EESA
THE ELECTRIC ENERGY SOCIETY OF AUSTRALIA

ENGINEERS AUSTRALIA

EDUCATING ELECTRICAL POWER ENGINEERS

By Dr. David Sweeting

It is common knowledge that privatisation of the electricity supply industry over the last ten years has led to a significant reduction in the number of people employed in the industry.

This has occurred at all levels within the industry including electrical engineers, engineering offices and technologists. The resulting restricted availability of jobs for new graduates has resulted in a reduction of students taking electrical power options and this in turn has led to a reduction in the number of academic staff with power specialisations.

Whilst this can viewed as a cyclical reduction of previous over employment, the Electric Energy Society of Australia EESA had anecdotal evidence that redundancies were coming to an end and that a shortage of electrical power engineers had begun to appear.

Australia has enjoyed secure electricity supply at competitive prices in recent years, by working the system harder. The Energy Supply Association of Australia (ESAA) however believes that investment outlays of $20 to 40 billion will be required in the years up to 2010 to maintain this situation. This is liable to require increased staffing levels, which take up to five years to develop.

The EESA in conjunction with the Electrical College Board, ECB, of Engineers Australia and the Electricity Supply Association of Australia, ESAA, sponsored a survey of the projected supply and demand of electrical power engineers and engineering associates.

The survey was carried out by Professor Vic Gosbell and Duane Robinson of the University of Wollongong. Their report, “Assessing the future of electrical power engineering” is available on the EESA website (http://www.eesa.asn.au) and the Engineers Australia policy website (http://www.ieaust.org.au/./policy/publications.html).

The age profile of electrical power engineers is shown in Figure 4 of the report. The triangular structure of this profile is similar to other studies of skilled workers. It was present when railway engineers were surveyed (Engineering for Rail Sector Growth by Athol Yates).

Figure 5 from the report shows a similar profile for electrical power engineering officers. This will make it difficult to expand further the replacement of engineers with technologists because the same problem exists with the technologists.

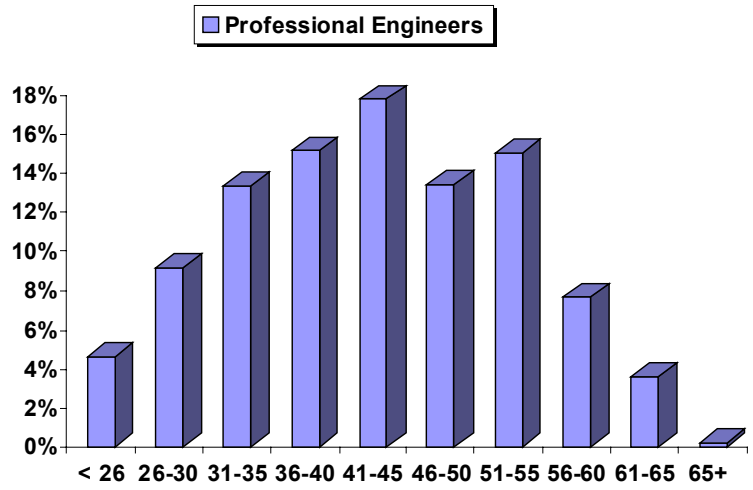

Figure 4: Age profile of professional power engineers, including staff and contractors

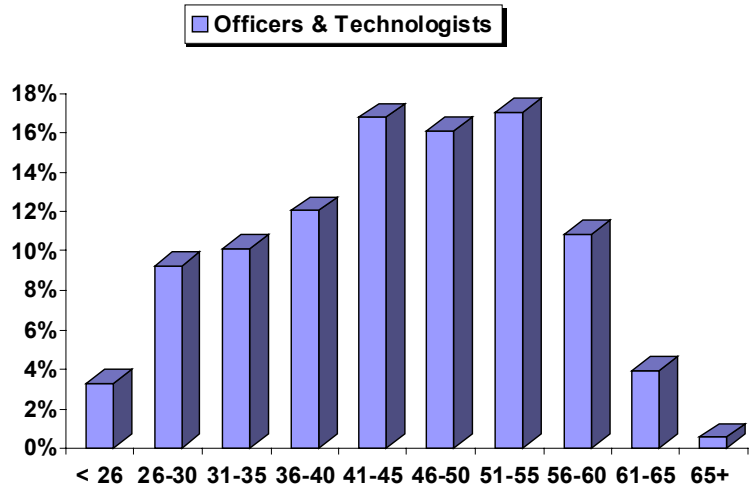

Figure 5: Age profile of power engineering officers and technologists, including staff and contractors.

