

AUSTRALASIAN ASSOCIATION FOR ENGINEERING EDUCATION

NEWSLETTER

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Monash University in Melbourne, Australia, will host, on behalf of UNESCO, the 1995 International Congress of Engineering Deans and Industry Leaders, between 3 and 6 July 1995. A Congress brochure, including a call for papers and other Congress contributions, is now in circulation. A short Congress progress report is presented by the Congress Honorary Chairman and AAEE President, Professor Peter LePoer Darvall, overleaf. Picture above shows Swanston Street, a multicultural and vibrant street, in the centre of Melbourne. Cars are no longer allowed in this area.

FROM THE PRESIDENT



Prof. P. Darvall

You will by now have received some details of the 1995 *International Congress of Engineering Deans and Industry Leaders* to be hosted by the UNESCO Supported International Centre for Engineering Education (USICEE) and to be held at Monash University from 3-6 July 1995. This Congress is sponsored by The Institution of Engineers, Australia, together with other national and international organisations, including your Australasian Association for Engineering Education, as co-sponsors.

All those with an interest in engineering education, whether from industry or education, are urged to prepare a paper and to participate in the 1995 Congress. The name of the Congress is a traditional one, and seems to connote heavyweights doing deals. However, the Congress is not just for engineering deans and industry leaders but provides the perfect opportunity for all to contribute to discussions of issues concerning engineering education in an international forum. Engineering educators at all levels have the chance to influence change and innovation in their profession through this Congress. Joint papers from academics and industry are particularly welcome.

The USICEE has initiated a number of actions in preparation for the Congress in order to stimulate interest around the world and to address a number of important issues which can be later raised at the Congress. A *National Symposium for Engineering Deans and Industry Leaders* will be held in Lodz, Poland from 26-27 September 1994 and an *International Conference on Engineering Education - An Indian Perspective* will be held in Visakhapatnam, India between 21-23 November 1994. Further, the Russian Association for Engineering Education will collaborate with the Australian Association for Engineering Education and USICEE in the organisation of a conference on engineering education in Moscow in May 1995. These and other conferences, such as the *3rd World Congress on Engineering Education* in Cairo in November 1994 and the *Beijing Conference on Development and Role of Women in Technology* in September, we believe will provide a variety of themes to be addressed at the 1995 Australian Congress.

The Australasian Association for Engineering Education's own *6th Annual Convention and Conference* at UTS from 11-14 December will provide another opportunity to discuss important issues for Australian engineering education so that they can be on the agenda for the 1995 Congress. It will not be too late to use the Conference to make some last minute arrangements for Congress papers.

The *Call for Papers* brochure has indicated a large number of topics, but this is not an exclusive list, and papers on all important issues relating to engineering education and industrial training are sought. The date for receipt of synopses is 15 December 1994. AAEE members are requested to invite their industry friends and academic colleagues in other countries to participate in this Congress.

Review of engineering education

The Australian Council of Engineering Deans and The Institution of Engineers, Australia have prepared a submission to the Department of Employment, Education and Training (DEET) for a substantial grant to conduct a review of engineering education in Australia. The Association is keen to play an important role in this review. Further details later.

Quality and innovation

Many of the quality portfolios submitted recently by universities no doubt include references to best practice in engineering education and in its administration. We would be pleased to include in the Newsletter any items on this topic to enlighten all of us, and to provide the best possible learning experience for the young men and women whom we serve in our universities.

QUALITY, DIVERSITY, TECHNOLOGY: THREE INTERWOVEN ISSUES IN ENGINEERING EDUCATION

Overview



Mr Roger Hadgraft

This short paper was inspired by the 5th Conference of the Australasian Association for Engineering Education in Auckland in December 1993. The Conference was based on a theme of Aiming for Quality, but two other themes emerged during the papers and discussions, namely:

- * diversity - the need for tolerance in engineering of culture, gender, language, and other social issues, and
- * the appropriate use of new technologies to achieve a new style of engineering education.

Each of these three matters is discussed, and a possible solution is suggested of adopting a Problem-Based Learning (PBL) approach to the curriculum. What became increasingly obvious during the conference was the trend, as we approach the 21st century, that problems faced by engineers are increasingly moving from *hard* (technological) problems to *soft* (social) problems. Since engineering courses tend to be highly focused on technology, this will require a major rethink in engineering curricula.

Some authors have been mentioned in the text. Please refer to the conference proceedings for the full version of their papers.

Quality

The one quote about quality that really appealed was this one:

Nobody has to do Quality. Survival is not compulsory. Deming

Rob Wilkinson (President, IPENZ) was the opening keynote speaker. He described Quality as the seed from which an organisation must grow, rather than the tinsel on the (Christmas) tree. It is essential to build in quality, rather than weed out poor quality. Continuous business renewal is the aim, and implementing TQM is a 6-8 year task. Senior management must do quality and not just talk about it.

Most importantly, TQM is about empowerment of people through self-directed teams. In our case, this means self-directed teams of students responsible for their own learning (a traditional aim of PBL).

Everyone needs to know and feel they are needed. Everyone wants to be treated as an individual. Giving someone freedom to take responsibility adds resources to the team or project which otherwise would not be used. Again, allowing students to take greater responsibility for their own learning adds resources to the teaching and learning process. Too often we assume that only the lecturer contributes knowledge to the teaching process. By empowering students, we can tap into their abilities as well, particularly by allowing their work to contribute to the accumulation of teaching resources such as notes, spreadsheets, computer programs, etc.

A paper by David Holecek (a fourth year student) and the author addressed the need to introduce a TQM approach in the teaching/learning process. By considering Deming's 14 points (somewhat condensed here), the following important changes are required:

- * Constancy of purpose - resolve the teaching/research dilemma by moving them closer together through PBL (Problem-Based Learning).
- * Eliminate the need for inspection (formal examination) by working closely with students so that their understanding is guaranteed and observed at first hand. Computer marked

assessment might also help in this regard for rote learning or simple algorithmic skills. Empower the students to be responsible for their own learning so that they will seek understanding. Eliminate (as much as possible) numerical quotas such as exam marks while still retaining some form of grading to encourage excellence.

- * Work with our providers (schools) so that our intake students are of the highest, most consistent standard possible.
- * Seek continuous quality improvement by seeking problems and addressing them, eg through staff/student liaison committees (see Bullen et al).
- * Training and education in the process of learning is essential for all staff and all students. This must occur from day one at university.
- * There must be an effective management structure to implement these ideas.
- * Drive out fear by building trust and communication. Empowerment of the students is essential. Break down barriers between groups - particularly between staff and students, but also between academic and general staff.
- * Develop pride of workmanship. This can best be done for the students when they take a much larger role in their own learning - self-directed learning, perhaps not in everything that is done, but in a substantial part of it.

