Reinvigorating University-based Education, Research and Development in Nuclear Engineering and Technology

a report by
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The province of Ontario in Canada, like many jurisdictions in the industrialised world, is experiencing a nuclear revitalisation. Recent announcements assure nuclear refurbishment and new builds. However, we still do not know the particulars about the path forward. Perhaps we will build an enhanced CANDU 6 or two. Perhaps, it will be a CANDU ACR. Or it might even be an offshore design. But whatever the details, it is clear that we should have started yesterday to address the gap between the intellectual capital that we have in place and what we will need. Given the lead times involved in ramping up the knowledge sector, this is an immediate issue. The uncertainty in the details of the path forward makes it difficult for any one company to make solid commitments to new hires. In addition, companies tend to be coy with their hiring projection figures for competitive reasons. This has translated directly, in the minds of potential nuclear students, into an uncertain career path and, consequently, sluggish enrollments in colleges and universities.

Collectively, however, the needs are clear. Ontario will need a lot of trades people, technicians, engineers and scientists. This points to the need to act collectively, because there is too much scatter in the projected hiring data for any one company. The bottom line is that if industry wants unrestrained help from colleges and universities, then they had better project a substantial, solid and steady demand picture for the decades to come. If not, the academics will just keep on doing what they do best, which may or may not line up with what industry needs.

On the positive side, we are witnessing a number of local and international gatherings to address this issue. At these meetings a number of activities for co-operative exchanges have been identified. But I feel that we need to provide scale and perspective if we are to keep these activities properly directed. So I have been looking for an overriding theme to keep us centered. And we need to do a gap analysis to provide the vector from where we are to where we want to be.

I suspect that we can all agree on the desirability of access to energy supply as an underpinning of society. Further, we all see nuclear as a significant component of the supply mix. That is our centre. We can also all agree that intellectual capital is one of our main assets and that it is in limited supply for a number of reasons (demographics and competition from other industrial sectors to name just two).

The Demographic Gap

The demographic gap spans most countries and sectors. We should, then, be aiming to establish a broad platform that extends its reach beyond nuclear into other energy and industrial sectors because much of the intellectual capital we need is non-nuclear. If we do not co-ordinate our efforts with these sectors, we may get into an unhealthy competition for this scarce resource. Co-ordinated education and training programmes are possibly ways to optimise our collective ability to get as many people up to speed as quickly as possible. I think we have existing institutions and mechanisms to handle skill-based training (but we need more of it). The universities are also doing a good job at the research level (but we need more of it). We just need to fund more exchanges between universities and industry and between countries. So, in short, to get more people up to speed more quickly, we need to get the machine going without regard for where these people will end up. A simple example would be welders. The world needs lots of welders; we need some regular welders and some top-class nuclear welders. So, we can help the colleges and industry create lots of regular welders. We need that feed stock to create nuclear welders, and the bigger and better the feed stock, the easier it will be to generate the nuclear grade welders that we so sorely need. Ditto for generating that rare PhD in nano-corrosion. We need good undergraduates to draw from. As a colleague recently observed, we need to make the existing pie bigger rather than try to get a bigger piece of the existing pie.

The Institutional Gap

Industries typically hire college and university graduates from the traditional disciplines and then train them for the specifics of the job. Universities traditionally provide broad-based degrees at the

undergraduate level and specialised education at the graduate level. This leaves a gap – there is currently a limited path forward for the professional development of the working professional who is not so academically inclined. These are often the best engineers in the field but they do not qualify for graduate school. Perhaps more to the point, graduate school will not give them the skill set that they need anyway. They need to be 'nuked' by a series of workshops or courses at the undergraduate level. The image I have is of a solid chemical engineer becoming nuclear-savvy so that she can make appropriate design and operational decisions for process systems in a nuclear plant. Many of the courses should be of the type found in company internal training courses and in nuclear specific undergraduate level courses. Companies should share these courses.

The Geographic Gap

In this day and age of electronic communication, we should decide on a common shared whiteboard/ voice-over Internet (VOIP) platform so that an expert in the UK can give a course to students in Canada, or a lecturer in southern Ontario can have students in Ottawa and Bruce 'attend' classes in the middle of a snow storm. The lives saved alone warrants the expense. Again, bigger pie.

Sharing Our Strengths

The above identifies a heading, a broad measure of the gaps, and a broad sweep of how we might collectively close the gaps. But sweeping statements do not give us a bigger pie to share. Each of our institutions have strengths that we can share. Allow me to outline a few that I am directly connected with.

McMaster University has long had an active research and educational nuclear programme and we have a successful 5MW research reactor. We have seen the effects of rapid group in the 1960s and 1970s, a flat or declining few decades and now resurgence. Other universities in Canada, such as Ecole Polytechnique and Royal Military College, have also had, and still have, solid nuclear programmes over the years. Others, like the University of Toronto and the University of New Brunswick, have less entrenched nuclear programmes. Now, Queen's University, the University of Waterloo, the University of Western Ontario and the new University of Ontario Institute of Technology have joined the nuclear ranks. Industry showed considerable insight and strength when it created the University Network of Excellence in Nuclear Engineering (UNENE) in 2002 to help address the skills gap. Industry is funding new professorial Chairs and Associate Chairs at six universities with more likely to come. In specific terms, UNENE has three distinct objectives:

1. Enhance the supply of highly qualified graduates in nuclear engineering and technology.
2. Reinvigorate university-based research and development in nuclear engineering and technology focusing primarily on mid- to longer-term research.
3. Create a group of respected, university-based, nuclear experts for public and industry consultation.

Canada has another major activity that involves addressing the gap: CANTEACH. A public domain Web-based technical repository for CANDU reactors, with about 1,500 document files, this is a work in progress. We are running as fast as we can to capture knowledge before it fades (http://canteach.candu.org).

Both these initiatives are examples of how Canada is addressing the intellectual capital side of things and are unique in the world, as far as I know, in the extent of these initiatives given the size of the Canadian nuclear enterprise and the resources at hand for these purposes. We have been active with the International Atomic Energy Agency (IAEA) Nuclear Knowledge Portal initiative and I believe that they consider the Canadian initiatives as model initiatives.

A third initiative, which predates the other two, is the website that I run for my students here at McMaster (see www.nuceng.ca). It is not fancy but it is an example of what can cheaply be achieved in making nuclear engineering accessible to students. Course material is made freely available to students and professors worldwide to encourage exchange and a collective approach to education. There is a Who's Who page to link students to professors in Canada, a Careers page for help in them getting a job, resource links and so on. Lately, I have been recording my lectures so students can asynchronously see and hear my lectures. See course EP4D03 on that site, for instance. None of these things are fancy or profound or expensive, but they do the job.

Conclusion

The identified demographic, institutional and geographic gaps can be bridged buy activities like the few mentioned above. A very real barrier to bridging these gaps is the concern for security on a national and institutional level. Can we be enlightened enough to know that these concerns are moot if we limit our collective efforts to base level education, training, research and development? Can we be enlightened enough to realise that shared experiences and joint efforts are the stuff of understanding, respect and trust? The process of bridging the gaps is as important as the solutions they enable. ■