From the survey, the report calculates that over the next five years 627 engineers will be lost to the industry due to the excess of retirees over graduates. The industry anticipates that around 692 more engineers will be required and the report's authors estimate that around 63 engineers will be lost to other activities. The conclusion is that around 276 new graduates will be required each year.

On the supply-side only 52% of the 512 annual electrical engineering graduates are local students with the rest being overseas students. Of these only 67% take at least one power specialisation in their final year. There are therefore only 218 local graduates with at least one power specialisation per year.

The survey therefore predicts there is likely to be a growing shortage of electrical power engineers. Evidence from overseas indicates that this is not a uniquely Australian problem. Most of the developed countries are having the same problems, with only China reported to

be producing electrical power engineers in significant numbers. Australia is therefore not likely to be able to immigrate itself out of this problem.

Electrical power is one of the main staples of modern society. Nothing works without it. Neither water supply or sewage pumps, communications, hospitals, manufacturing nor commerce work when the electrical power stops. This is a predicted skills shortage in a critical part of society.

The survey also found that 73% of employers who, are at present seeking new staff, were having difficulties finding suitable candidates. This was reported to be more an issue of suitability than sufficient applications.

This issue, which surfaced in the survey and was much stronger in its follow-up workshop, demonstrates that a gap has developed between what graduates are capable of and what industry expects and desires.

Part of this gap is that few want to train people these days. Some employers want engineers with ten years of experience. Organizations and practising engineers have insufficient time to mentor young engineers through their early practising years. The industry needs to address this drop off in mentoring activity.

The main reason for the gap however is the pressure to include so many desirable courses within the four-year degree time frame. Most people would realise that it is not possible to teach a student everything they may need to know throughout their career. EA's Course Accreditation Manual recognises this with: "Modern approaches recognise that the depth of knowledge and understanding, both technical and contextual, that are fundamental to real engineering capability, come from equipping students to learn for themselves, not from forcing knowledge on them."

Engineers Australia accredits undergraduate courses in accordance with the Washington Accord. See http://www.washingtonaccord.org. This provides Australian, British, American etc. graduates with international recognition of the equivalency of their degrees. It is essential that we continue to fit within the Washington Accord framework.

The accreditation process is performed in accordance with the "Manual for the accreditation of professional engineering programs", which can be found on http://www.ieaust.org.au.

This process allows the university to design the study program and market that program to students. The only content restriction comes from section 5.2 of the manual.

5.2 Program Structure and Content

The program structure and content must be such that the graduates acquire the generic attributes listed in Section 2 and achieve the program objectives. Typically a four-year professional engineering program should have the following elements:

- mathematics, science, engineering principles, skills and tools (computing, experimentation) appropriate to the discipline of study. This element should not be less than 40% of total program content;
- engineering design and projects. This element should be about 20% of total program content;
- an engineering discipline specialisation. This element should be about 20% of total program

content;
- integrated exposure to professional engineering practice (including management and professional ethics). This element should be about 10% of total program content;
- more of any of the above elements or other elective studies. This could be about 10% of total program content.

Engineers Australia also has a set of Competency Standards, which are used to assess membership applications from outside Australia. These include "Indicative range statements for enabling competencies". My understanding however is that they are not used in assessing Australian course content.

Apart from the guidelines above, there are therefore no lower limits on the Mathematics, Physics, Chemistry and Engineering Sciences in a degree. Nor does a degree in electrical engineering have any specific content of the four main streams of communications, computing, power and control. In fact, one stream can be almost missing.

Employers need to realize this and allow for the reality that they may need to train their graduates in the specific skills they seek. It is the lack of this realization, which is the main gap between employer expectations and graduate capability.

In Australia, the Australian National Training Authority (ANTA) (www.anta.gov.au) provides a national focus for Vocational Education Training (VET), which covers everything from Certificate 1 to Advanced Diploma courses. Under ANTA, the national Industry Skills Councils (ISC) with input from state based Industry Training Advisory Boards (ITAB) produce national training Packages, which specify Qualifications that are composed of units of competency which are written in terms of job outcomes or performance criteria that incorporate the required essential knowledge and associated skills. These qualifications or in some cases units of competency are delivered by Registered Training Organizations (RTO) (Often TAFE) who are registered by the State Training Authorities (STA). The Diploma and Advanced Diploma graduates from the VET system can apply for Associate membership of Engineers Australia. The first National (not state based) Diploma and Advanced Diploma training packages for the Electricity Supply Industry are being prepared at present (www.ee-oz.com.au). VET graduates (electrical engineering officers and technologists) therefore come from a much more prescriptive system with more uniform skills than degree graduates.

