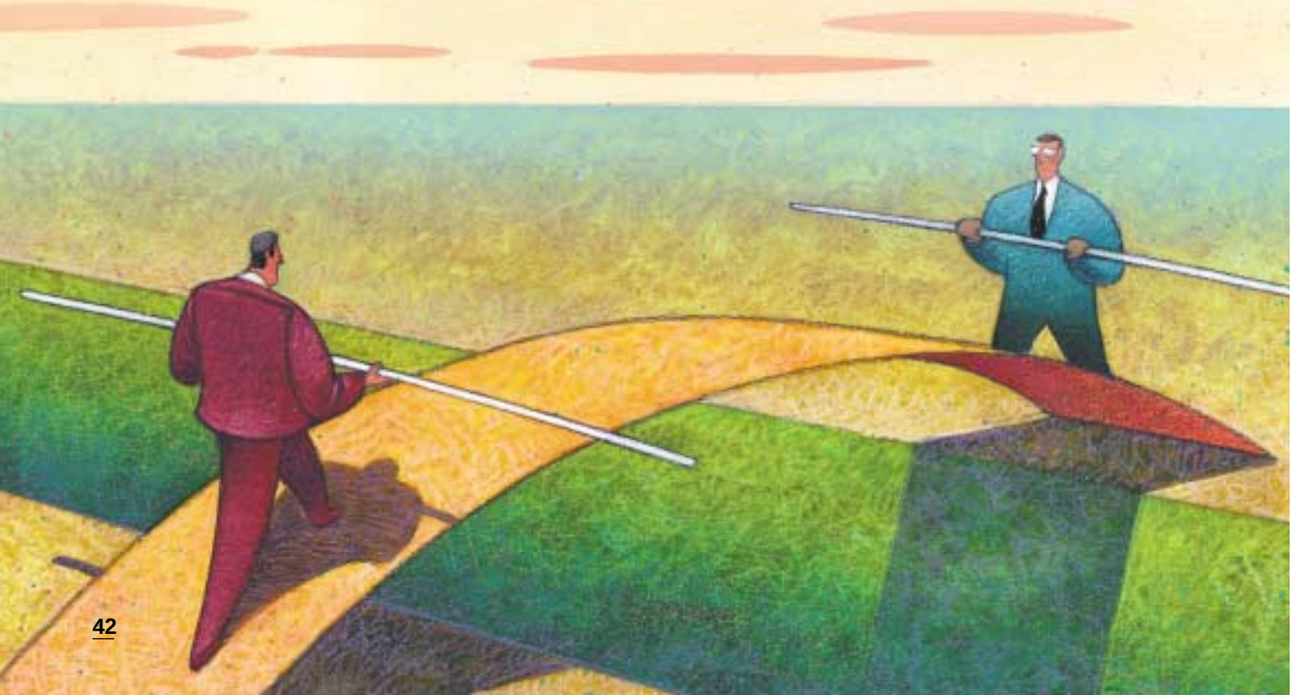
Two Schools of Thought

By Perry J. Greenbaum

Because of its vast distances and sparse population, Canada has always depended on a robust telecommunications infrastructure, a dependence that's grown to global proportions. Yet, surprisingly perhaps, there are few if any standards or regulations governing the software that controls everything from 911 emergency response lines to the Internet—or the people who develop it. Would software designed by licensed practitioners add value to, or increase the reliability of, our telecom infrastructure? Is the public unknowingly being put at risk by our dependence on devices controlled by unregulated software? The engineering profession may think so, but industry appears to remain largely unconvinced.



One of the rising stars of the high-tech sector, until recently, has been the telecommunications industry. At its zenith last year, equipment-makers like Nortel Networks, JDS Uniphase and Cisco Systems were furiously turning out routers, switches and gateways for the Internet economy.

Unknown to the general public is that many of these devices rely on a combination of software and computer chips to control their operation. Increasingly, these software-embedded pieces of equipment are becoming a more common part of Canada's telecom infrastructure.