Diversity

There is a significant impact (largely unnoticed) of culture in everything we do. For example, there is a large difference in manager behaviour across countries - even in small regions such as Europe. This includes individualist (eg USA) vs collectivist (eg Japan) cultures. Australia is individualist. Engineers need to understand these differences.

Engineering artefacts can have enormous social effects, eg the telephone, railways, freeways, etc, yet engineers rarely contemplate this; nor are they asked to consider these issues at university. In fact, engineering courses are quite successful in training groups of students with quite diverse views into a stereotypical, technology-oriented one.

We need to harness the diversity of cultures in the staff and students to develop an empathy within the classroom for diversity in all its aspects. *The only thing that matters is people.* This can be as simple as respecting other professions rather than putting them down. (We will have to abandon all those lawyer jokes). Can we define such cultural competencies?

Russell Jones, in his acceptance speech for the AAEE International Medal, pointed out that there is a pressing need in engineering graduates for:

- * Foreign language skills
- * Cultural understanding
- * International business know-how
- * A knowledge of international professional and technical standards - ethics, warranties, tenders, law, and so on.

David Thom indicated that engineering design has been taught and practised in isolation from its social and environmental implications. We need a new ethical design, and a new technical culture that understands the fettered technology of the future (based on sustainable development).

Mr Salmon emphasised the need for a systems approach to engineering problem solving. (This was first recognised in the 1960s). As part of this, we need to develop an ethical relationship with nature. In the future, we need to provide access to work and recreation without transport, and we need to cope with the new toxics which are CO₂, waste and

congestion. These are likely to be managed through the use of regulation, education and economic incentives.

How do we develop a new course that can achieve these things - social and environmental issues, languages, information retrieval skills, communication skills, management, tolerance for diversity, and an understanding of equity, teamwork, entrepreneurship, systems analysis, ethics, legalities, aesthetics, culture, consensus, religion and so on?

Teaching Technology

Various examples of Computer Aided Learning (CAL) were demonstrated, such as Toolbook (G. Melissaratos), and Authorware (Michael Moore). However, the technology is still being used mostly to reproduce lectures, rather than trying to jump to a new form of resource-based education. That is, we are still spending our time trying to put information into students' minds rather than develop their problem solving and information retrieval skills. More of this later.

Mr Zwimpfer (Telecom, NZ) described the technological trends of computers, multimedia, mobility and consumer electronics. Assisting technologies are digital networks, intelligent networks, and fibre optic. Fibre optic will replace airborne communications because of the limited bandwidth of airborne communications. However, if we add more fibres, we can have as much bandwidth as we like. Similarly, traditional cable borne communications (telephone) are increasingly becoming airborne (namely mobile phones).

The traditional view of the office is changing. More and more workers are becoming mobile or working from home. Social interactions are still important, and the videophone will provide some of that for these workers (eg AT&T switchboard operators working from home). Likewise, open learning will become the norm. This is a resource-oriented view of learning. Lectures will decrease in relevance, and resource-oriented, problem-based learning will be the primary mode. Likewise, there will be less emphasis on teaching students to remember content (already available on CD ROM).

Mr Stevens (Apple Computer) characterised 1975-90 as an era when users learned from their PC, and the next decade as the time when the PC learns from the user. This capability will be based on significant increases in processing power (Power PC, Pentium, Alpha, MIPS) which will further improve the user interface (eg voice recognition). Telephone integration with the PC is part of this. The software phone already exists.

A new course form?

To try to see how some of these technologies might be used in future engineering courses, a special forum was organised. The author proposes that we need to make effective use of computer technology, not to replace lectures, but rather to invent a new style of engineering education. This would be resource-based, with students provided access to a wide range of computer programs, spreadsheets, and programs such as Mathcad. This will allow us to spend less time on teaching algorithms, and more time on important issues such as problem formulation which includes the cultural issues discussed above.

Each year we treat each student as a blank sheet, whereas we could be giving each new year's students a growing collection of spreadsheets and other software encapsulating the algorithms in each course. Much of this could be the output of students in previous years. Thus the students could be directed to consider more complex issues, freed from the tedium of calculations. This is the shift from hard science to soft science mentioned earlier. Such a course would need to use a problem-based approach, drawing on these resources as required. Such a problem-based approach is more in tune with the realities of the workplace, and is more likely to be successful in developing creativity in our students.

One of the advantages of an environment rich in computer models is that we can spend more time stressing the importance of understanding modelling. This was a point raised by Trevor Daniell and the author in our PBL paper (which focused on hydrological modelling).

It is hoped that these ideas will be further developed on the recently established AAEE mailing list. To join the list, send an email message of *sub AAEE firstname lastname* to LISTSERV@eng.monash.edu.au. Thereafter, send your ideas and comments to AAEE@eng.monash.edu.au. You can join the PBL-LIST, HYDROLOGY and MATHCAD lists in the same way.

Conclusions

The interconnecting threads of quality, diversity and technology will reshape engineering education in the future - perhaps markedly by the end of the decade. Problem-Based Learning, and other forms of resource-based learning will allow students to develop an understanding of cultural and other social issues in context with technological problems. The aims of PBL are consistent with the aims of the TQM movement as described by Deming. A PBL approach also provides for effective use of computer technology in the teaching process. A resource-based approach would allow us to provide students with a wide range of computer programs, tutorials, on-line books and other reference material in an environment where the students take a leading role in defining their own learning needs. This is essential for the future when engineers will be increasingly required to retrain themselves.

Roger Hadgraft
Senior Lecturer
Department of Civil Engineering
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UNDERGRADUATE LABORATORY FACILITIES. STUDENTS DESERVE BETTER.



Mr Mark Breznik

With the Hong Kong media recently reporting on the poor state of teaching equipment in Australian universities with the headline *Engineers warn university faculties on poor equipment*, Australia's reputation as a respected and credible supplier of education is being challenged. Undergraduate engineering teaching facilities at some Australian universities are either non-existent, extremely limited or hopelessly antiquated. Funding targeted directly at re-building our undergraduate laboratories is urgently required.

Over a period of 2 weeks during mid-February of this year, Terry Wilson, Area Sales Manager for Armfield Limited, a UK supplier of engineering teaching equipment, and I toured 12 universities in New South Wales and Victoria visiting 25 engineering schools and faculties. This is a personal view of our observations and I hope it adds to the voices calling for a revision of policies in the area of the provision of undergraduate teaching facilities.

Amongst the universities visited, the range of teaching equipment on hand, access to support staff and plans for future acquisitions were wide and varied. A couple of the universities, in view of the considerable resources available to them, had outstanding undergraduate facilities. But for the majority, with the student population increasing from 350,000 to almost 600,000 in the decade to 1993, resources are being stretched and lecturers are being expected to perform the almost impossible from the mostly invisible.

