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Continuing Education for Engineers in Australia*

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Continuing education for engineers is one of the greatest challenges facing the profession today, but funding sources, the market niche identified for the delivery process, as well as the environmental foci for continuing education and the support machinery for publishing and dissemination of information, all need to be assessed.

INTRODUCTION

ENGINEERS are caught in the pincer pressures of:

- keeping abreast of the rapidly-receding frontiers of technological knowledge, and
- maintaining a failsafe level of project development.

In contrast, doctors expect that their activities will only be stalling tactics, and eventually everyone grows old and dies, while lawyers might expect to lose half the cases in adversary court proceedings. The demand for unforgiving success on shifting ground is possibly unique to engineering and as the rate of technological change intensifies, the ethical aspects of up-to-date knowledge are generating pressures unanticipated a generation ago [3]. See Fig. 1. Engineers must now sacrifice a small part of today's productivity to acquire new knowledge, so that tomorrow they will still be competent. Academics achieve this through sabbatical leave and ongoing research, but industry engineers need some concessions from market-place pressures as well as for continued learning, and some options are as follows:

- graduate degree; or short course which may be more attractive because specific to needs, and contained financially and time-wise
- involvement in professional societies which are clearing houses for new ideas
- attendance at conventions/conferences/seminars/workshops/lectures
- industry sabbaticals if a pilot scheme shows these to be economically viable
- videotaped lectures and software for personal computers can provide a self-paced, cost-effective, and convenient learning experience

Profession	Ethical pressures
Engineering	Failures are visible, accountability is direct, and immutable laws of physical and natural sciences leave little scope for manoeuvering or interpretation. Social, economic and political impacts of projects.
Medicine	Everyone eventually grows old, suffers various infirmities and dies. The physician fights a battle with fate and inevitably loses.
Law	Adversary proceedings result in the loss of half the cases, plea bargaining may be necessary, and the most hardened criminal may be defended without prejudice. Truth is relative and depends on the skill of advocacy and strength of personality, and is assumed to lie somewhere between competing views.
Business	Maximize profits and externalize liability as much as possible, or take out insurance against it.
Media	Exception reporting and sensationalism. Sex and violence sell papers and improve ratings.
Politics	Use all means possible to defeat opponent consistent with the law, even if morally reprehensible; electorate will judge relative rights or wrongs at the polls. Take every opportunity to blame opposition for ills and take credit for achievements.
Military	Obey orders without question, and sacrifice oneself for the collective good.
Education	Forming the minds of the next generation with yesterday's skills, rather than tomorrow's.
Unions	Wage hikes and strikes threaten corporate competitiveness.

Fig. 1. Spectrum of ethical issues.

- subscriptions to learned journals
- involvement in trade fairs, exhibitions, chamber-of-commerce activities, honorary community-service organizations
- mass media: television, radio, magazines and newspapers.

The Japanese spend much effort monitoring technology innovation around the world, and translating foreign journals and conference proceedings, know what can and has been done, and thus avoid the trial and error and expense of rediscovering the wheel. Foreign tours of duty by Japanese engineers are encouraged, provide a broad awareness of the status, challenges and opportunities in technology on the global scale, and act as an intelligence conduit for corporate headquarters in Japan.

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THE REGISTRATION ISSUE

THE IEAust/APEA* register was inaugurated in July 1989 in an attempt to ensure that engineers only work in their area of expertise, keep their knowledge up to date, project a more professional image, and so perhaps head-off any concerted effort to establish a State Registration Board. In America, registration is a State rather than Federal prerogative, but unlike Australia, America has had some form of registration specifically for engineers since the turn of the century. However, even in America with its long tradition of registration, a 'case against' seems to be emerging as follows:

- Large nationwide disparities in education standards at the turn of the century mandated registration to ensure weaker graduates achieved minimum professional standards. Standardized accreditation of engineering courses to a high standard by the Accreditation Board for Engineering and technology has deflated this concern in the 1980s.
- Geographic variations necessitating local skills responsive to:
  - permafrost in the North/Alaska,
  - tornado in the South,
  - high altitude in the Rockies,
  - seismicity in the West, and
  - high rise in the cities,
- have been transcended by the capability of computer software. An engineer with his floppy disc can become an 'instant expert' on local requirements.
- Manufacturing, industrial, academic, and government exemptions from registration have rendered electrical and mechanical engineers essentially exempt, yet civil engineers who are locked more into the tradition of the past still support it.
- State Registration Boards may not only be composed of a majority of lay people making judgements on technical issues after a failure, but once the State intervenes, civil engineers are forced to 'wash their dirty linen in public'.
- The learned society for civil engineers, the American Society of Civil Engineers, with its code of ethics and experience requirements for Membership, really duplicates the state registration process, and ASCE might assume a *de facto* registration role if covered by professional indemnity insurance. Insurance premiums should be moderate consistent with a minimal track record of failures.
- Factors of safety have traditionally been used to mask uncertainties, unpredictabilities, and the inevitable errors due to human fallibility, but were enshrined decades ago when structures were simpler, and now need reassessing to contain failure risk. The cost to the client of increased factors of safety must be weighed against the cost of multiple checking, registration of structural engineers, and/or possible failure.
- Registration at the State level impinges on freedom of Interstate trade and commerce, discriminates against out-of-State engineers, and undercuts flexibility in responding to regional variations in requirements for engineering manpower.