In short, software is to telecommunications as fuel is to an automobile—it keeps things moving. In this case, it's bits and bytes of data that zoom over the airwaves. Whether it's a wireless telephone, an air-traffic control system, or a 911 emergency-response system, at the heart of such technologies is software, which for the most part has been developed by people other than licensed professionals.

That's a growing problem, says Peter Frise, P.Eng., an engineering professor at the University of Windsor. "There are no requirements to employ professional engineers to design software, even in safety-critical applications," says Frise, who in 1997 chaired a Professional Engineers Ontario (PEO) task force that examined the role of professional engineers in such emerging technologies as biotechnology, software development and information technology.

Little has changed since then, which ought to concern the public, Frise says. "Society may not realize the consequences of a software error," he points out. "It's more than a matter of a word-processing program not working properly. There are public safety concerns." The concerns that he and others share can best be narrowed down to this worst-case scenario: software failure leading to equipment failure. And if that equipment is a 911 emergency-response system, the consequences are alarmingly palpable. Not surprisingly, Frise advocates that only professional engineers have the final authority on design. (See "The Act says…")

This is also the view of Roger Barker, P.Eng., PEO registrar and chief executive officer, who explains the extra attributes a P.Eng. brings to the software design process. "A P.Eng. licence ensures that the person has a basic understanding of engineering principles, has been through a monitored internship period that includes a professional practice exam on law, ethics and liability, and is bound to a code of ethics that holds the public interest paramount. He or she is accountable to a regulatory body that can take away the licence to practise if the individual doesn't maintain the required standards," he says. "It is the combination of all of these requirements for licensing that makes a P.Eng. someone who knows not only how to write software, but also someone who understands the implications of what's being controlled."

Generally, however, the telecom sector views things differently, mainly through the pragmatic lens of commercial interests, arguing that a strong enough business case hasn't been made that it'll derive a commercial benefit by having P.Engs on staff. "The professional engineer licence becomes more attractive if it produces a discernible difference in value to employers," says Gerry Armstrong, P.Eng., vice-president of quality and customer satisfaction at Celestica Inc., a Toronto-based contract manufacturer for the information technology (IT) and telecom sectors.

Others in the telecom sector go so far as to say that the reason PEO is pushing hard on this issue is because provincial legislation that would make it mandatory for professional engineers to oversee software development would likely also fatten PEO's membership roll.

Such goes the debate between the engineering profession and the high-tech sector. The open question is whether the public is, in fact, at risk because a good part of the information superhighway–including the Internet, the telephone system and broadcast media–relies on an infrastructure that is, if not software-controlled, software-dependent.

Acting in the public interest

Given that the use of software is so widespread, one has to consider its implications in the design and deployment of telecom infrastructures. One of the core issues is the way the term "software engineering" is casually thrown about by the IT sector. That frustrates Peter DeVita, P.Eng., PEO past president and head of DeVita Associates, a system integrator and distributor of non-desktop computer products, who holds vigorous views: "Programming is not software engineering. It's like drafting to a civil engineer–it's a tool to implement a design."

There's a difference in purpose between the two fields, he points out: "The engineer tends to think in terms of interaction with the physical world." Thus, if software controls a physical device like a cell phone, that's software engineering. But if the software is a database program, that's computer science. That fine distinction is lost on many people, he says, even on professional engineers.

The outcome of the current slipshod definition, DeVita says, is that people with very

The Act says…

"Practice of professional engineering means any act of designing, composing, evaluating, advising, reporting, directing, or supervising wherein the safeguarding of life, health, property or the public welfare is concerned and that requires the application of engineering principles, but does not include practising as a natural scientist."

little training can say they are computer programmers. "It seems as if people with as little as three months of training can call themselves software programmers," he notes.

But restricting software design in particular areas to P.Engs raises the bar by ensuring "that working in the restricted scope of practice are only those people who have had proper training." Licensure, he says, assures the public that the person licensed has had the necessary training and basic experience, and has sworn to a code of ethics–a practice that is common in such professions as teaching, law and medicine. "You don't want your barber taking out your appendix, yet both use a knife," he notes. "It's the same kind of analogy."