In one Civil Engineering laboratory, the lecturer lamented the university's undergraduate teaching policy. He would have 3rd year students come into his lab who did not know what a pitot tube looked like. Certainly the topic had been covered in *chalk and talk* sessions in first year, but practical experience was non-existent. When this was mentioned to the Mechanical Engineering lecturers at the same university, they had to admit that they were in exactly the same situation - 3rd year students who had never seen a pitot tube. Both departments had no practical equipment for teaching undergraduate topics.

A Review of Facilities

Much is regularly written in the professional education journals about developments in teaching materials and equipment. Indeed, the focus is on utilising educational and information technology such as computer assisted learning, interactive multimedia and computer simulations.

In contrast, apart from the IEAust report on mechanical engineering, there has been almost nothing written in the last two years on the state of our engineering teaching equipment and future strategies in this area [1]. With little direct funding available, there is effectively no incentive for the area to be investigated.

Of the four chemical engineering departments visited, all were well stocked with both home made and off the shelf teaching equipment. While some equipment was up to 20 years old, all appeared to be well maintained with small amounts of funding regularly available for updating.

The same can not be said with the state of the six out of seven civil engineering departments visited. One department was fortunate to have a laboratory manager that had established excellent facilities and was working towards integrating existing equipment with video and PC-based presentations. The remaining six departments ranged across: extensive set-ups of 1960s vintage equipment, some home made equipment, primarily research with a few undergraduate pieces or almost no teaching equipment. Funding in most cases has not been available for years, and I am sure that an IEAust report on civil engineering would yield similar results to those in the mechanical engineering survey.

The visits to five mechanical engineering departments was much the same as the experience with civil engineering. A large institution with considerable funds had outstanding facilities. The remainder either had not seen an injection of funding since the late 1960s or else available funding led to a focus on research to the exclusion of teaching equipment. At this time it is also worth noting a characteristic that we saw a couple of times, where new buildings were established, but there was no funding remaining or allocated for laboratory equipment. Again, this left lecturers with well appointed offices, but unable to offer students practical laboratory time.

Finally, six food technology departments were visited. Here, there was one outstanding existing facility, another facility that is currently being built up and will surely become an outstanding facility, one with limited 1960s vintage equipment, several that can put up with current resources but required upgrading and one with virtually no equipment. Interestingly, the strongest food technology departments are those that are stand alone, not those which are offshoots of a larger department with its own teaching and research agenda.

Warnings on Laboratory Facilities

Since 1986, the export of educational services to full fee students has been widely reported in the Australian media. The sector contributes over \$1 billion dollars per annum to the economy and contributes \$250 million of income to the universities concerned. By 1993, there were over 40,000 overseas students attending Australian universities, a fivefold increase in the last five years.

As Kim Beazley pointed out in a Ministerial Statement, the *key to international education success is a reputation for quality - for high quality degrees and awards and high quality student services* [2]. This is indeed a fine sentiment, but we risk losing the reputation that Australia's education professionals have worked so hard to establish. Indeed, some commentators already quote research that confirms a widespread view among foreign students that US and UK education is of higher quality, while Australian education is generally seen to be of lesser quality [3].

We should take note of the warning signals. The IEAust recently drew attention to the problem in the College of Mechanical Engineers survey of 14 mechanical engineering

departments. Out of 223 major items of equipment surveyed, 30 per cent required replacing and 27 per cent were more than 10 years old. This experience was reinforced during our tour of engineering laboratories where much of the equipment that was still in use or in various states of disrepair was typically of 1960s vintage.

But more importantly, IEAust's survey and warning that three universities risked losing professional accreditation for their mechanical engineering courses was also reported in Hong Kong's media. In fact, so much was it noticed, that a copy of an article on this issue was faxed by a staff member at The Hong Kong University of Science and Technology to Armfield in the UK for reference. We cannot forget that Hong Kong sends the most students to our educational institutions. In 1992, Hong Kong students numbered nearly 10,000, constituting 18.5 per cent of all full-fee overseas students. The ramifications of this type of negative publicity are obvious and require urgent attention.

It is also worth noting that universities in South East Asia are aggressively investing and updating facilities with literally millions of dollars worth of the latest state of the art teaching equipment. The Asian Development Bank and World Bank as well as governments are working hard to develop the engineering talent required to drive their *Tiger Economies*. Here again, Australia needs to take note of the competitive pressure that we are under to provide a world class service and invest in our educational *plant*. We simply cannot allow another 10 years to pass as our teaching stock become no more than quaint museum pieces of a bygone era.

Targeted Funding

The heyday of Australian universities expenditure on a large scale was certainly in the mid to late 1960s. More recently, despite government spending of around \$4 billion per annum and an expected federal outlay of \$14 billion on universities in the next three years, funding per unit of student load has fallen by about 15 per cent in real terms in the last 10 years (Higher Education Council 1992) [4].

While the fall in funding is part of the problem, the allocation of these limited resources towards research which is *being given all the kudos and larger and larger shares of the money at the expense of teaching is also being cited* [5]. This view has been strongly expressed by Max Charlesworth, where he also points out *The only way universities can get substantial extra money is through the research kitty that has been clawed back. Winners of ARC grants get warm letters of congratulations from their vice chancellors and deans for adding lustre to the Alma Mater and usually the first act of research grant winners is to buy themselves out of teaching.*

During our tour, we had heard the view expressed that 1st and 2nd year students would be taught by the *chalk and talk* approach as there was little or no undergraduate teaching equipment available, whilst 3rd and 4th year students would use whatever *research equipment* was available.

The simple fact is that the funding regime by its nature offers very few avenues for funding undergraduate teaching equipment, as opposed to research equipment funding. Hence, IEAust's recommendation that DEET be made aware of the special requirements of mechanical engineering departments. This requirement can easily be multiplied over and over across the various engineering departments that we encountered. A funding option allowing the upgrade and upkeep of teaching equipment is vital.

Conclusion

The threat posed by the IEAust survey and the attention it has gained overseas, and is likely to continue gaining while Australian universities are under international competitive pressure, requires serious consideration by Australian funding bureaucrats. This is especially the case when South East Asian universities are being very heavily funded and teaching facilities developed are state of the art.

The experience of visiting the 12 universities with departments ranging across civil engineering, mechanical engineering, chemical engineering, environmental engineering and food technology showed that in the majority of institutions, the lack of funding is likely to have led to a reduction in teaching capability at these institutions.

Not only is this likely to affect the quality of engineering teaching in Australia in the future, but it also has the potential to seriously damage Australia's image in the Asia-Pacific region as a reputable supplier of educational services.