Australia does not have severe educational and geographic disparities, or the record of structural failures America experienced at the turn of the century that gave rise to registration, while the explosive growth in computer capabilities and the numbers of mechatronic engineers raise further doubt about registration. Engineering compartmentalization is however in train via Local Government Engineer (LGE), Engineering and Water Supply (EWS) and mine manager certificates, structural registration would be another step, and the ultimate might be DipEd's for academic engineers. Such trends are symptomatic of rigidity, bureaucracy, and unresponsiveness to increasing rates of change. The IEAust/APEA register is at the National rather than State level, avoids Government involvement, interprets continuing-education credits flexibly, and so may achieve acceptance in spite of debates about 'CPeng' and 'non-member fees'.

JOINT VENTURE OF CONSORTIA

Traditional reasons for presenting undergraduate courses on campus are:

- teachers/courses/facilities are accredited so teachers are experts as well as skilled communicators, courses are up to date and relevant, and laboratories, computers, etc are adequate
- systematic/formal teacher/student/lecture/examination process is the most efficient vehicle for transfer of skills/knowledge
- specialist teachers can devote time to research and keep abreast of the frontiers of knowledge, and so provide the impetus for advancement of knowledge that eventually filters back to the industry.

However, at the continuing-education level, industry is often substantially ahead of academia, has developed ideas and technology quite independently of academia, and professional societies have a growing role in orchestrating industry input to continuing-education offerings in concert with campuses. America has two decades of campus-based continuing education experience, and the end result has been declining student numbers, and a growing realization that campuses just do not have the resources to sustain a stand-alone delivery process. Campuses seem to have lost their way,

* See list of acronyms at the end of the paper.

budgets have been frozen, and community confidence has been eroded. In fact, an external cycle or 'Pentagon Factor' has been activated for Australian education [5]. See Fig. 2.

The IEAust might seek formation of a consortium with APEA, ACEA, and similar engineering societies to fully tap the engineering market, and this consortium might then joint venture with a parallel consortium of tertiary educational institutions with some of the manpower and facilities needed for continuing education already in place. See Fig. 3.

The Register of Professional Engineers was established in July 1989 jointly by the IEAust and the APEA, and was designed as a *de facto* licensing vehicle for Australian engineers. IEAust members must satisfy continuing-education requirements of 150 hours of exposure each triennium to maintain their registered status, and thus the register and continuing-education are inextricably linked [2]. Thus an IEAust-APEA consortium to administer the register in concert with the Continuing Education Centre seems desirable immediately. See Fig. 4 for a modified joint-venture scenario responsive to recent campus amalgamations likely under new government policy.

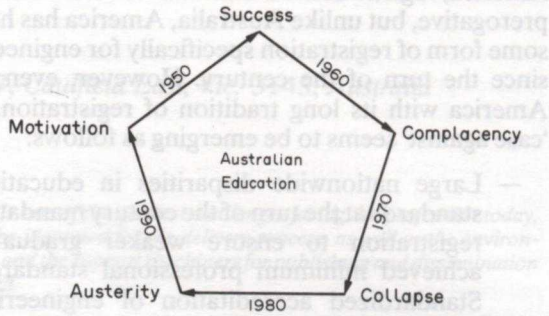

Fig. 2. The Pentagon Factor.

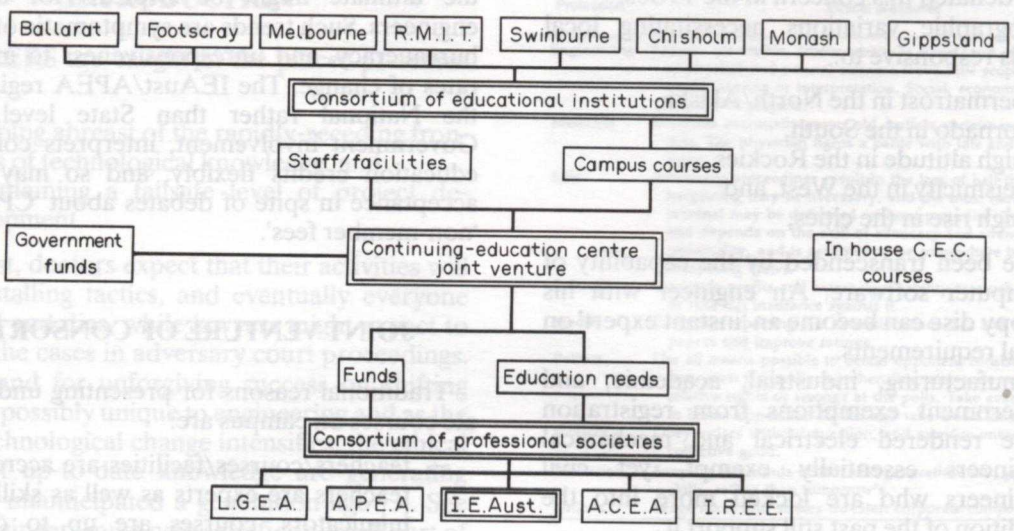

Fig. 3. Continuing-Education Centre: Joint Venture of Consortia.

