taught, mentions the important fact that variability of load is a driver of cycle time.[1]

Many courses still being delivered a few years ago, when I left my last technology advisory committee, were clinging to obsolete technology such as time study or economic order quantity-driven production planning, neither of which most industries still use. I hope that Fahidy's university is more aware of recent trends in production management, such as this variability principle.

I did not suggest that "gut feeling and simple arithmetic" will solve many engineering problems. What the article does suggest is that several important, overlooked problems can indeed be solved with thought and arithmetic. Two principles that I emphasized to students, and which I hope Fahidy's institution also does, are: think first and try the simple solution first. As A.P. Sloan, engineer and founder of General Motors said:

"Never resort to calculus until you've exhausted the possibilities of two matchsticks and a piece of string."

I would be highly interested in Fahidy's critique of a book that rigorously applies statistical math and operations research to production planning and control, an area that doesn't see much of it. The book, *Increased Profits Through Better Control of Work In Process*, is the one cited in my article.

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[1] Gue, F.S., In Defense of Cycle Time, Inventories and Production, May 1992.

Belittling comments cause for concern

I was stunned by the comments of Professor Jeffrey A. Packer, PhD, P.Eng., contained in the article "Public protection and public trust: the raison d'être of the professional engineer, (p. 43, January/February 2002 issue). He displays a cavalier attitude towards professional engineering by belittling the relevance and status of the P.Eng. licence.

I would expect a professor of civil engineering at any Canadian university, let alone one with the renown of the University of Toronto, to have a better appreciation of the relevance of the professional engineer licence. His case, in particular, raises the concern that if he is not engaged in professional practice through the teaching and research of civil engineering, what in the world is he doing in a civil engineering department in the first place?

If this is the message he is communicating to his students, it is no wonder that Lisa Anderson, P.Eng., commenting in the same article, that she is "always surprised when a recent graduate shows no desire to become licensed."

Michael K. Walker, P.Eng.
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Sustainability an ecological inevitability

I read with interest the article "Sustainable development and Canada's next century" (January/February 2002 issue pp. 40-42). I am pleased to see that engineers are considering sustainability as a serious public welfare issue.

Sustainability issues are long-term, hard to quantify, and very difficult to operationalize. As such, I applaud the efforts of the CCPE (Guideline on the Environment and Sustainability) and the NRTEE (environment and sustainable development indicators) in helping to put principles into practice. In his article, Dr. Smith correctly cites the need to both preserve natural capital for irreplaceable services of nature and to ensure that uses of non-renewable but substitutable resources are offset by investment in renewable substitutes. But his advice to engineers falls short in some important areas.

The first shortfall deals with the specific case of biotechnology. Such a fast-evolving field is a nightmare for anyone seriously thinking about the long-term–we just don't know if genetic engineering will be our bane or blessing. Yet such long-term thinking is exactly what sustainability challenges us to do. If our conclusion is that we cannot rule out a small, but significant risk that biotechnology may cause irreparable harm to the aforementioned ecological services, then I suggest that the logical, difficult, but correct public policy is to postpone implementation of such technologies until such risk may be effectively ruled out. How else can the precautionary principle be understood?

The second shortfall deals with Dr. Smith's comforting prognosis that "the [sustainability] indicators will be at too 'macro' a level to be of help to individual engineers working on specific projects." The individual project is exactly the level at which most decisions of environmental consequence are made. Investment projects can provide data for use in aggregate indicators of sustainability. Engineers commonly have the best understanding of the physical (as opposed to financial) flows of natural resources involved in executing a project. We should have a corresponding responsibility to evaluate and publish an account of these flows on a project basis, and to make the data readily available for aggregation at a higher level.

And there are well accepted ESDIs that function at the project level, albeit imperfectly. One of the most promising is the "environmental footprint," which simply calculates the area of land required to carry out an endeavour in a sustainable way. It is the best approach I have seen to operationalize sustainability in a simple, understandable procedure that factors in the "big three" factors of environmental impact: population, consumption and technology. Footprint analysis is being taught to thousands of environmental science and planning students in Canada and the U.S. each year. How many engineers study and apply it?

Sustainability is not just sound public policy; it's pretty much an ecological inevitability–a mark of any system that's around for keeps. Let's work to make it part of our everyday thinking as citizens and our everyday work as engineers.