- [1] Hall, S.L., A Study of Equipment in Mechanical Engineering Education in Australia, The Institution of Engineers, Australia, 10 June (1993).
- [2] Beazley, K., International Education in Australia Through the 1990s, Ministerial Statement, Canberra: AGPS (1992).
- [3] Smart, D. and Ang, G., Exporting Education, *IPA Review*, 46, 1 (1993).
- [4] Maslen, G., *Education Supplement*, Bulletin, 17 August (1993).
- [5] Charlesworth, M., From Dawkins to Where?, *J. of Tertiary Education Australia*, 15, 1 (1993).

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THE NEED TO CHANGE ENGINEERING EDUCATION OBJECTIVES IN TERMS OF SUSTAINABLE ENGINEERING



Mr Arndt Stephan

We are all responsible for what happens on this earth and for how it happens. Each one of us must do everything in our power to ensure that the future is worth living.

Deutsche Aerospace AG

Aims and Significance

Our technology-based society has created many global problems which endanger its own future and require immediate action in order to cope with the threat. A general change in human awareness must be created.

The engineering profession is a major contributor to the current situation. Therefore, the profession itself should initiate and back up a long-term transition through a change in the engineer's mind and in engineering education. In the past engineers and scientists did what they were told to do by politicians or commercial managers. Now, these professionals should stand up and develop their own professional ethics leading to environmental and human friendly technologies.

One objective of this new approach should be to investigate and evaluate current global problems such as CO₂, Ozone degradation, or pollution, and determine the impact of different technologies on these problems. The most challenging task is to derive new strategies for engineering education, particularly in the curriculum, so that it takes into account the possible solutions to global problems. Special emphasis should be on the future development of third world countries.

Background

The last decades of mankind, particularly in the developed countries, have clearly had an enormous impact on life on planet earth. These changes are recognisable in our society and

AUSTRALASIAN ASSOCIATION FOR ENGINEERING EDUCATION

6TH ANNUAL CONVENTION AND CONFERENCE

INSPIRING INTEGRATION



Faculty of Engineering,
University of Technology, Sydney

11 - 14 December 1994

The Association's 6th Annual Convention and Conference to be held in December this year is entitled *Inspiring Integration*. This year the organisers aim to bring together industry, academia and students to discuss and debate the current imperatives in engineering education. The initial event at the *Inspiring Integration* Conference will be the 6th Annual General Meeting and Convention for the Association. This will be held on Sunday, 11 December 1994 and all members and interested parties are welcome to attend. The major organising themes for the following three days are: Future Scenarios, Partnership & Integration, and Learning Innovations.

Special presentations will include, but are not limited to:

- * Challenges for the Future Engineer
- * Directions in Professional Employment and Education
- * Educating Engineers for Innovative Enterprise
- * Formation of Professional Engineers
- * Innovations in the Delivery of Education
- * Issues in Operating Partnerships
- * Learning in Practice
- * Professional Engineering in a Transnational Context

Conference Features

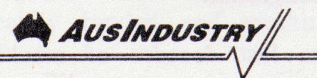
- * An exhibition of industry and academic programs and courses that are related to engineering education, both in the workplace and for continuing professional development. The exhibition will also include displays illustrating the recent advances in classroom teaching aids and methods, and will highlight major new technologies and information pathways.
- * An interactive workshop, led by Mr John Leaney, the *Robyn Williams* of Engineering, will explore major issues in engineering education and the future of technology in an open discussion with industry and opinion leaders.
- * The Conference Cocktail Party, is to be held on Monday, 12 December, in the Grand Foyer of the Power House Museum, a site where technology and engineering come together.
- * The Conference Dinner, to be held on Tuesday, 13 December, in the forecourt of the Sydney Opera House, overlooking the water. A feature of the dinner, aside from world-class cuisine, will be the surprise after-dinner speaker, who we are sure will amuse and delight.

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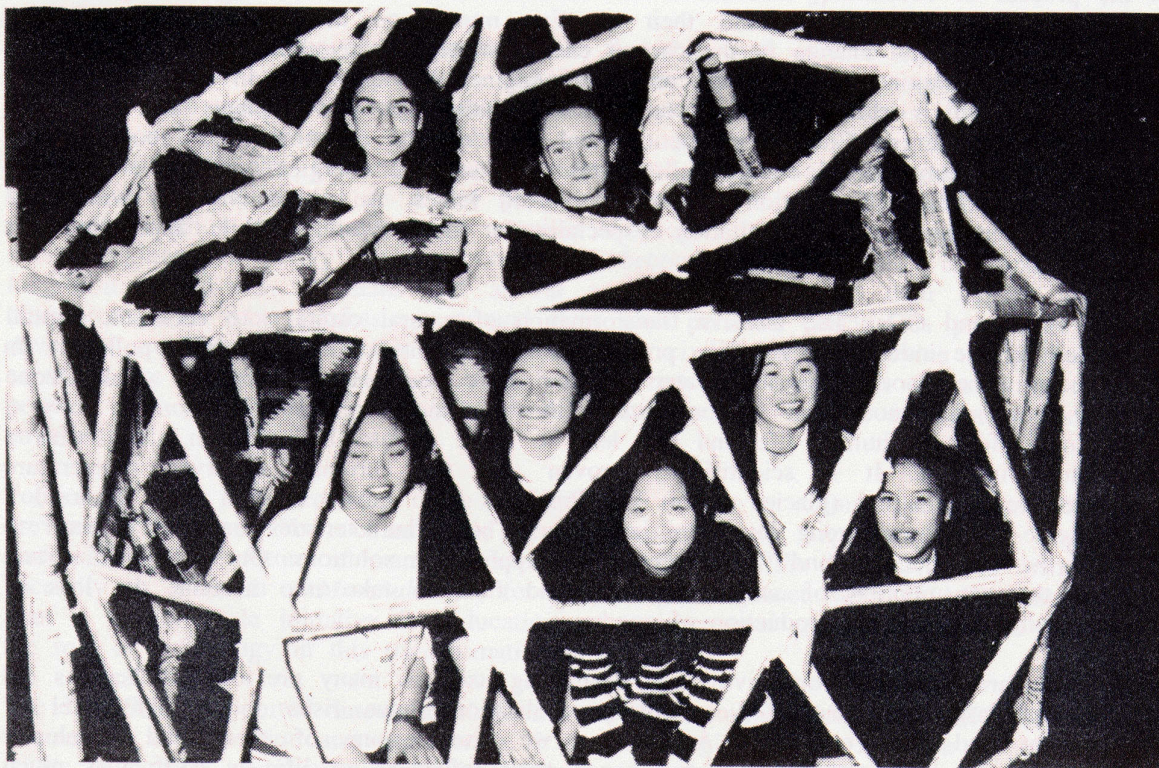
Registration fees:

	Earlybird	Full registration
	to October 14 1994	after 14 October 1994
Inspiring Integration Individual	\$485	\$525
Inspiring Integration Corporate	\$485	\$525
Student Registration	\$150	\$150
Australasian Women in Engineering Forum	\$ 85	\$120
Combined Registration (Forum & Conference)	\$525	\$575

The inaugural Australasian Women in Engineering Forum to be held on Saturday, 10 December at UTS aims at bringing together practising professional engineers, EEO and equity managers, and training and human resource professionals in a forum to develop and discover new methodologies and strategies to promote and advance women in engineering.