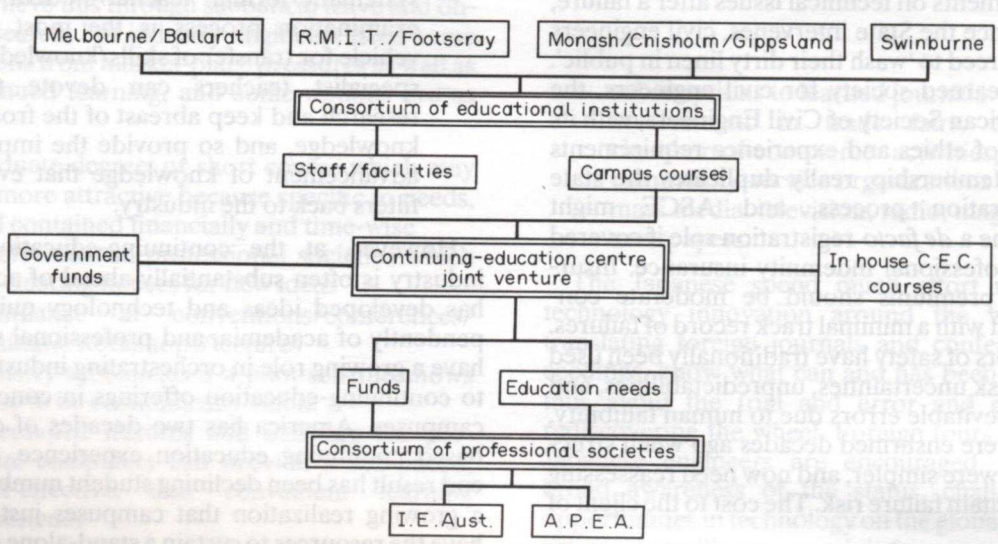

Fig. 4. Interim Organization—Continuing-Education Centre: Joint Venture of Consortia.

APEA MANAGEMENT DIPLOMA

APEA inaugurated a management diploma in 1989, and of all the formal graduate courses offered in tertiary institutions over the last two decades, few have had comparable success. Seven hundred and fifty students were initially enrolled Australia-wide, and the enormous success seemed to indicate that:

- management education was high priority for engineers,
- involvement of engineering societies in graduate education was important, and
- distance education for graduate study was convenient and flexible.

This course might well have been offered through a joint IEAust/APEA CEC.

FUNDING

In recent times, the federal government's 'White Paper' on higher education, the CTEC review of engineering education [6], ASTEC's report on education and national needs, together with the IEAust's Wragge report on engineering education towards the year 2000 [4], all specifically mention the growing importance of continuing education to engineers working in a world of escalating rates of change. Thus, the government, in particuar, identifies continuing education as a major challenge [8], and a user-pays principle is increasingly being invoked for post-first-degree studies. The time may now be right for the IEAust to make representations to the government for partial funding of the IEAust's Continuing Education Centre (CEC), and justify this in terms of national economic priorities and needs.

Privatization environment

The CEC might eventually develop to the level of *de facto* private university, offering short courses, as well as PG1 (Diploma), PG2 (Masters), and PG3 (Doctoral) qualifications. Privatization is an idea whose time has come. Thatcherism, Reaganomics, and gravitation of China and Russia to a market place economy, all symbolize that the era of big government and government control is on the wane globally. Ever since Karl Marx's—*Das Kapital*—'from everyman according to his abilities, to everymen according to his needs'—a trend towards socialism has been apparent. However, in the mid-1970s, Milton Friedman, Noble Laureate in economics from the Chicago School, reversed a century of Marxist socialist sentiments. Friedman's two main tenets for small government were:

- if a man has a dollar, he spends it more carefully than if he gives it to the government to spend for him, and
- when a man spends a dollar in the market place, he gets what he wants; but when he gives the dollar to the government in taxes, and is in a 49% minority to elect that government, he may not get what he wants.

Privatization initiatives are now starting to penetrate the tertiary education sector, with Bond University setting the pace, and Tasman, Catholic, Albury-Wodonga Agricultural, and others being planned. The community has become disillusioned with the achievements of traditional tertiary education, savage criticism has repeatedly appeared in the mass media, and government has responded with the promulgation of the 'green' and 'white' papers on tertiary education. Fifty years of academic tradition could be swept away, and into the vacuum so created, new initiatives such as private universities could prove viable. The proven value of private education at the secondary school level, the introduction of the tertiary tax, the increasing financial self-sufficiency of State universities as a result of consulting incomes, as well as Friedman's philosophical underpinning of privatization, are all conspiring together to increasingly render private universities a viable alternative to state universities. Some arms of state universities are even now choosing a private identity, as for example in the graduate school of management at Melbourne University. Even the engineering union, the Association of Professional Engineers Australia, is now running a highly successful graduate diploma in engineering management, with accreditation by the Victorian Post-Secondary Education Commission.