David Tamblyn, M.Eng., P.Eng.
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Ideas and action welcomed by OSPE

In his letter to the editor "OSPE short on specifics" in the March/April issue (p. 8), Geoff Francis, P.Eng., contends that the society has been "silent on specifics" and expresses uncertainty about how we will identify our issues and take positions about them.

I agree with Francis' point that engineers, through an organization like the society can bring a unique perspective to public policy debates. Our logical approach, impartiality and concern for the public interest distinguish us from many other professional organizations and lobby groups, making our input quite valuable to the Ontario government, the public and the media.

In the 11 months that have passed since the first elected board of the society took office, we have relied on the ideas and initiative of engineers just like Francis to help set our direction and policies. Our presentation to the Walkerton Inquiry and subsequent establishment of our Safe Water Task Force came out of the desires of water systems engineers to contribute to the public debate around water safety. Last fall, we undertook an ambitious member research program that included 4000 responses to our online survey and two-hour focus groups with members and students.

The society's first strategic plan grew from the work of 100 engineers who helped us evaluate this research and plot our course for the future. And our recent advocacy with all three provincial political parties stemmed from the work of a province-wide committee of engineers who helped us begin the task of reaching out to the government and opposition.

These are but a few of the many areas in which the society's members are taking an active part in shaping the direction and policies of the organization. I would suggest that Mr. Francis and other like-minded engineers not sit on the sidelines but join us and help us grow to become the organization that we know the profession needs. All members of the engineering profession will have to move from making general comments on what the society should do and begin articulating ideas and working together to make them a reality.

Robert A. Goodings, P.Eng.
Chair, OSPE

Wind power has come a long way, but...

Peter Smith's article in the March/April issue, "Deregulation to spark innovation in changing electricity market" (pp. 27-29) was excellent. I would like to offer a few figures to show the true potential wind power may have on our electricity grid in the near term.

In 2001, Ontario's total electricity demand was approximately 150 TWh or 17,123 MW averaged over the year (note the peak demand the same year was 23,630 MW during the summer, over a period of 20 minutes).

The new 1.8 MW Vestas V80 wind turbine located next to the Pickering Nuclear Generating Station is typical of what could be expected for future wind farm developments. Although wind turbines typically require only four to six days of maintenance per year, an average capacity factor of between 20-25 per cent is typical given average wind speeds in the best locations in North America. As an example, the Huron Wind 600 kW turbine at Kincardine, one of Ontario's areas of highest average wind speed, has had an average capacity factor of 21.9 per cent from 1997 to 2000. Using this statistic, a 1.8 MW turbine can be expected to produce 3456 MWh of electricity over a year.

Therefore, to contribute 10 per cent of Ontario's electricity demand, 15 TWh (15,000,000 MWh) or 1712 MW of installed power (equivalent to the output of four of the eight units at the Pickering nuclear plant operating at an 80 per cent capacity factor), 4341 1.8-MW turbines would be required–slightly higher than the figure quoted in the article. As mentioned, this ignores the need to store power for peak demand when base load power sources cannot supply the required load.

The cost of the OPG wind turbine was about $3 million installed. For 10 per cent of Ontario's supply, this would carry a total cost of $13 billion for materials and construction, corresponding to a price of $7.59 per watt. To compare, the construction cost target for the next generation CANDU NG reactor is $1,000 per kW installed, or $1 per watt.

Note, as well, that unlike fossil and nuclear sources, wind farms have very large land requirements. In order not to be victims of air flow interference, turbine columns should be placed three blade diameters apart (perpendicular to the wind direction), and at least eight diameters between rows. For a farm of 4341 turbines, each with a blade diameter of 78 m like the V80, a total area of 15.4 km by 41.1 km or 633 km^2 is required–approximately equivalent to the total land area of the Greater Toronto Area (630 km^2). (Note that the above figure of cost does not include the cost of this land, rezoning, road access to each tower, nor electrical distribution equipment spread over a large area.)

Although wind power has come a long way in the past 25 years and will undoubtedly have an important impact for specific applications, given current technology and availability, it hasn't quite yet matured to the point of being considered a means of replacing base load power.

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