Another issue highlighted by the Gosbell report is the shortage of high school students taking mathematics and physics at the HSC level. This is causing problems not only in terms of limitations on the number of students that can reasonably expect to complete an engineering degree but also in terms of training enough teachers to bring through the following generations.

The EESA and the Electrical College Board believe that this is an issue for Engineers Australia and both State and Federal Governments.

Steve Williamson, the Director of Marketing and Communication at Engineers Australia has the task of addressing this issue and there are a significant number of projects being undertaken.

Engineers Australia has realized that a large number of students have already rejected many occupations whilst still at primary school. Any program to influence student perceptions of engineering as a career therefore needs to include both primary and secondary school activities.

It may however take more than contributions to the education schemes to turn around skills shortages. The media, political campaigns and the entertainment industry also influence student perceptions.

The Gosbell report also surveys universities and academics. The age profile of electrical power academics shown in Figure 17 of the report involves a cliff at around the age of forty. This could become a bigger problem than the increasing lack of power engineers.

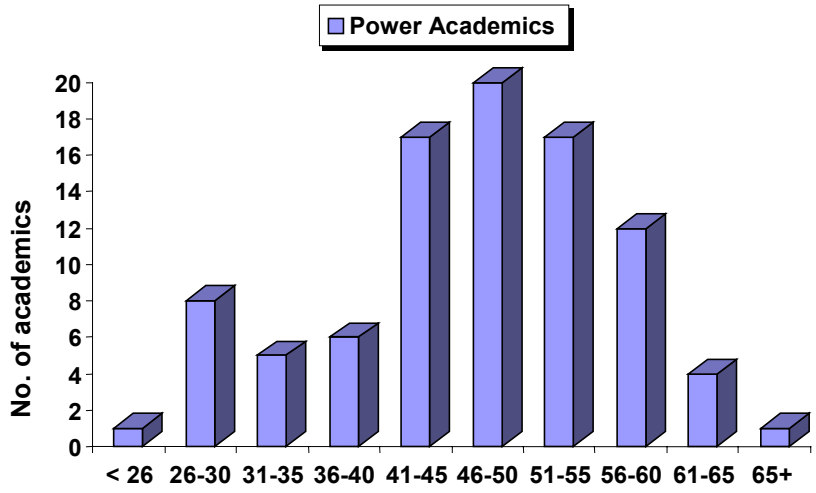

Figure 17: Age profile of power engineering academics.

This cliff is again a result of the changes in the power industry over the last ten years when recruiting has been minimal. The subsequent reduction in students has fed through to a reduction in academic staff. This reduction however has not been uniform across the age profile.

The electrical engineering schools reliance on overseas students for their viability is apparent from the fact that 52% of final year students are from overseas. Overseas students therefore need to be considered in any changes to the structure of the education system.

The electric power industry will need to find a mechanism to redress the collapse of power engineering academics that the above graph predicts. There is no sign of Government activity addressing these issues at present.

Whilst Engineers Australia can address the school student and undergraduate course content issues, the industry itself will need to take action on the lack of suitable job applicants and the impending problems of staffing electrical power schools.

This is likely to require:

- Encouraging undergraduate students to take power engineering. This is likely to require a more consistent flow of available jobs.
- Adopting a wider manpower input by employing non-specialist power engineers and providing training to achieve the skills required. This will require postgraduate courses.
- Encouraging mentoring and continuing education schemes. This also requires postgraduate courses.
- Encouraging existing engineers to remain in engineering rather than moving to management and other career paths. This may require changes to pay scales.
- Supporting some centres of excellence in power engineering with research and other funding to maintain a viable academic resource.
- Supporting electrical schools that do not have major power streams to ensure they provide a minimum level of power within their courses.

One of the options to achieve this is to set up an Australian Power Institute to obtain and coordinate research funding and organise post graduate training to replace that which has been lost from the undergraduate courses.

There is a proposal to set up such an Institute, which will be oversighted jointly by industry and the Universities. It is intended that this start in the three eastern states and develop into a national Institution along lines similar to those being developed in other countries. More information on this can be obtained from www.api.edu.au.

Footnote: Dr. Sweeting F.I.E. Aust. managed the University of Wollongong Project on behalf of Engineers Australia, the EESA and the ESAA. He is a member of the EESA National and NSW committees.