American private universities have provided checks and balances on the public institutions, and vice versa. The former went out of business unless their courses were high quality and their graduates were employable, thus providing a role model for the latter. The public institutions were more accessible to the underprivileged, and so could accommodate demands for tertiary education from those who could not afford full fees.

Other funding options

Formal campus courses are jointly funded by budget appropriations for education together with the individual's Higher Education Contribution Scheme or by tax concessions to individuals making direct payments. The attractiveness of the APEA's Diploma is often defined in terms of the latter criterion. However, a whole array of other interlocking options are now being assessed:

- income support from government as well as tax concessions
- industry training levies, wage maintenance, education leave
- savings by individuals, and wages forgone.

The bottom line in justifying such costs must be a more healthy economy for the government [7], more competitive goods and services for the company, and career advancement for the individual. Credit transfer, skills recognition, and

accreditation are integral components for ensuring the viability of continuing education efforts, and for providing incentive to change. The IEAust's CEC is now certifying courses, and recording course credits completed, but ambiguity of credit comparisons, together with the uncertainty of employer acceptance, have created inhibitions. Models for Australia are tending to be developed from European or American precedents, but by far the most technologically successful nation in the post-war period has been Japan, it is obviously doing something right in advancing the skills of its engineering workforce, and should be targeted for study in this regard. After WWII, Japan had lost an empire, had a shattered economy, had to import key minerals and energy, was not self-sufficient in food production, could not easily tap the wealth of technical information in English to facilitate transfer, yet forty years later it is competing with the rest of the world at its own game on its own turf and winning.

MARKET NICHE

A whole range of continuing education courses are already operational in some form or another, so the IEAust's Continuing Education Centre must avoid being seen as duplicating what is already available. Some uniqueness might be achieved as follows:

— HiTech dissemination of educational offerings via satellite, teleconferencing, diskettes for CAI, etc. See Figs. 5 and 6. America has already established a National Technological University that exclusively utilizes satellite delivery, and this is expected to provide an educational productivity multiplier by downgrading manpower-intensiveness of education, and upgrading its technical intensiveness. At another level, computer-aided-instruction has a similar goal, the teacher and the textbook being replaced by the disk for

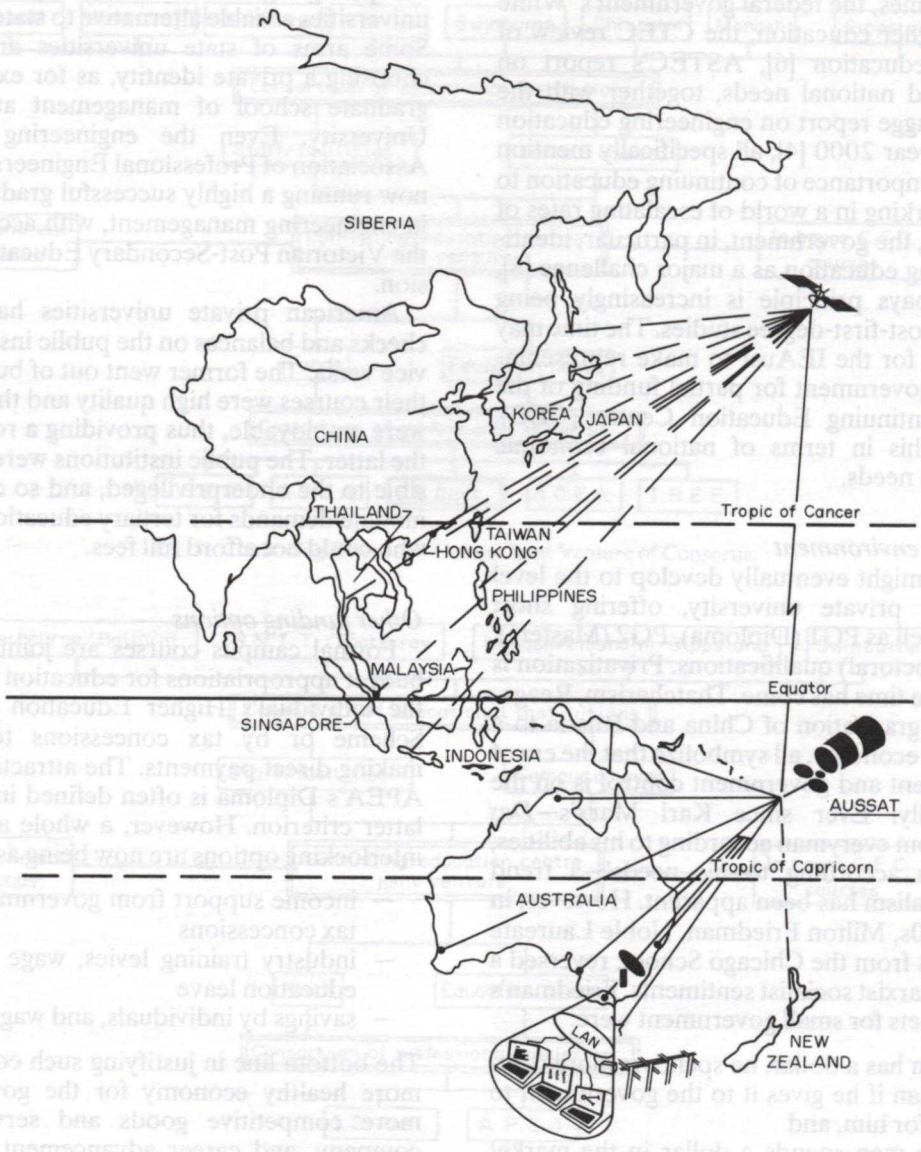

Fig. 5. Satellite communications—IEAust (Vic).