Structural economic issues that create barriers for women in the workforce and education systems will be explored, along with processes for personal and organisational change and development.

The Forum format includes workshops, presentations, group work and open debate, all of which will be working towards preparing a folio of outcomes. The folio will be published after the conclusion of the Conference.



Registration packs and more information about the Forum and the Conference are available by contacting either:
 Ms Kate Fiddy (02) 330 2603 or
 Ms Victoria Hunt (02) 330 2754 or
 by faxing a request for information to: (02) 330 2611 or (02) 330 2714
 (e-mail: k.fiddy@uts.edu.au).

our environment. Both current and future problems tend to be global rather than local. Hence, people do not see the necessity for local action and tend to push the blame for the problem onto somebody else. In addition, our technology-based world has reduced the awareness of our dependence on nature. According to Prof. H. Grassl from the Max-Planck-Institut for Meteorology in Hamburg this behaviour can lead to a catastrophic decay of life on earth since a transition to a more sensitive life-style is too late when the consequences are already in view. The main reasons for our current situation are [2][4]:

Population: The world population's growth over the last two centuries has been exponential, reaching 5.5 billion in 1992. The main reason was the scientific, economic and industrial revolution, which began in Europe in the 18th century and which decreased the mortality rate significantly while maintaining the same birth rate, resulting in a big population boom. These modern achievements were exported to the rest of the world where their effects are still evident. To date, the developing countries have a very high growth rate and their proportion of the world population will increase further in future decades. Their low standard of living fosters the implementation of western life-styles, characterised by an enormous consumption of scarce resources, in order to achieve a higher standard of living. Keeping in mind that just 25% of the world population (industrial countries) is using approximately 80% of the world's annual energy production, the consequences this process would have on life on earth are evident. People living in mega-cities with several million inhabitants simply lose their awareness that human life is dependent on nature.

Energy: To date our demand for primary energy is covered mainly by fossil fuels (95%) like coal, oil and gas. Nuclear energy (fission) accounts for 2% of demands, with alternative energies such as photovoltaic, wind, geothermal, etc responsible for the remaining 3%. The unrenovable resources currently being used were formed over millions of years and man is in the process of consuming them in a few centuries. Due to the looming shortage of our current non-renewable energies and their negative impact on the environment (pollution, radioactivity), a radical change in the current energy strategy is required. The energy mix is based on the invention of steam and combustion engines and electricity in the 19th century. This phenomenon is characterised by large energy units like power plants and the wide distribution of energy. Energy production and the energy consumer are geographically separated. Using small local energy cells based on alternative energies would overcome the problems of pollution, distribution and the associated losses. An alternative fuel with good potential for storage and transportation, especially for non-polluting mobile applications, is hydrogen.

Ozone, Water and CO₂: The massive transformation of natural capital into economic capital introduced by the industrial revolution, produced huge amounts of non-recyclable pollution. In more recent times, normal air and water pollution have been extended by the weak Ozone layer and colossal amounts of carbon dioxide in the atmosphere. Both phenomena have a devastating effect on human life and can lead to more intense UV-radiation along with a temperature increase. It is scientifically proven that the currently observed temperature variations are not natural (glacier decay) [5]. Problems have grown from a local basis to a global scale and show strong long-term behaviour. These characteristics make it difficult to confront the consequences and find accepted and appropriate solutions. Our economic system supports the consumption of scarce resources and fails to take into account the loss of natural capital through the production of goods.

Many signs are present of our civilisation destroying itself as many previous civilisations did [1]. In the last few thousand years many civilisations have risen to a high level of development and then collapsed. As far as we know, none of them had developed technology as sophisticated as ours and hence their influence on life on earth was much smaller. A collapse of our society would probably have a much greater impact on planet earth.

Clearly from what has been mentioned, the only approach for the survival of our civilisation is for the people living in the richer western countries to reduce their consumption of raw materials and goods (collision with growth-policy). Our current economic system based on growth policy has to be transformed into a development system. In other words, the

emphasis on quantity is to be replaced by a quality policy.

One way this can be made politically acceptable is by developing people's consciences to the point where they are prepared to measure the success of life by their creative self-fulfilment, rather than by their possession of status symbols. This concept can be made more precise if we draw a clear distinction between quality of life and standard of living. Standard of living can be expressed as Gross National Product (GNP) which is a purely materialistic measure of wealth. Quality of life is a much more subjective measure.

A good illustration for this distinction is the following example [1]. If one plots the daily food input to an adult in kilocalories against the health of the individual, at very low calorie inputs the person is starving. However, as food input to people is increased further their health rises to an optimum and then slopes down the other side as they become obese.

The UNESCO Supported International Centre for Engineering Education and Sustainable Engineering

The reasons for our current situation, even the social problems, are related to our technology-based life-style.

Clearly the engineer cannot solve all the world's problems alone because this requires general sacrifices, state efforts and long term political decisions. Nevertheless, the engineer can and must show whether there is a feasible solution. The engineer has the executive power for change in our technology-based world. The engineer or applied scientist is necessarily involved in the moral problem of whether his or her work is producing something which improves or harms the life of human beings in general. Instead of reacting as an individual, he or she must be concerned with this global problem.

The pure scientist can be amoral in the sense that this work can be regarded as completely disconnected from human applications, although it is becoming increasingly difficult for any branch of pure science to be separated from its practical consequences for humanity. The engineer, on the other hand, must always consider questions to which there is no clear-cut answer, such as the balance between short-term benefits and long-term disadvantages, between a valuable benefit to a few people combined with a small disadvantage, such as noise or pollution, to a much larger number of people. It is the personal responsibility of every engineer or every person considering becoming an engineer, to look at these long-term, world-wide problems and as far as possible to mould their career, and their discussions with other professions, around their own personal conclusions produced by their developed conscience, as to the way in which our civilisation can survive through the next century. The engineer, more than anybody else, can see, and must demonstrate to other people, the engineering possibilities and limitations of man's relationship with the environment.

Politicians like the American Vice-President Al Gore or climate researchers like the previously mentioned Prof. Grassl have already recognised the importance of the engineering profession for the future of mankind. In his book *Earth in the Balance*, Gore mentions the necessity to establish a *Marshall-Plan* for the rescue of planet earth [3]. One step of the plan is a worldwide initiative for education in environmental questions. He also emphasises the role of technology in this transformation process.