DeVita argues that the IT professions should be overseen by a regulatory body like PEO: "If engineering is considered applied science, and we are applying science and technology where the public interest is affected, then the engineering profession is in the best position to regulate those areas of practice. It's a natural fit."

And there has been headway in this area, including discussions between engineering and computer science associations, mainly through the Canadian Information Processing Society (CIPS), whose members "seem to be on the leading edge for software professionals in their desire to become licensed," DeVita says.

As well, the first three software engineering programs in Ontario faculties of engineering were recently accredited by the Canadian Engineering Accreditation Board (CEAB) (see "CEAB accredits first software programs," *Engineering Dimensions*, July/August 2001, pp. 8-9).

But while accreditation of software engineering programs is a good start at establishing software development as a professional engineering discipline and software developers as professionals, it doesn't regulate software engineering practice today. And protecting and serving the public interest should demand a more proactive approach: "You don't want to wait for an accident to happen before something gets done," says PEO's Barker.

Making a business case

Still, the telecom sector generally doesn't buy the idea that its systems are less safe than others. "Having a staff full of P.Engs will not lessen the likelihood of system failure," says Celestica's Armstrong, who's been a P.Eng. for about 30 years. Celestica Inc., a $15-billion company, has 32,000 employees working at 37 manufacturing and design plants worldwide. About 2000 are engineers, including 500 in Canada.

Armstrong is an advocate of market forces, which say that companies that make quality products will succeed, and those that don't will find themselves out of business. As well, leading-edge companies in the telecom sector can ill afford to ship shoddy products, especially in today's competitive environment. This being the case, Armstrong cites three situations that would motivate

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What high-tech wants

When the Canadian Engineering Resources Board, a standing committee of the Canadian Council of Professional Engineers, released the report *Engineering Work in Canada: Biotechnology, Software Development and Information Technology* in April 2000, it drew a clear picture of how the high-tech industry differs from traditional engineering fields. Among other things, the report sheds light on what high-tech employers would value in addition to an engineering education. Intended to identify trends in three rapidly growing and technology-intensive industries and part of an ongoing, multi year research project on Engineering Work in Canada, the biotechnology-, software development- and IT-sector research comprised interviews with human resources directors and engineering managers in 93 companies. The research found that generally, growth in the three industries is four times the economic rate, and has been accelerating in the past five years. It also found that:

- engineering work is considered to be design of a product or process, based on results developed in the basic science stage;
- a minority of companies with a pronounced engineering orientation (mostly in the IT sector) recruit engineers for most general management functions, but in none of the industries is there natural progression for engineers into management unless they acquire an MBA or company-specific management training;
- non-technical skills that contribute to the productivity of multidisciplinary teams, such as teamwork, communications, writing, presentation, business understanding and leadership, are valued in engineers and project management skills are mandatory. In the biotechnology and IT sectors, engineers are required to understand quality control theory and systems;
- there are no clear lines between engineers and technologists, although design functions tend to be engineering, and production and trouble-shooting to be technology;
- in a significant percentage of companies, maintenance of skill currency is regarded as an individual responsibility;
- engineering graduates are held in high regard in these industries, especially graduates of co-op programs, and recent graduates are preferred when looking for individuals with programming skills, but graduates' non-technical skills are under-developed and companies are unaware of internship, mentoring or engineer-in-training programs as vehicles for graduates to acquire non-technical skills;
- companies identified strongly with technology-oriented professional associations, and moderately with professional associations that promote ethics and standards of professionalism, but none would make membership in a professional association necessary to obtain employment, and few consider it in recruiting or promoting;
- two-thirds of companies hold negative views on professional regulation, particularly if it intrudes on their managerial rights.

As noted, this research identifies the value employers place on non-technical skills and their dissatisfaction with recent graduates' abilities in this area. It also reveals the high value these sectors place on demonstrated knowledge of project management and quality control. The research also identifies the value employers place on the fostering and provision of professional and ethical values by licensing bodies, as well as their belief that professional development is a necessary but personal responsibility of employees. If the engineering profession can build these valued attributes into the requirements for licensing—or demonstrate that they're already embodied—it can only help to build the business case for licensure that serving the public interest may already call for.