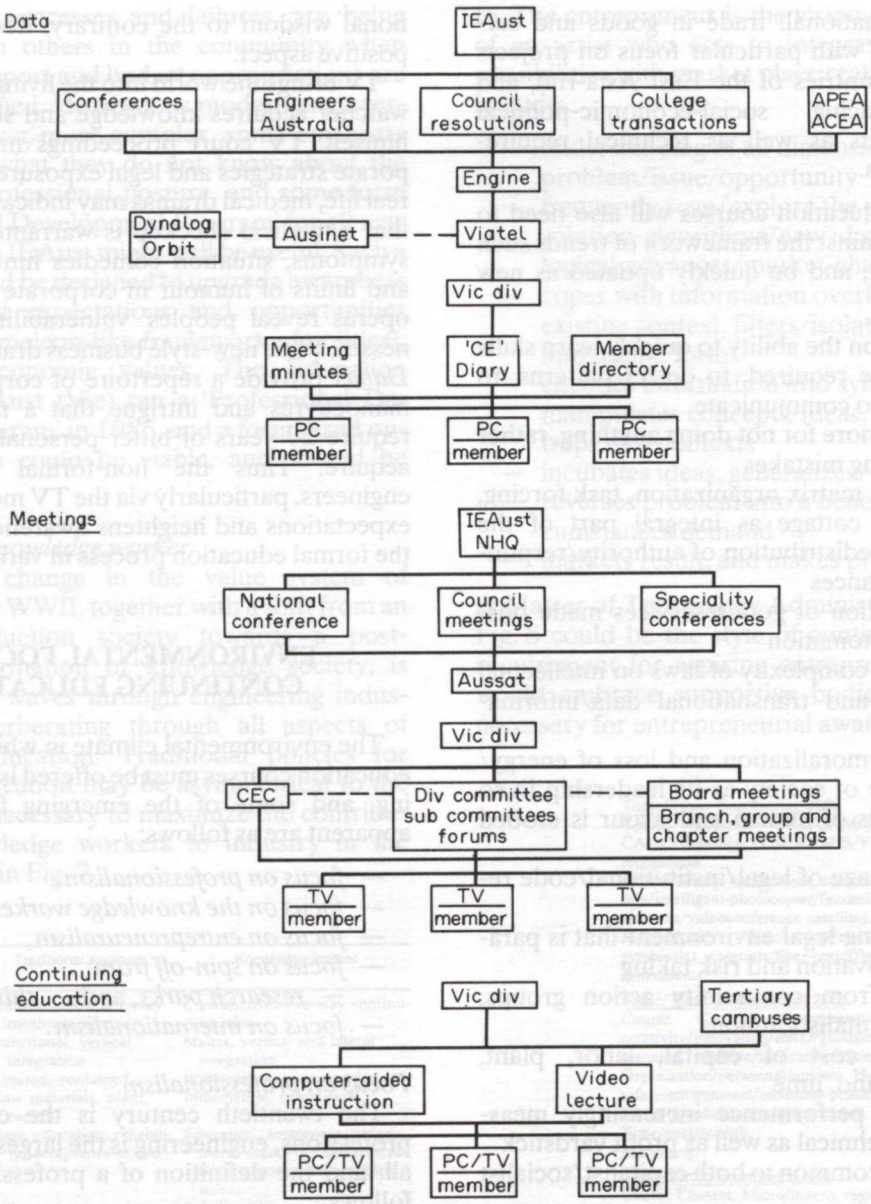

Fig. 6. Communications for IEAust (Vic). Medium-term options to the year 1995.

personal computer use. A recent survey of IEAust members in Victoria has indicated that 65% identify 'private reading' as their main mode of continuing education [2], and the computer disk is really the space-age extension of the book or magazine [9].

— With rapid decline in communication costs, the services of international experts might be retained to provide a cutting-edge flavour to the education offerings, expose course participants to the very latest ideas and knowledge, and generate leadership kudos for the IEAust in the educational stakes. Australian engineers must increasingly gravitate towards a global awareness, the Australian standard of living cannot be maintained without expanding exports of engineering goods and services into international markets, and so the international dimension of Australian engineering must be reinforced as indicated.

— The specific course topics might best look to the future needs, and could well embrace the following:

- technical: robotics, artificial intelligence, fifth-generation computers, space technology, offshore and antarctic requirements
- management: upgraded to project management focus, including time-cost-quality trade-offs; full project delivery process incorporating concept-feasibility-finance-design-construct/manufacture-commissioning-demolition; as well as industrial relations, government regulations, litigation, etc.