The UNESCO Supported International Centre for Engineering Education (USICEE) combines the aspects of education and engineering. It acts on a global basis and one of its objectives is the support of developing countries. In my opinion, the USICEE has the ideal capabilities to implement a new approach in engineering education on a long term basis. A change in the engineer's mind is an evolutionary rather than a revolutionary process. Thus the education of our future engineers is a major step in solving global problems. The USICEE should think about the implementation of new engineering principles, considering sustainable technology, in its objectives.

Especially conscious students should be encouraged to study engineering and enter industry,

so that they rise up within it and play an increasing role in eliminating global problems in their own area of responsibility (local approach).

The examples above have shown the interaction of different problems. It is not the aim of this article to present the ideal solution. A systematic approach involving different topics is necessary. It is hoped that the article finds the right feedback among engineering academics and industry personnel, creates awareness of our problems and shows the potential role of the USICEE, an initiative of UNESCO.

We cannot look into the future but we can lay the foundation for it - because future can be built.

Antoine de Saint-Exupéry

Therefore, let us act before it is too late!

- [1] Thring, M.W., *The Engineer's conscience*. London: Northgate Publishing Company Ltd (1980).
- [2] Jischa, M.F., *Herausforderung Zukunft - Technischer Fortschritt und ökologische Perspektiven*. Heidelberg: Spektrum Akademischer Verlag, Heidelberg (1993).
- [3] Gore, A., *Earth in the Balance - Ecology and Human Spirit*. Boston: Houghton Mifflin Company, Boston (1992).
- [4] Vester, F., *Neuland des Denkens - Vom technokratischen zum kybernetischen Zeitalter*. München: dtv Verlag (1991).
- [5] Grassl, H., Das System kann kippen, Interview published in *Der Spiegel* 8, 21 February, Hamburg 21 (1994).

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- * The author is a final year student at the Rheinisch-Westfaelische Technische Hochschule Aachen, Germany, currently working on his diploma project in the Department of Mechanical Engineering at Monash University and he is also associated with the UNESCO Supported International Centre for Engineering Education.

MEMBERSHIP BLUES

During 1994 the AAEE Executive have been trying to clarify issues concerning fee payment and membership. Apart from the members who have not got round to renewing yet, some financial members have moved without telling us their new address and others alternate between using their work and home addresses which can cause some confusion.

Another problem appears to have been with the payment system via The Institution of Engineers, Australia. Since 1992 the Institution has kindly collected membership fees for the Australasian Association for Engineering Education and the system has worked very successfully. However, some members have been claiming the subvention of \$15 when they are not entitled to it because they have not nominated AAEE as their society of first choice. Other members have been sending the wrong money.

Unfortunately, this year we have also experienced delays in receiving notification (and money) from the IEAust. Some members have been told by AAEE that they were unfinancial when they had, in fact, paid the institution but that information took months to reach AAEE. This caused unnecessary embarrassment all round. We even discovered over 100 subscriptions to the Journal had not been processed so we not only did not send the Journal to those subscribers, we had to re-order more copies of Volume 5, No.1, because we did not know how many subscribers we really had.

If you think that your details of address or payment are wrong could you please contact Pat Kreuter, the Administrative Officer at the UNESCO Supported International Centre for Engineering Education (USICEE), who is trying to update and correct the database. Pat can be contacted on Telephone: +61 3 905-3887 or by Fax on +61 3 905 1547. Her e-mail address is kreuter@eng2.eng.monash.edu.au

LETTER TO THE EDITOR - FOLLOW-UP TO ARTICLE ON PROFESSOR TOM FINK

In the last Newsletter (Vol.6, No.2) Professor Trevor Cole wrote regretting the death of Professor Tom Fink. Following the publication of this article, we received a phone call and letter from Mr Warner H. Kuttner who was a fellow student with Tom Fink at The University of Sydney and who was thus in a position to remind us that Tom Fink was a graduate in Aeronautical Engineering, not Mechanical Engineering. Mr Kuttner, a well-known consultant who has an award for Aeronautical Engineering named after him and who is still interested in engineering education and other relevant engineering issues of the nineties, was even able to send a copy of Tom Fink's final year entry in The University of Sydney's Engineering Year Book which makes mention of Tom's then fascination with gliders.

USICEE UPDATE

The UNESCO Supported International Centre for Engineering Education began operations at Monash University in January this year. Since then, the temporary offices in the Faculty of Engineering have been a hive of activity. The main objectives of the USICEE are to facilitate the exchange of expertise and research on engineering education and to act as an international clearinghouse for information on textbooks, engineering teaching courseware, software and equipment utilised in engineering education. Work has already begun on projects in these areas.

As well as the Director, Associate Professor Zenon J. Pudlowski, the Centre now has a part-time Administrative Officer, Pat Kreuter, and a full-time Project Officer, Ian Kerr, who is working on gathering survey data for research into engineering education activities, initially at Monash, but later throughout Australia and overseas.

The USICEE has established a Management Advisory Committee to provide support for the Centre's activities and give advice on the operation of the Centre. The Committee includes the following academics from the Faculty of Engineering at Monash University: Dr Terry Berreen (Mechanical Engineering), Mr Roger Hadgraft (Civil Engineering), Dr Kishor Dabke (Electrical Engineering) and Dr Alex Ormond (Engineering - Caulfield Campus). Terry Berreen and Roger Hadgraft have been made Associate Directors of the Centre. Professor Peter Darvall remains Chairman of the Centre despite his new role at Monash University as the Deputy Vice-Chancellor (Research and Development).

The Advisory Academic and Industry Committee is currently being formed. It will include prominent local and international academics, particularly concerned about engineering education, as well as representatives from industry, government and relevant professional organisations.

Current Activities

A survey on *Computer-Aided Instruction for Engineering Students* has already been accomplished. It provides valuable information on the use of computer-assisted instruction in engineering education in the Faculty of Engineering at Monash University. As well, a comprehensive review of engineering teaching in the Faculty with special emphasis on textbooks, courseware, software and original methodologies is already under way. Both these activities are sponsored by the Monash Development Fund.

The Centre has the specific mission to transfer this information from developed countries to developing countries worldwide. Particular emphasis is placed on Asia and the Pacific

region. Contacts have already been made with academic institutions in the Philippines, Indonesia, Vietnam, Thailand, Papua New Guinea, PRC, Russian Federation and Fiji, with visitors from Fiji, Thailand, the Philippines and Vietnam all having spent some time at the Centre. Already a co-operative agreement has been signed between the USICEE and The Centre for Information Technology (CITE), Vietnam, a very significant initiative in the increasing involvement of Australians in that rapidly changing country.