- international: trade in goods and services, with particular focus on projects in countries of the East Asia-rim, and embracing social-economic-political aspects as well as technical requirements.

Continuing education courses will also need to be developed against the framework of trends such as the following, and be quickly updated as new trends emerge:

— emphasis on the ability to quickly learn skills as they are required, to detect patterns, to innovate, to communicate
— penalties more for not doing anything, rather than making mistakes
— diversified matrix organization, task forcing, electronic cottage as integral part of the network, redistribution of authority/responsibility balances
— customization of goods/services made possible by automation
— increasing complexity of laws on intellectual property, and transnational data/information flow
— general demoralization and loss of energy/work-ethic of society as its leadership in so many fields of human endeavour is eroded away
— growing maze of legal/institutional/code restrictions
— deteriorating legal environment that is paralyzing innovation and risk taking
— pressure from community action groups, environmentalists, unions
— escalating cost of capital, labor, plant, material, land, time
— corporate performance increasingly measured by technical as well as profit yardstick
— problems common to both capitalist/socialist nations.

TV: non-formal continuing education

One hundred years ago, man would work most of his waking hours in a British mine, 12 hours a day, 7 days a week, in the hope that surplus resources generated would not only provide a few luxuries and isolate him from the vagaries and brutalities of Nature, but also provide fuel for the fire of Empire expansion. So to today this *modus operandi* continues unabated. The community might now collectively decree a halt to progress, capitalize on past achievements, work one or two days per week, and indulge itself in an hedonistic existence. But it does not. Man still strives as hard as ever, and the 40-hour work week is more apparent than real. The tensions and complexities of modern life demand that he spend another 40 hours a week acquiring knowledge and interpersonal skills mandatory for his effectiveness in high density, interactive communal living. The predominant ingredient in the second 40-hour period is TV watching, which in spite of conventional wisdom to the contrary, does have a very positive aspect.

TV brings the world into the living room, and the watcher acquires knowledge and skills in spite of himself. TV court proceedings may reveal corporate strategies and legal exposures applicable to real life, medical dramas may indicate to the viewer that a medical checkup is warranted for his own symptoms, situation comedies hint at the power and limits of humour in corporate dealings, soap operas reveal peoples' vulnerabilities and weaknesses, while new-style business dramas typified by *Dallas* provide a repertoire of corporate survival manoeuvres and intrigue that a manager might require 20 years of bitter personal experience to acquire. Thus the non-formal education of engineers, particularly via the TV media, unleashes expectations and heightens awareness that impact the formal education process in various ways.

ENVIRONMENTAL FOCI FOR CONTINUING EDUCATION

The environmental climate in which continuing-education courses must be offered is rapidly changing, and some of the emerging foci that seem apparent are as follows:

— *focus on professionalism*,
— *focus on the knowledge worker*,
— *focus on entrepreneuralism*,
— *focus on spin-off from*:
  — *research parks*, and — *think tanks*, and
— *focus on internationalism*.

Focus on professionalism

The twentieth century is the century of the professions, engineering is the largest profession of all, and the definition of a profession may be as follows:

— high level of specialized training and examination at the tertiary level, together with accreditation/certification, and possibly licensing.
— professional society, meetings, learned journal and excellence awards,
— code of ethics, discipline of wayward members,
— autonomy, professional judgement exercised and respected,
— prestigious status and authority in the community, pivotal role in community affairs, and altruistic attitude and commitment to community welfare, and
— selective and restrained use of industrial action as a vehicle for achieving goals.

A major aspect of IEAust's charter is to promote professionalism, and exercise a watchdog role over the professionalism of its members. Engineers are being watched and studied: the technology developed, the projects engaged in, the ethical

standards, the successes and failures, are being compared with others in the community when community support and budget appropriations are being apportioned. However as modern engineering becomes ever more complex, some engineers do not know what they do not know about the appropriate professional posture, and some form of 'Professional Development Program' for all new members of the IEAust might well be useful. Such a 'Program' would be designed to upgrade awareness of professional expectations and opportunities against the chameleon-like framework of political, social, and economic values. The Education Branch of IEAust (Vic) ran a 'Professional Development Program' in 1986, and a formalized ongoing program could be viable, and should be assessed [3].

Focus on the knowledge worker

A marked change in the value system of engineers since WWII, together with a shift from an industrial-production society towards a post-industrial information or knowledge society, is sending shock waves through engineering industries and reverberating through all aspects of engineering education. Traditional policies for continuing education may be asymmetrical to the requirements necessary to maximize the contributions of knowledge workers to industry in the future, as seen in Fig. 7.

Characteristic	Traditional engineer	Knowledge worker
Management style	Authoritarian, one-way communication	Consultative, two-way communication
Appropriate organization	Functional, vertical integration	Matrix, vertical and lateral integration
Impact of decisions	Limited, contained	Wide-ranging, open-ended
Critical resources	Raw materials, plant, capital	Information, computers
Skills required	Basic education, reliability, acceptance of routine	Education, awareness, judgement, creativity, self-motivation, opportunistic problem solver
Discretionary time	Nil	Substantial
Worker satisfaction	Low	Very high for a 'winner'
Worker needs	Security	Recognition, opportunity
Productivity	Man-hours per engineering task, profit per worker, variation = 2:1	Papers, patents, computer programs and new policies per worker, difficult to quantify in dollar terms, variation = 50:1
Promotion factors	Seniority, loyalty	Ability, success
Mobility	Low, specific skills	High, general skills, universal to all industries and firms
Unions	Relatively strong	Seen as sub-professional

Fig.7. Comparison of traditional engineer with knowledge worker.

Focus on entrepreneuralism

The engineer as entrepreneur is a relatively new phenomenon in Australia, and just whether entrepreneuralism might be effectively taught in continuing-education courses is open to debate. Some say entrepreneurs are born as such, that the unforgiving demands of engineering education tends to crush any entrepreneurial flair anyway, and that the risk-taking by the entrepreneur in the face of uncertainty is difficult for engineers to relate to. The entrepreneur is the visionary with the flair of an artist who acts to integrate technological possibilities with market place reality, and his skills include:

- understanding of all dimensions of a problem/issue/opportunity
- frequently scan/explore the environment for solution-algorithms/new ideas/technological-advances/market-changes
- copes with information overload, breaks existing context, filters/isolates/simplifies into usable form
- encodes information into symbolic form, manipulates concepts/ideas, recognizes/traps new contexts
- incubates ideas, generalizes/validates/infers
- reverses problem into a benefit should circumstances demand
- markets result, and makes profit.

A Master of Technology Administration shown in Fig. 8 could be the style of continuing-education requirement for aspiring entrepreneurs, and this would embrace supportive bodies-of-knowledge necessary for entrepreneurial awareness.

Topic/Time: Engineering 40%
Course Content: CAD/CAM/CAF/CAQC/Robotics/VLSI/AI/MIS/Voice-recognition.
Office/factory automation: communication/intelligent-photocopier/facsimile/videotex/videoconference satellites.
Mechatronics: (mechanical/electronic symbiosis), materials/fiber-optics/lasers/instruments.

Topic/Time: Management 20%
Course Content: Entrepreneurism/creativity/innovation/R&D/gambling – planning (strategic/tactical/operational).
Organization/personnel/unions. Health/safety/environment/consumer-protection.
Design/production/miniaturization.
Time/cost/quality.
Marketing.

Topic/Time: Economics 10%
Course Content: Micro/macro, regional/national/global.
Financing/venture-market/central commercial-World-banks/IMF/GATT.
Interest/inflation/exchange-rates, trade/budget-balance.

Topic/Time: Law 10%
Course Content: Supreme court, legislation from the bench, contracts/anti-trust, legal audit.
Domestic/foreign ethics.

Topic/Time: Politics 10%
Course Content: UNO/OECD.
Superpower rivalry, trade wars.
Government: Executive/legislative/judicial-branches – risk/regulatory environment.

Topic/Time: Sociology 10%
Course Content: pluralism/internationalism/language culture. Public relations, media conditioning.

Fig. 8. Master of Technology Administration.

Focus on spin off from research parks

Victoria is presently planning for six HiTech precincts, a number of other technology parks are already up and running, while a Japan–Australia multifunction polis or technopolis may also well be

located in Victoria as in 'Silicon Valley Downunder'. The symbiosis of Stanford University and Silicon Valley has helped propel the U.S. into the HiTech age, and a similar concept might well be considered for Australia. Victoria, with its abundant energy resources like the Ruhr, with 35% of Australia's manufacturing, and with the status of corporate, financial and educational centre of Australia, is well-placed to capture the 'Valley' ascendancy not only in Australia, but in SE-Asia as well. However, with disperse academic activity, and modest corporate sector by world standards, a viable 'Silicon Valley Downunder' might necessitate:

- a consortium of Melbourne's U/CAE/CSIRO R&D expertise,
- A Melbourne/Canberra/Sydney corridor location, with sufficient space, e.g., Broadmeadows, and proximity to airport and satellite tele-communications,
- A Sister-Valley status with Silicon and Route 128 in the U.S., Kyushu in Japan, Akalla in Sweden, Schenzhen in China, and various in the U.K. to act as a conduit for cutting-edge ideas, and to encourage multinationals to develop multi-profiles, and
- support financially or in kind or principle from Australian and Victorian Governments, industry and unions, as well as from the scientific/engineering communities.

The continuing-education aspects of research parks might embrace:

- industry-academia cross-fertilization and intellectual ferment for mutual benefit, and with minimum time delay,
- adjunct lectures and guest seminars by industry engineers to give industry perspective to courses,
- opportunity for industry engineers to acquire graduate degrees on a co-op basis,
- academic research proposals developed against the framework of on-going industry liaison should be more relevant, and may attract direct funding from park corporations, and
- students may visit industry laboratories, use state-of-the art equipment, and make professional contacts for mutual benefit.