The USICEE also has a focus on the needs of countries in Central and Eastern Europe where several Australian institutions have established excellent contacts. During the visit to Russia by AAEE representatives (see separate report in this issue) in July this year, a Memorandum of Understanding was signed with the Russian Association for Engineering Education (RAEE). A further Memorandum of Understanding has also been signed with the University of Mining and Metallurgy in Poland. A Four-party Agreement on academic collaboration with the Universities of Strathclyde, the University of Pavia, the Technical University of Lodz and Monash University is expected to be signed later this year.

The headquarters of AAEE have been transferred to the USICEE to facilitate the collaboration between the two organisations. Members of the AAEE, especially those based at Monash University, assist in the operation of the Centre by providing resources and expertise.

An amount of money has been granted from AIDAB (Australian International Development Assistance Bureau) to generate a database of academic institutions and individual academics particularly interested in engineering education in Poland, the Czech Republic and Slovakia and to send educational books and journals to these countries. Already a large parcel of resource materials has been sent to the Library of each of the technical universities in the three countries and *AAEE Newsletters* and other information have been sent to over 200 academics on the database. There is a good prospect of obtaining further money to be applied for this purpose in other countries.

Planned future activities

Following on from the Monash surveys, a proposal for an Australia wide survey of engineering institutions and engineering teaching is in the planning process.

The USICEE will further expand its database of engineering academics. This database will be utilised for the dissemination of information on research results. To improve the quality of engineering training in developing countries, the Centre must establish a mechanism for the efficient flow of information between universities in developed and developing countries. Apart from the continuing survey research, the most important activity at this stage is the organisation of the *1995 International Congress of Engineering Deans and Industry Leaders*, on behalf of UNESCO, at Monash University. It is hoped that this event will bring together top academics and senior industry figures and will create a forum for discussion and the exchange of information. The Centre will endeavour to develop a range of courses on topics relevant to industry with the aim of strengthening the dynamic collaboration between the USICEE and industry.

One major objective of the USICEE is to set up a number of interest groups on specific topics in engineering education. The Computer-Based Learning Group (CBLG) already has over 40 interested academics at Monash, where two successful meetings have been held. A Program Based Learning Group is also in existence and other groups have been suggested. The Centre hopes to facilitate the extension of these groups into wider networks.

PREPARATIONS CONTINUE FOR PNG CONFERENCE

The University of Technology in Lae, Papua New Guinea, has received over 200 abstracts from 25 countries for the November conference. The Fourth AEESEAP Triennial Conference, to be held 13-16 November, looks set to be a great success. The conference will continue the tradition of providing a forum for the presentation and exchange of ideas on the

effective education of future engineers. Attendees will have the chance to evaluate past achievements and examine new challenges within our rapidly-changing, technological world. Authors have been notified of provisional acceptance of their papers, and camera-ready copies of full papers are due. The organisers are planning to group the papers into the following themes:

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|---|------------------------------------|
| * Computer-Aided Design | * Computer-Aided Teaching |
| * Continuing Education | * Curriculum Issues: International |
| * Curriculum Issues: Developing Countries | * Education & Industry |
| * Engineering Management | * Innovations |
| * Issues in Research | * National Perspectives |
| * Evaluation & Assessment | * Environmental Engineering |
| * Technology Transfer | * Quality Management |
| * Teaching Methods & Strategies | |

The first day of the conference will include an opening ceremony, a plenary address, a regional survey report, the Motorola student award report, and member-country reports. The second and third days will have plenary addresses and three or four simultaneous technical sessions. The fourth day, the 17th August, will include a General Meeting for Voting Members. There will also be an interesting and enjoyable social programme organised for delegates and for accompanying persons.

A registration package containing conference details as well as information on the host country is being mailed to authors and those who have expressed interest.

The conference registration fee is US\$300. This includes one set of conference proceedings, morning and afternoon refreshments, lunches, a welcoming reception, a cultural evening on Monday, and a conference dinner on Tuesday. The fee for accompanying persons is US\$100.

For further details or to obtain a registration package, please contact: The Secretary, AESEAP 94, Conference Organising Committee, Department of Mining Engineering, PNG University of Technology, Private Mail Bag, LAE, Papua New Guinea, Fax: (+675) 457-534.

VISIT OF AN AAEE DELEGATION TO RUSSIA

A delegation representing the Australasian Association for Engineering Education (AAEE) visited Russia from 2 July to 15 July at the express invitation of the Russian Association for Engineering Education (RAEE). The members of the delegation were Associate Professor Zenon Pudlowski, 1st Vice-President and Executive Director of AAEE, Professor Trevor Cole, Immediate Past President of AAEE, Mr Edward Whitehead, Member of the Executive Committee of AAEE and Director, Education of the Institution of Engineers, Australia and Dr Terry Berreen, Secretary/Treasurer of AAEE. Dr Berreen was a last-minute replacement for Professor Darvall, President of AAEE, who was unable to finally accept the Russian invitation because of commitments following his taking up the full-time position of Deputy Vice-Chancellor (Research and Development) at Monash University on 1 July. The visit of an Australian delegation was in response to the visit of a Russian delegation on engineering education to Australia in November 1993, as reported in the AAEE Newsletter of March 1994.

The delegation was met at Sheremetjevo Airport, Moscow, by Professor Alexei Nesterov, General Director of the RAEE and from that time until the delegation departed from St Petersburg Airport twelve days later, the RAEE provided hotel accommodation, transport, translation and guides for all the technical and sightseeing visits in Moscow, to Vladimir and Suzdal, and in St Petersburg and environs. The purpose of the visit was to continue the exchange of information and experiences following the Russian visit to Australia and to therefore maximise the potential of both Associations, the RAEE and AAEE. The RAEE planned the itinerary for the Australian visit to include visits to universities in both Moscow and St. Petersburg and for meetings with the RAEE and with the Committee and

Minister-Chairman of the Russian Federation Committee on Higher Education.

In Moscow the delegation met with the Australian Ambassador, His Excellency Cavan Hogue at the Australian Embassy, the meeting also being attended by Roger James, the Senior Trade Commissioner. The Ambassador gave an overview of the changing political situation in Russia, followed by a wide ranging discussion on a number of educational matters including the types of educational short courses that would be most likely to receive financial support by the Australian Government, the extent of conversion industries in Russia converting from previous military purposes to peaceful purposes and environmental engineering. This was followed by a short meeting with Tim Menetrey, First Secretary (Immigration) on problems associated with the migration of Russian engineers to Australia and the recognition of foreign qualifications.