Focus on spin off from think tanks

The Commission for the Future is the Federal Government's think tank, is headquartered in Melbourne, and has recently commenced work on five priority areas:

- technology and the future of work
- education, training and retraining for a technological future
- the information society
- demographic change in a technologically changing society
- a clearinghouse for future issues.

Some engineers may be a little suspicious of distinct departures with tradition as the Commission for the Future symbolizes, but as with the more traditional strategic planning that engineers are familiar with, the fundamental goal seems to be to clarify people's thinking about options for the future, rather than to make specific policy recommendations subject to before-and-after success audits. Futurology became topical with 'The Limits to Growth' by the Club of Rome a decade ago, and the precariousness of predicting the future became all too apparent; but what also became apparent is the escalating rates of change mandate increasing emphasis on preemptive future planning. However, just where the balance lies between future planning that eventually becomes a straight-jacket inhibiting opportunism and flexibility, and just-in-time or crisis management depends on whether industries are:

- primary, secondary or tertiary
- in the public or private sector
- are low- or high-tech
- are self-contained in Australia or are export/import orientated
- are basic to Western societies or are developing because of specific Australian advantages.

The Commision for the Future might be likened to the genesis of an Australian MITI, but as yet without the decision-making authority, bi-partisan support, industry acceptance, or a track record of successes.

Continuing education courses must not only address the present challenges to the profession, but escalating rates of change mandate an increasing focus on the future, and scenarios generated from Australian think tanks such as the Commission for the Future, as well from foreign sources such as MITI, the Club of Rome, the Hudson Institute, UNO and OECD strategic planners, etc. all have a legitimate input to continuing education courses.

Focus on internationalism

No national economy today can stand alone, each nation tends to do what it does best consistent with security requirements, and the global cost-effectiveness of division of labour and the booming export/import trade is indisputable. However, as growing numbers of LDCs join the array of commodity exporters, commodity prices are the lowest since the 1930s and Australia's only route to affluence is via exports of value-added goods. Local management must not only be effective in an isolated and traditionally protected local market, but must now compete head-on for world markets, must capitalize on the economic ascendancy of East Asian-rim countries, must be able to scan technological horizons for opportunities, must be aware of foreign marketplace-dynamics/cultures/languages/politics, must be able to assess risks, and must be prepared to spend more time out of

Australia doing business. GATT has however yet to clarify policies on trade in services, as are in effect for trade in goods, and interim bi-lateral agreements may be useful. Above all, Australian industry should be looking to the two technologically-ascendant nations, Japan and America, for role models on international trade and economic effectiveness. Increasing numbers of engineers are going to be preoccupied with international considerations in their professional careers, and continuing education courses needed to address these challenges are minimal at present. Mismatches in government policy, technology levels, language and culture, etc. might well be embraced in such courses.

PUBLISHING ARM

The U.K.'s IEE has accumulated profits of two million pounds from publishing activities of recent times, and much of these profits resulted from penetration of the enormous American market. The publication of academic or learned-style books and monographs by the IEAust as a legitimate part of its continuing-education activities seems desirable, but an economy-of-scale multiplier could only be achieved by tapping global markets. The specialized nature of such publications cannot be justified for exclusive Australian distribution on economic grounds. However, it must be said that the author(s) of these books and monographs should have established reputations and credibility in the international world of learning, and that topics and subject matter might be at the frontiers of knowledge and appropriate to future needs of engineering-intensive industries.

Even in the Australian context, the IEAust's 45,000 members should be able to support a far more active publishing program. Engineers Australia, the Transactions, conference proceedings, and specialist reports might well be augmented by written records of on-going Branch meeting. The latter might be compiled on an annual basis as the Branch Proceedings, sold through the CEC, and hopefully then placed on circulation lists in companies and government departments to generate a multiplier effect in the dissemination of information.

The great wealth of international published works needs to be more systematically tapped, regular digests of key works produced for local consumption, and translations made of foreign language publications as appropriate. Japanese publications might be specifically addressed in this regard. The advantages of the printed word such as durability, transportability, and reproducibility, are of great continuing-education benefit.

CONCLUSIONS

As rates of change escalate in engineering disciplines, increasing resources must be dedicated to continuing education opportunities for engineers. The IEAust provides the structured interface between educational institutions and the practising profession, and effectively straddles the continuing-education domain. Thus the leadership that the IEAust has shown in establishing the Continuing Education Centre as a pilot initiative in Victoria should be strongly supported, but some fine tuning may well be necessary to ensure optimum utility.

Acronyms

ACEA—Association of Consulting Engineers, Australia
APEA—Association of Professional Engineers, Australia
ASCE—American Society of Civil Engineers
CAI—computer aided instruction
CE— 'Chartered Engineer'
CEC—Continuing Education Center (IEAust)
GATT—General Agreement on Tariffs and Trade
IEAust—Institution of Engineers, Australia
IEAust(Vic)—Victorian Division of IEAust—(Vic Div)
IEE—Institution of Electrical Engineers (U.K.)
IREE—Institution of Radio and Electronic Engineers
LGEA—Local Government Engineers Association
MITI—Ministry of International Trade and Industry (Japan)
OECD—Organization for Economic Cooperation and Development
UNO—United Nations Organization.

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