The meeting with the Committee and Minister-Chairman, Dr Vladimir Kinelev, of the Russian Federation Committee on Higher Education took place in the offices of the Minister. Dr Kinelev had been in Australia last November for one week with the Russian delegation. The Minister outlined details of a proposed UNESCO Supported International University of Engineering (IEU), for which the Rector's Office would be located in Moscow, but otherwise the IUE would be far reaching throughout Russia. The IUE would pursue its educational activity in the field of higher postgraduate and additional professional education by a system of special postgraduate and doctoral courses. In this activity particular use would be made of already established satellites in a distance learning system to ensure the widest influence of the IUE. The Minister sought the support and participation of Australian universities in the supply of specialist courses at this International University of Engineering.

At the meeting with the RAEE at their Moscow headquarters and afterwards at dinner at the Press Agency *Novosti*, matters of mutual interest to both Associations were freely discussed, including mutual support for future conferences. In particular, the RAEE sought support for their *International Conference on Engineering Education* (further details in this newsletter) to be held in Moscow, in May 1995. The RAEE would bring reports and conclusions from this Conference to the *1995 International Congress of Engineering Deans and Industry Leaders* at Monash University, in July 1995. Support was also sought for an International Conference on Informatics and Education in Russia in 1996 and the possibility of a joint conference in Russia in the East-West Series of Conferences. The RAEE also sought, as originally discussed in Australia and listed as a possible action in the Collaboration Agreement signed in November 1993, the establishment in Moscow of a sub-centre of the Monash UNESCO Supported International Centre for Engineering Education (USICEE). Later, a Memorandum of Understanding between USICEE and RAEE was signed to the effect that USICEE will assist in the establishment and development in Russia of a regional Centre for the development of engineering and technology education in Russia.

At each of the university visits there was an open discussion with the Rector or Vice-Rector and Heads of Departments covering the strengths of that university, its aims and philosophies, matters of mutual interest in engineering education to Russia and Australia, and the possibility of university to university relationships between Russia and Australia. These discussions were followed by a visit to areas of technical and educational interest in that university.

The two universities visited in Moscow were two of Russia's most prestigious institutes, now given the status of university. They were the Moscow Power Engineering Institute (now a University of Technology) and the Moscow Machine Tool Institute (now Moscow State University of Technology - *Stankin*). The Power Institute, founded in 1930, is one of the largest educational and scientific centres of Russia, covering all spheres of modern power, electrical and electronics engineering. As well as being a teaching institute, it is also a research institute and has close collaboration with foreign countries and with the institutes of the countries of the former Soviet Republic. The Machine Tool Institute, a renowned Russian centre for machine tools, has its main directions in new technologies, metal cutting processes and automation.

The delegation travelled from Moscow to St Petersburg by train and visited three

universities in St. Petersburg. The St. Petersburg State Electrotechnical University is the oldest electrotechnical institute in Russia. The visit there included a tour of the recently completed technopark at which research and development is directed towards commercialisation as previous research at the university had been based on military contracts. However the University has broadened its interests and has an International School of Management, Leti-Lovanium, which is an International Faculty with partners from Belgium, the United Kingdom, the United States of America, and Luxembourg, and was launched in 1990 as a response to the growing need in Russia for management education. The one year program of full-time study is structured on an average class size of 50, of average age 30 and with a male/female ratio of 17:3.

The State University of Technology and Design was originally an institute directed towards the textile and consumer goods industries. Of the 16 Institutes of Textiles in Russia this St. Petersburg Institute was the only one to be given university status. It has also broadened its scope and now contains six Faculties - Mechanical, Chemical, Technology, Economics, Clothing and Fashion, and Leather and Shoe.

The final university visited in St. Petersburg was the Baltic State Technical University which was founded in 1930 as a Military Mechanics Institute. It now has Faculties of Space Technology, Measurement Equipment, Automotive Equipment, Industrial Management, Humanities and Science of Mechanics and Management. The delegation was able to visit some of the research and teaching laboratories containing Russian satellites and rockets. The University has developed an external structure so that its bachelor students have the choice of proceeding, after obtaining their general bachelor's degree after four years, to masters or a diploma of engineering or after three years of the bachelor's program to the Baltic Academy of Technology and Economy.

The visit to Russia certainly continued the exchange of information and experiences between the two Associations as well as providing direct contacts with key academic staff from the Russian Universities. These Universities, which were previously leading Russian Institutes, had all only received university status in recent years. In a changed political climate they were facing some of the problems experienced by engineering faculties in Australia, namely the attracting of better students, the placement of graduates, the broadening of courses to reflect the need for some management or business content and the attracting of outside funds. The delegation was extremely well received and looked after by Professor A. Nesterov and his team from the Russian Association for Engineering Education.

*Dr Terry Berreen
Department of Mechanical Engineering
Monash University
Secretary/Treasurer of AAEE*

THE INTERNATIONAL CONFERENCE ON ENGINEERING EDUCATION, MOSCOW, MAY 1995.

This Conference is to be organised by the Russian Association for Engineering Education (RAEE) who have made the following announcement of possible topics:

- * Tendencies in higher engineering education development under world integration processes.
- * Standards and educational-professional programs of engineering education, academic mobility and problems of recognition of educational certificates.
- * New teaching technologies in engineering education. National and international computer-assisted databanks.
- * Programs of education, student and faculty exchange.
- * Post-university engineering education: refresher courses and retraining of specialists.
- * National systems of evaluation of engineering educational institutions and their international accreditation.

- * Certification of engineers, problems of professional recognition of educational and qualificational certificates.
- * Ecology, safety and modern engineering decisions.

Further details regarding final topics, call for papers etc will be provided as soon as details are obtained. Members may obtain further information by communicating directly with:

Dr Alexei F. Nesterov, General Director, Russian Association for Engineering Education, 103848 Moscow, Pushkinskaya 13, Telephone: +7 095 292-1098, Fax: +7 095 200-6127, E-mail: star@utech.exlink.msk.su



A delegation representing the Australasian Association for Engineering Education (AAEE) visited Russia from 2 to 15 July 1994 at the express invitation of the Russian Association for Engineering Education (RAEE). A report on the visit to Russia is included in this issue. The delegation was received by the Minister of Higher Education of the Russian Federation, Dr V.G. Kinelev, in his office. Pictured are (l-r) Prof. E.P. Myshelov, Prof. B.S. Mitin, Prof. T.W. Cole, Dr V.G. Kinelev, A/Prof. Z.J. Pudlowski, Mr E. Whitehead, Dr T. Berreen and Prof. A.F. Nesterov.

For details of the Association and membership applications write to the Editor:

Associate Professor Zenon J. Pudlowski, Faculty of Engineering, Monash University, Wellington Road, Clayton, Melbourne, VIC 3168, Australia, Telephone: +61 3 905-4977, Fax: +61 3 905-1547, e-mail: ZJP@eng.monash.edu.au

Association members and academic institutions are invited to contribute to the Newsletter on matters relating to membership and engineering education.

Send contributions to the Editor at the address above.